VOL. IV. Registered at the G.P.O. for transmission to Canada by Canadian Magazine Post. NO. 40

THE WIRELESS WORLD

PRICE
6D NET

JULY
1916

Kara Sea Expedition

—

Disc Dischargers

—

Adventures on a State Yacht

This Magazine can be sent free to our troops abroad by leaving it at a Post Office

A Radiotelegraphic Expedition to the Kara Sea

Report by the Engineer V. A. Tarasoff

In order to make it possible to establish regular voyages to the Kara Sea, it was first of all necessary to provide that sea with distinguishing beacons, to make measurements of the routes and to establish posts of observation for receiving information about the movements of the ice. It has taken three years for such a route to be established. Now maritime beacons have been set up and measurements have been carried out by the Chief Hydrographical Administration, whilst the Chief Administration of Posts and Telegraphs has erected three radiotelegraphic stations on the coast, which serve as observation posts for the movements of the ice-fields and for studying the climatic conditions.

We will not dilate further on the question of the equipment of these stations, but we should like to tell the reader the impressions which the author gathered from his voyage to the Kara littoral during the expedition in the year 1914. This voyage was undertaken with the object of ascertaining on the spot the required data for radio stations in the future, as the Kara radio stations are the first to be established under such exceptional conditions.

The radio stations had only just been erected, and it was necessary for them to be taken over by the State, to be supplied with all the necessaries for exploitation and to provide the staff with fuel, provisions and other articles of everyday necessity for the approaching winter.

As these stations are under the control of the Archangel Postal and Telegraph District, this Administration chartered two steamers for the expedition, the *Vassili Veliki* and *Nicolas II*.

Both vessels were placed at the disposal of the Administration on July 12th, 1914, and from this date the loading began. On the *Vassili Veliki* were loaded the provisions, exploitation material, kerosene, petrol, oil and various kinds of material for the work of erecting radio stations for the approaching winter, and the *Nicolas II* took on board in the main wood, coal and "briquettes."

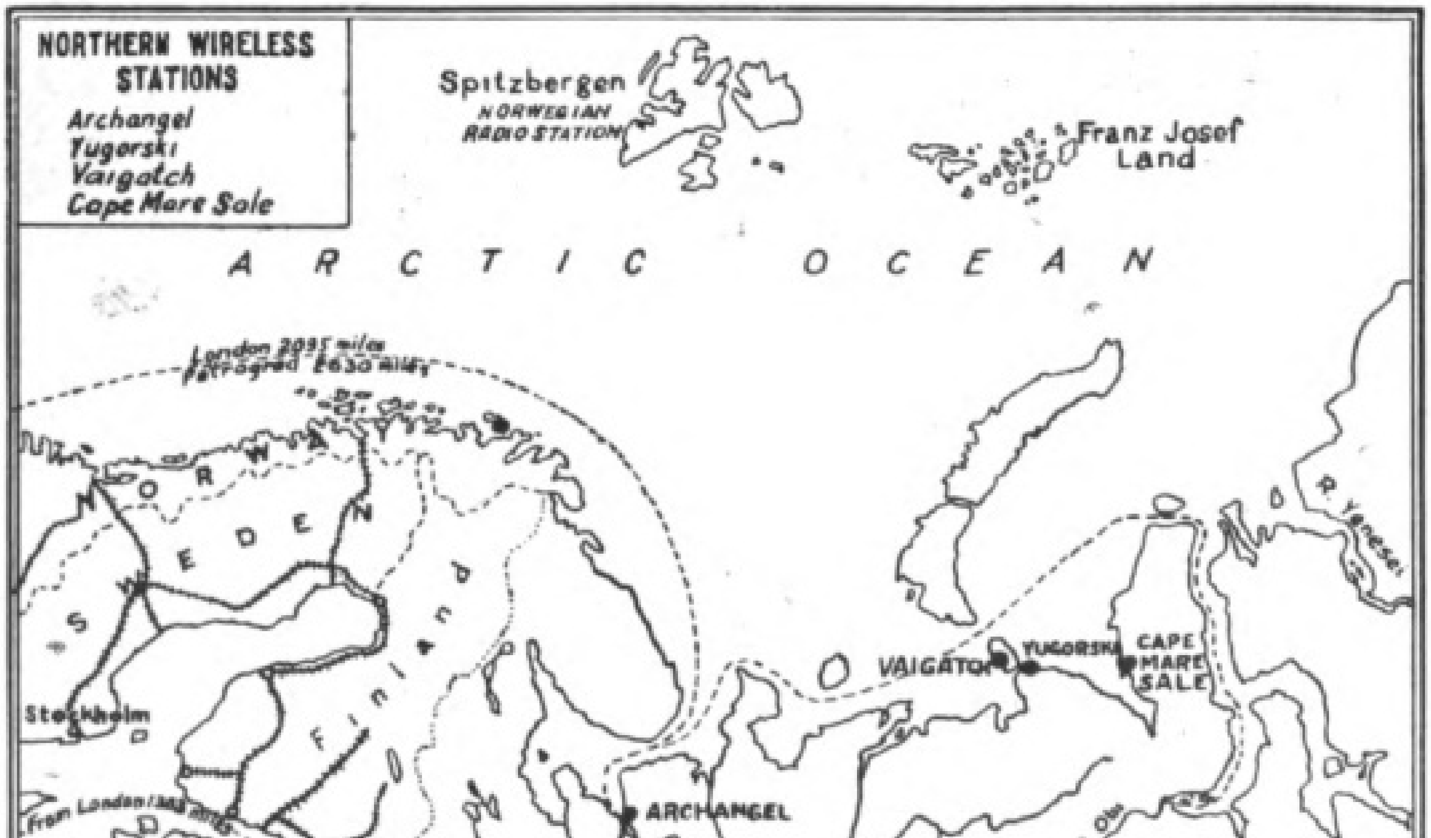
During the loading of the steamers the radiotelegraphic apparatus was erected upon the first of them, which was very appropriate in order to assure the greatest security for navigation among the ice.

On July 17th the loading of the *Vassili Veliki* was completed, the radio station was erected, and all was ready for sailing; while the *Nicolas II* was only to finish loading two days later. But time is money, and so is a time-charter of a steamer, and therefore it was decided not to wait till the *Nicolas II* had finished loading, but that the *Vassili Veliki* should sail during the night of July 18th, giving instructions to the remaining steamer to sail without delay as soon as loading was finished.

At 10 p.m. the steamer sailed away from the wharf, and the expedition started on its voyage. It was composed of the Chief of the Archangel Postal Telegraph District, the Chief Engineer and Engineer of the same district, the author, two members of the Archangel Hydro-meteorological Central Station, a physician, an assistant doctor, a student-electrician in the capacity of a practician, a student of medicine who had charge of the provisions, a person sent for geological research by the Academy of Sciences, three wireless officials, one for each of the Kara stations on the list, and about 60 labourers and artisans.

On the fourth day, away towards the horizon, the gloomy mass of the island of Vaigatch became visible ahead.

The steamer approached the Yugor Straits in the early morning. As the latter



SKETCH MAP SHOWING THE POSITION OF THE SIBERIAN WIRELESS STATIONS MENTIONED IN THIS ARTICLE

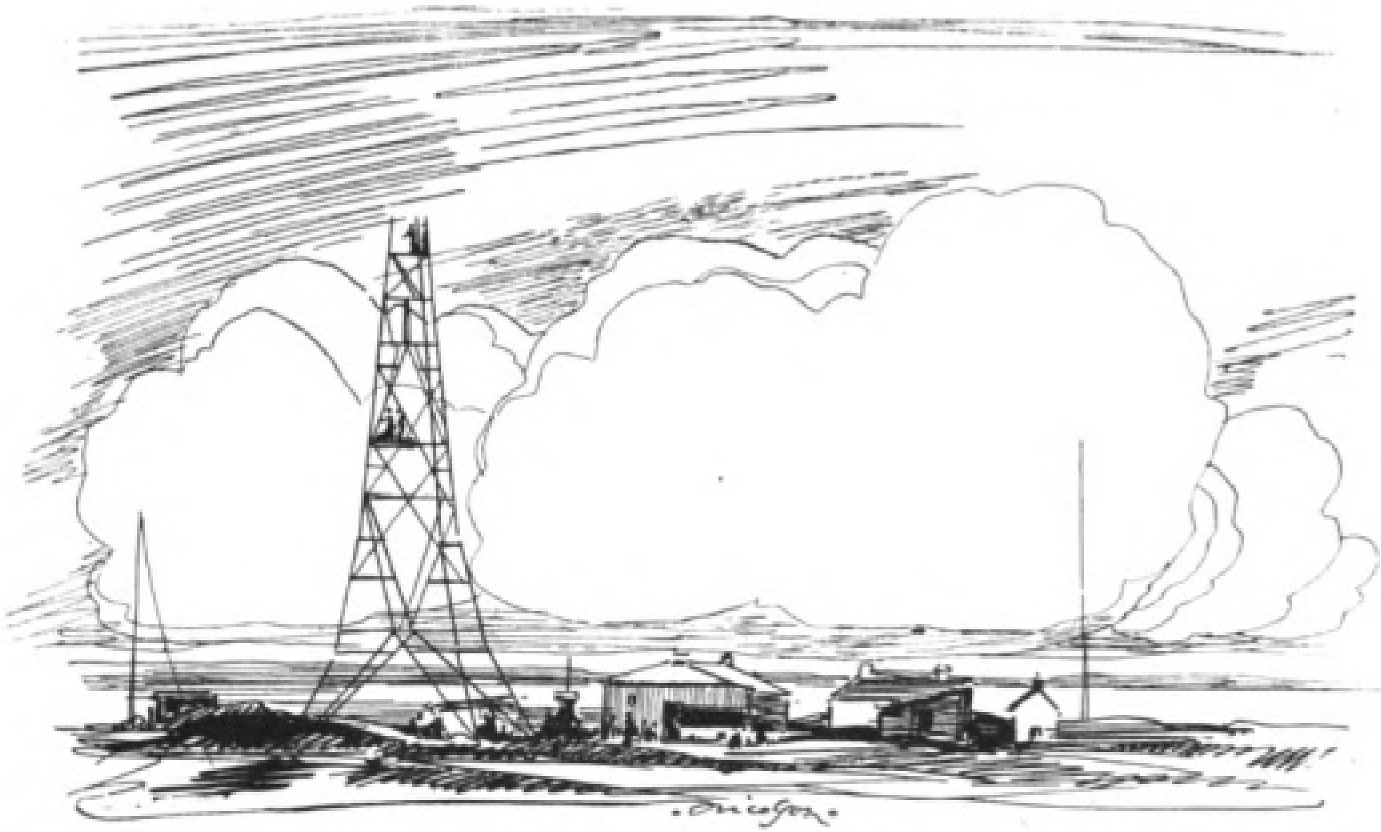
ARCHANGEL—RUSSIA'S WHITE SEA PORT

was compactly covered with ice-fields, which were brought hither by the north-east wind from the Kara Sea, and the other straits (the Kara Strait lying 67 miles farther north than the Yugor Straits) were also in great part encumbered with ice, it was decided to enter Varenka Bay and to wait there till the straits should get clear.

At 7 o'clock in the morning the steamer entered the bay and anchored.

The expedition rested for about a day and a half, and probably would have remained in the bay still a little longer, as the straits were still closed by ice, but one circumstance forced us unexpectedly to get off hurriedly from the anchorage. On July 22nd (August 4th our style), at about 7 o'clock in the evening, we received a radio-telegram of the following tenor: "Germany declared war against Russia, German cruisers are in the White Sea, hide in the Kara Sea and notify this occurrence to the steamers of the Murman Company which are at the mouth of the River Petchora." Afterwards it turned out that a group of Norwegian commercial steamers, sailing not far from the Murman coast, were mistaken for German cruisers.

Everyone was certain that the "German cruisers" would not venture into the Kara Sea, where only dire necessity and exceptional circumstances could drive them; however, as war in general brings about a speeding up of life in any country, this compelled the expedition to economise time and involved special measures for carrying out the tasks which had been assumed by the expedition. The decision was taken to leave the anchorage at once, and to go through the straits to the radio station at Yugor Straits. The route to be covered was about 27 versts, but we had to overcome great difficulties among compact ice, endangering the safety of the steamer, especially its rudder and propellers. In the case of the large ice-blocks



YUGORSKI STRAITS WIRELESS STATION—ERECTING THE MASTS

and the strong contrary currents we had to deal with in the straits, the fight was almost impossible. We moved on in the straits for about six hours and during this time we only reached the village of Khabaroff, *i.e.*, we advanced 10 miles. There remained 20 miles to the radio station in the Yugor Straits. On the bright golden morning sky it was already possible to distinguish the open-work outlines of the mast of the radio station. We dropped the anchor in order to await the beginning of the ebb tide and a change in the direction of the current in the straits. With the beginning of the ebb tide, at about 5 o'clock in the morning, the steamer began again to move forward, and after two hours we were near the Yugor Straits radio station at the anchorage, about 500 yards from the south shore of the straits.

There were six men on the station, four officials and two watchmen. The two latter were left here by the expedition of 1913. As regards the officials they were sent here in March, 1914, together with those who were appointed to Vaigatch, and they travelled the whole way from Archangel to the Yugor Straits by land, over the tundras through the Ust-Zilma. The men arrived at the Yugor Straits after a long journey which was rich in new impressions, and after a couple of days they entered into radio-telegraphic communication with Archangel. But two of them, who were appointed to attend to the Vaigatch radio station, continued their route to Vaigatch, where they arrived about a week later; and they also immediately entered into communication with the Yugor Straits, and through the latter with Archangel also.

After the arrivals of the officials at their posts, their life at first passed quietly; the new impressions of Polar scenery, hunting and excursions in snow-shoes filled up their free time. But they soon became accustomed to this and wearied of hunting and excursions, and a painful feeling of being cut off from the outer world and from people made itself felt. Echoes of these experiences reached Archangel through the radio-telegraph.

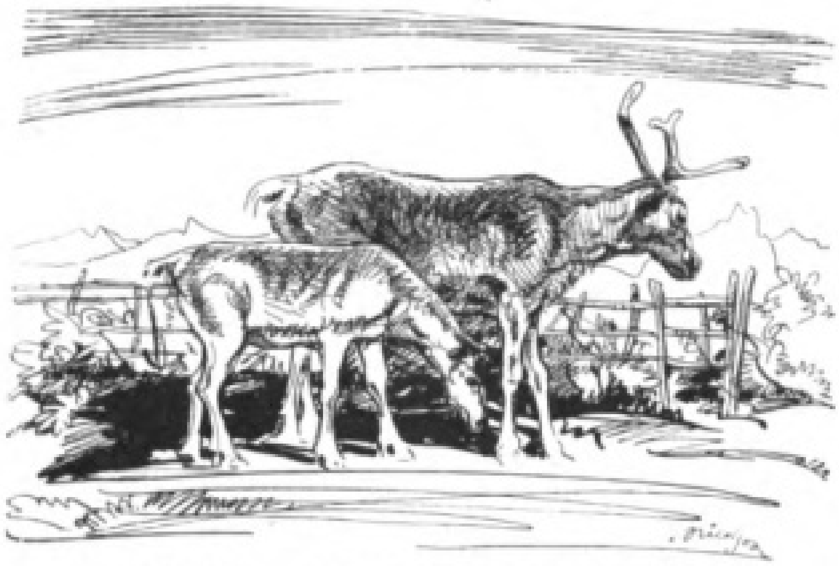
With respect to the buildings, they were found to be in a satisfactory condition. They are erected of hollow concrete blocks covered with corrugated iron ; the ceilings and floors are protected against freezing by layers of oil, moss, tarred paper and cork, and moreover the expedition has taken every care to make the buildings as far as possible suitable for wintering in the Polar cold.

The operations for the preparation of the buildings and the discharging of the steamer began at once after our arrival at the Yugor Straits. The discharging of the materials was the most important and the most difficult part of the work which awaited the Expedition. The sand banks and submerged rocks did not permit the vessel to approach the shore. The materials from the hold of the steamer had to be loaded on " Karbasses " (big boats capable of carrying a load up to about 5 tons), to be brought by them to the shore and then to be carried by the men to the station.

After three days discharging at Yugor Straits, and leaving a certain number of artisans on shore to carry out the work on the instructions given to them, the Expedition sailed for Vaigatch on July 24th, where it arrived the next morning and anchored in front of the Vaigatch radio station, which is situated on the Kara Straits.

At the place where the radio station is situated the coast of Vaigatch runs into the island and forms a sort of bay, which is bounded on the west by a group of small islands (Novossiltzeff, Voronoff), and from the east by the long island called Oleni. Here the water depth near the shore is greater ; the bottom is without submerged

"IN THE KARA SEA."



REINDEER. A CHARACTERISTIC FEATURE IN THESE NORTHERN LANDSCAPES

reefs, and therefore the steamer could approach to within a distance of 250 yards from the shore. This latter circumstance and the favourable weather enabled us to finish the discharging relatively quickly and easily. It took about two weeks to complete all this and also the work of preparing for the buildings.

On July 27th the second steamer of the Expedition, the *Nicolas II*, arrived with fuel. Its discharging proceeded simultaneously with that of the *Vassili Veliki*, and on July 30th was completed, whereupon the *Nicolas II* sailed on the same day to the Yugor Straits, passing through the Kara Sea, and on July 31st, after having completed all the work, the *Vassili Veliki* got off and sailed in the same direction.

After having travelled about 4 or 5 miles the Expedition noticed a ship coming the other way. This ship was the *Eclipse*, which was equipped by the Chief Hydrographical Administration for Polar navigation to search for the Expeditions of Lieutenant Brussiloff and the geologist Russanoff. The steamer was coming to meet us, for the purpose of receiving the radio-telegraphist who had been promised them to attend to their radio-telegraphic station. This latter was erected abroad, but the radio-telegraphist appointed by the firm for attending to the station turned out to belong to the reserve of the German Army, and he was put ashore in Norway, and the station remained unused. Meanwhile the Chief Hydrographical Administration attached great importance to this Expedition, and therefore urgently applied that one of the radio-telegraphists of the Kara stations should be put on board the *Eclipse*. Proceeding into the open sea, the *Vassili Veliki* soon stopped near the *Eclipse*, the radio-telegraphic station of which was quite in order, and, after having put on board the *Eclipse* the radio-telegraphist appointed to it, the *Vassili Veliki* continued her route.

On our return to Yugor Straits on August 1st we had to complete the work and the discharging of the fuel from the *Nicolas II*, awaiting favourable conditions which would make it possible to pass on to the Mare Sale (Salt Sea). The fact is that from the first days of our arrival in the Kara Sea we always received from Mare Sale the same discouraging reports : " In the sea, so far as the glass shows, there is compact broken ice ; near the shore the water is clear for a short distance, the wind is north-east." This showed that the Mare Sale was blocked with ice and that the direction of the wind indicated that these conditions would not soon alter.

After many discussions and repeated examinations of the chart, a course was taken to the north, and the mast of the Mare Sale radio station soon became visible. We succeeded in reaching the spot at 10 o'clock in the evening, and anchored a short distance from the shore.

The Mare Sale radio station is situated 135 miles south-east of the Yugor station, near Cape Mare Sale, and this is the most distant of all the Kara radio stations. The necessity of establishing a radio station at this place is explained by the following considerations. Ships which take the course from the western straits of the Kara Sea direct to the Island of Biely often meet compact impassable ice-fields on this route and are compelled to go round them along the south shores of the Kara Sea. Besides, it is often found in this part of the sea that the ice-fields travel to Yalmala and along towards the north. In such a case the Mare Sale radio station is very useful.

On Mare Sale the same operations were carried out as on the two other stations, only the discharging of the materials was more difficult and took more time. This was caused by the shallow water near the shore, which did not allow the loaded boats to approach very near, and by the steep ascent to the station.

On August 21st the work on Mare Sale was finished, and at 3 o'clock in the night of the 22nd the expedition sailed to Yugor Straits. During this passage we did not see a single ice-field, and the voyage was completed in 13 hours exactly.

The 22nd, 23rd, and 24th August were spent in finishing the work on the Yugor Straits.

All that was necessary had already been discharged on shore ; it only remained to bring it to the station, but even this became extraordinarily difficult, owing to a storm.

We succeeded in the main in finishing all the work at the Yugor Straits also. Having spent August 25th in Varneka Bay, in order to take in a supply of coal from the steamer *Nicolas II.*, the expedition left the anchorage on the 25th and sailed to Archangel, where we arrived on August 29th at 6 o'clock in the evening.

At present the following persons remain on the Kara stations :—At the Yugor Straits—a manager acting as chief engineer, a radio-telegraphist of the third class, a medical assistant, two watchmen and one labourer ; at the Vaigatch—a radio-telegraphist of third class, two fourth-class radio-telegraphists and two watchmen ; at Mare Sale—one third-class and one fourth-class radio-telegraphist and two watchmen. In addition a clergyman-missionary was allowed to settle down for the winter at the radio station at Vaigatch, whose mission was to convert the Samoyedes to the Greek-Catholic religion.

The Ministry have taken all the necessary measures to make the life of the staff at the radio station as comfortable as possible. Paying special attention to the question of the supplies of food for the officials, the Ministry have provided the radio stations with the most various provisions, which were

NANSEN, OF POLAR EXPLORATION FAME.

selected in conformity with local conditions on instructions of Archangel physicians. For Yugor Straits and Vaigatch provisions for 14 months were prepared and for the Mare Sale, where perhaps it may not be possible to get in every year, provisions were stored for 28 months. All these provisions are placed at the disposal of the managers of the radio stations, with special instructions for their preservation and consumption.

Bearing in mind the experience of 1913, when the officials, although they had sufficient provisions, nevertheless experienced difficulties because they were not able to use them skilfully, one special man was left this year at each of the radio stations—a second watchman—a person who was at the same time able to prepare all sorts of meals properly. Besides, advances were made to the officials for purchases of fresh deer-meat, when this might be possible at the beginning of the spring and on the arrival of the Samoyedes at these places. Finally, for the same reasons, in order to make the absence of fresh meat less hard, the officials and watchmen were supplied with arms and a sufficient quantity of ammunition for hunting wild fowl, which appear here in the spring in great abundance.

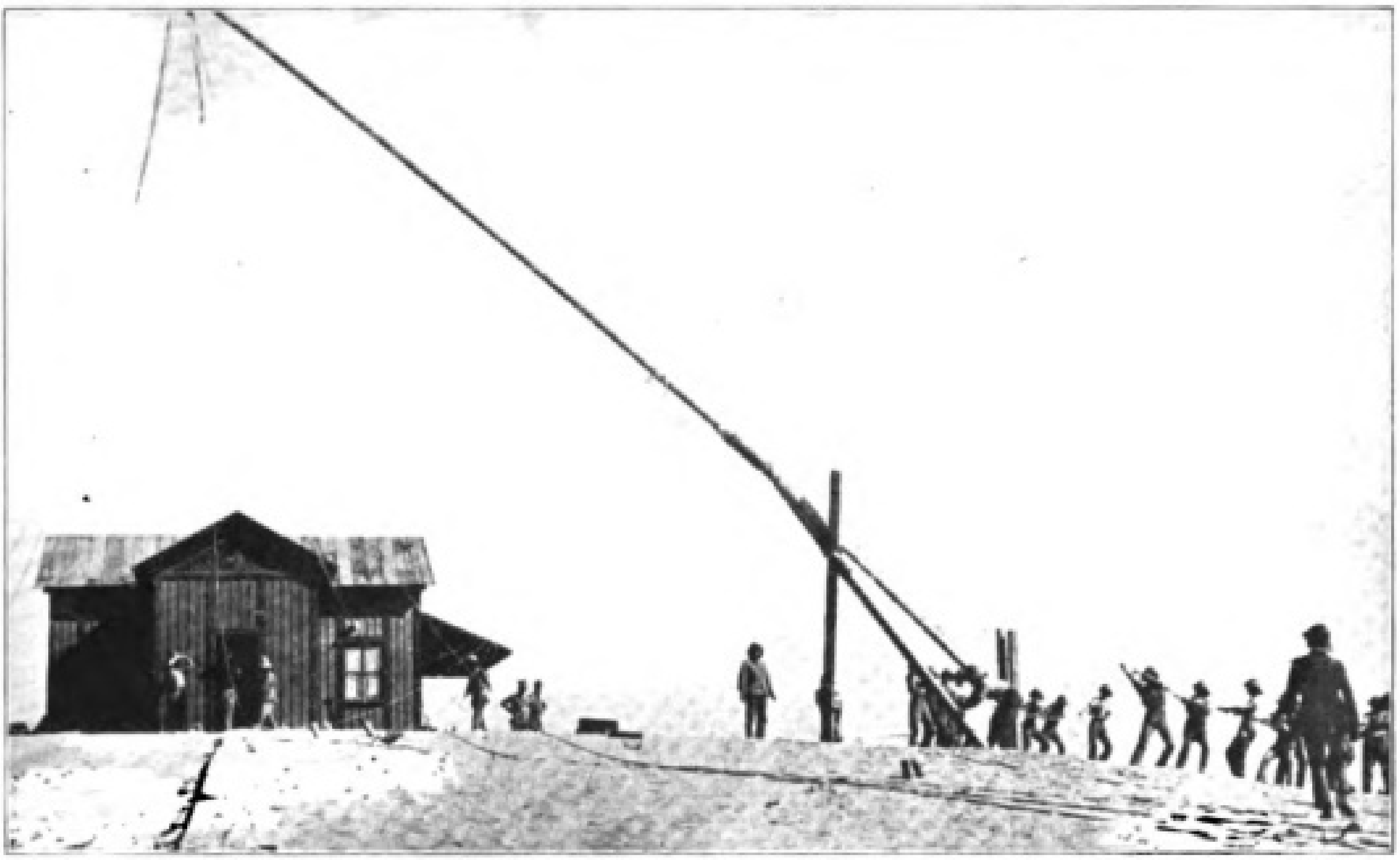
THE COMMANDER OF THE EXPEDITION—CAPTAIN SVERDRUP.

For the purpose of giving medical aid a trained hospital assistant was left on the Yugor station, who had also, in case of necessity, to visit the Vaigatch radio station. In addition all the stations are supplied with pharmaceutical stores containing a sufficient quantity of medicaments and popular text-books on medicine, and in serious cases the use of the radiotelegraph for communication with Archangel physicians is allowed to all free of charge.

In order to give the officials and watchmen the possibility of using their free time to best advantage, all the radio stations are provided with reading-rooms and with draughts and chess. Finally, for the purpose of fighting against somnolence and apathy, which are so undesirable here, special attention is paid to sport and music. Everybody was supplied for sport with snow-shoes, toboggans, guns, traps for catching arctic foxes, and lathes for metal work. By way of musical instruments, each radio station is provided with a gramophone with 50 records, a guitar, a mandoline and a balalaika (a Russian popular musical instrument—a sort of three-stringed guitar).

The Ministry of Posts and Telegraphs have done from their side all that it was possible to do for the staff of the Kara radio stations, and this gives one good reason to expect that the wintering of the officials on the radio stations will be without any complications. In everything the beginning is hard; in future it will be easier.

With the British Forces at the Suez Canal



[*Photo: Photopress.*

THE TOP PICTURE DEPICTS THE HOISTING OF AN AERIAL OF A FIELD WIRELESS TELEGRAPH STATION, WHILST THE LOWER ONE SHOWS THE ELECTRICAL CONNECTIONS BEING MADE.

[*Photo: Photopress.*

PERSONALITIES IN THE WIRELESS WORLD

MR. AUGUST COLLETTE,

Chief Engineer, Netherlands State Telegraphs.

THE Chief Engineer of the Netherlands State Telegraphs, August Everhard Rudolf Collette, was born on June 25th, 1857, at Maastricht, and studied for the profession of civil engineer at the Polytechnic School at Delft, where he graduated in 1882. He finished his studies as an electrician at the Polytechnic School at Dresden.

Practically ever since the Public Telegraph Service has been established in the Netherlands by the Government, the name Collette stands out amongst those of the leading personalities. Mr. Collette joined the staff of the Netherlands State Telegraphs in 1880, and was appointed Governmental Telegraph Engineer for special service in 1893. He succeeded his father, who retired in 1899, as Engineer-in-Chief of the Netherlands Telegraphs and Telephones, and as General Manager of the Technical Service. In the thirty-six years during which Mr. Collette has been intimately associated with the development of telegraphy and telephony in his native country vast progress has been made, and to him belongs most of the credit for this advance.

Wireless telegraphy has from the very first claimed his special attention. This was evident from the various trials carried out in the '90's, and from the very interesting lectures delivered by him on this subject. Mr. Collette is a member of the Permanent Commission for Wireless Telegraphs, the advice of which institution is always sought on the many important questions relating to wireless telegraphy. As a proof of the great influence exercised by the present Chief Engineer, it may be mentioned that he was appointed by Royal Letters Patent of June 1st, 1911, member of a committee of four to draw up plans for revising the working of the telegraph and telephone systems in the Dutch East Indies, and to report to the Dutch East Indian Government on the subject. With this end in view he made a comprehensive voyage all over the Dutch East Indies, and brought out a report to his Government which had a marked influence on the reorganisation of the telegraph and telephone service of this colony.

The Disc Discharger

By W. H. NOTTAGE, B.Sc.

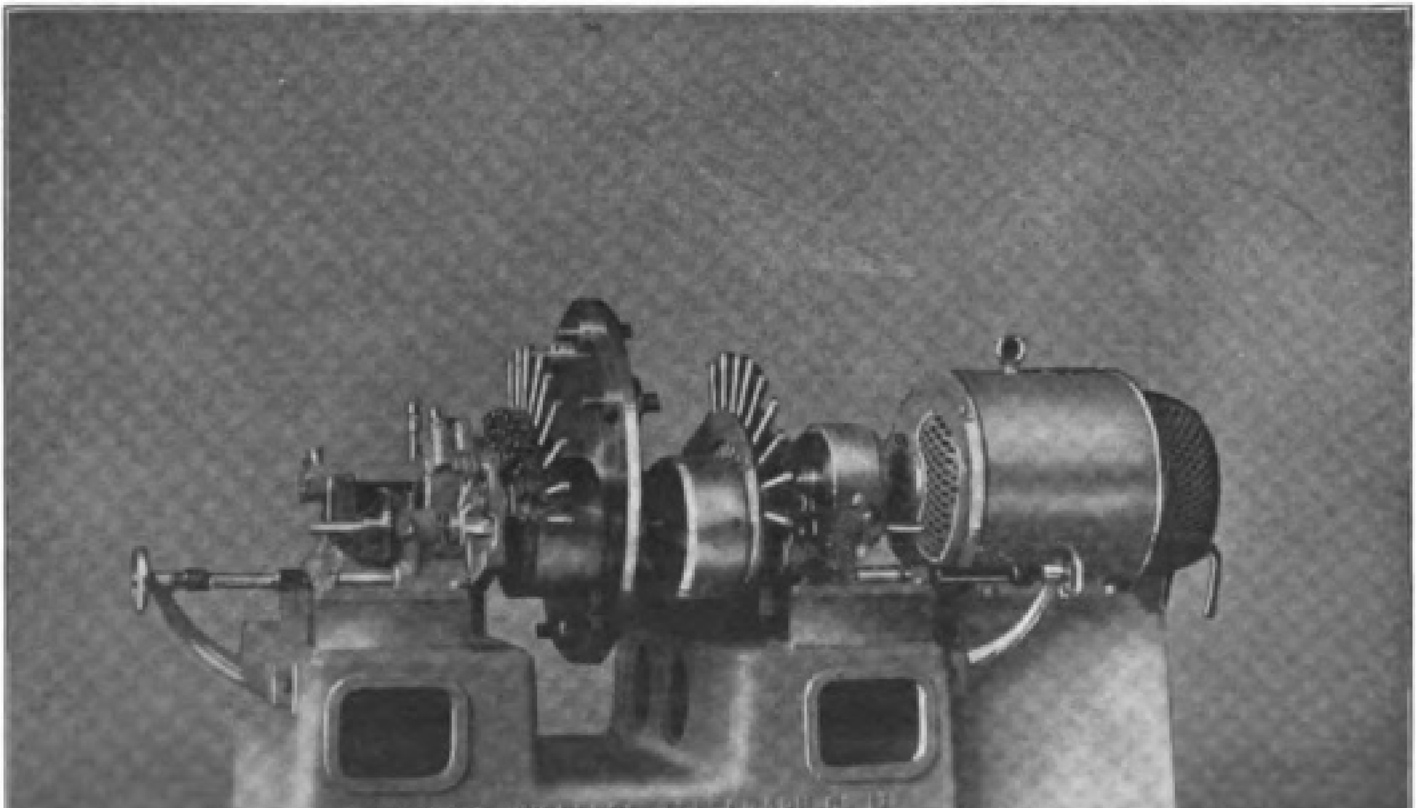
The discharger, or spark-gap, of an oscillatory circuit has to perform the following functions :—

1. Allow the condenser of the circuit to be charged to a high voltage from the source of energy (induction coil, alternating current transformer or high tension battery), and when charged,

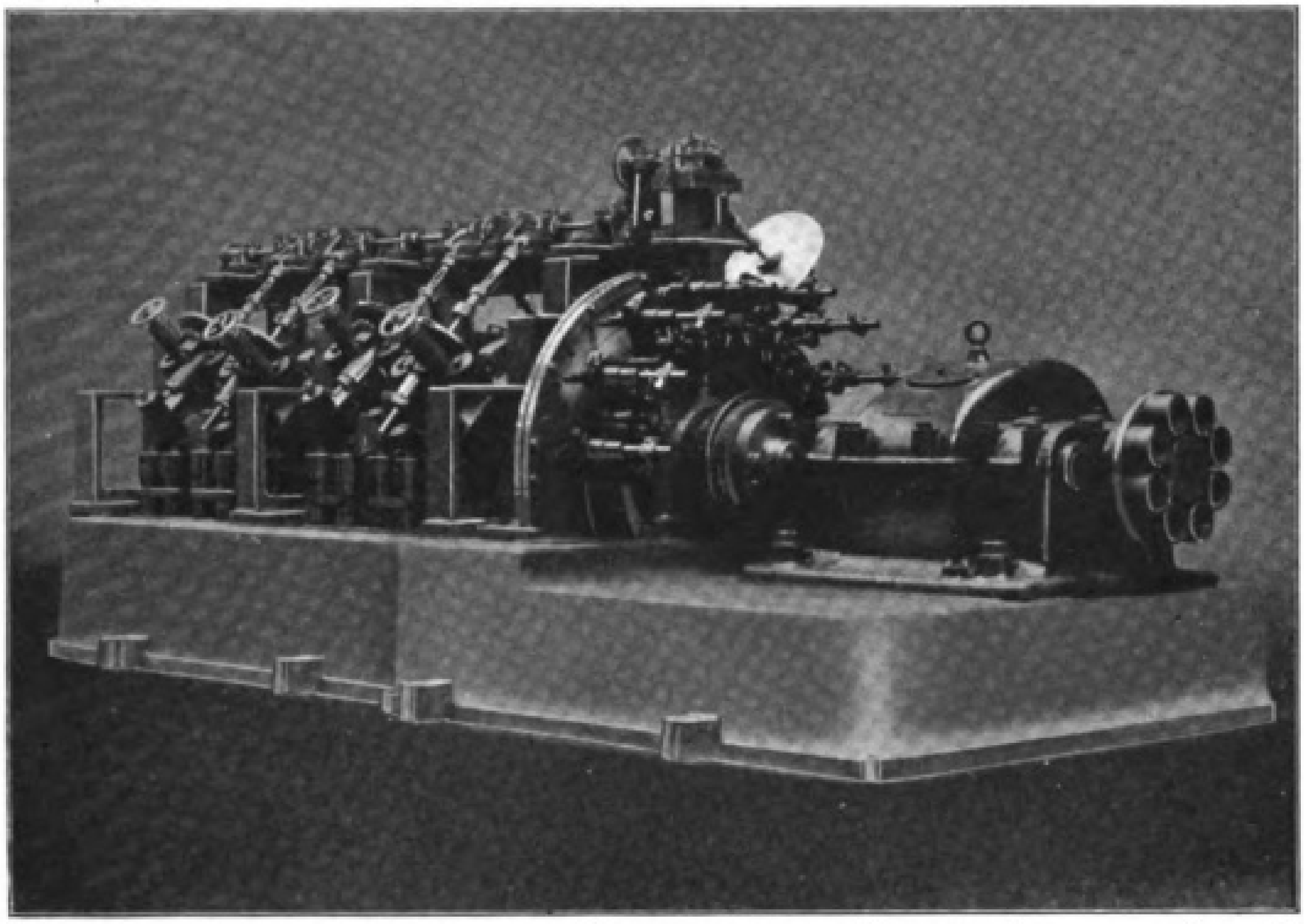
2. Allow it to discharge through the high frequency circuit of which the resistance, including that of the gap, must be low in order that the discharge may be an oscillatory one and as small a percentage of energy as possible may be lost by the resistance.

3. When the oscillatory discharge has ceased the gap must be in a condition to allow the condenser again to be charged.

Any discharger which fulfils the above functions will be sufficient for the production of oscillations in the circuit, but it is, for successful commercial telegraphy, necessary for the gap, in addition, to cause the charge and discharge to take place at uniform intervals of time. For best working the voltage to which the condenser is charged should be the same for each spark. There is some advantage if the discharger is capable of extinguishing the spark in the primary circuit as soon as



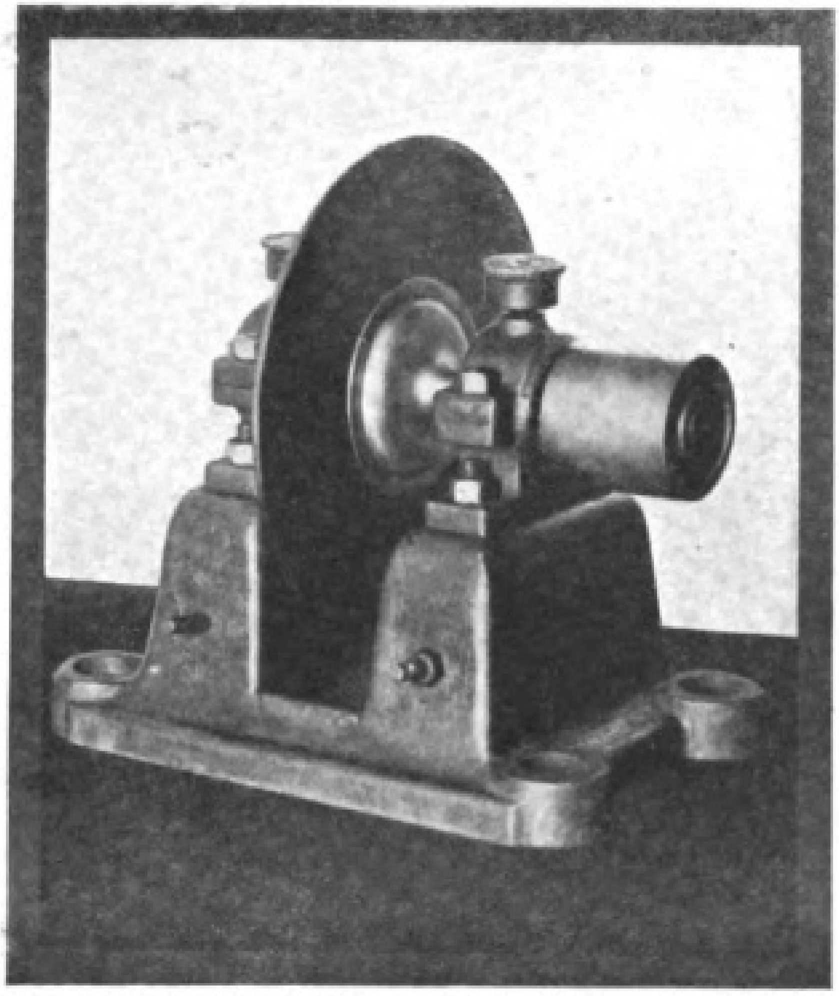
DISC DISCHARGER FOR 75 K.W. INSTALLATION.



CONTINUOUS WAVE DISC DISCHARGER (100 K.W.).

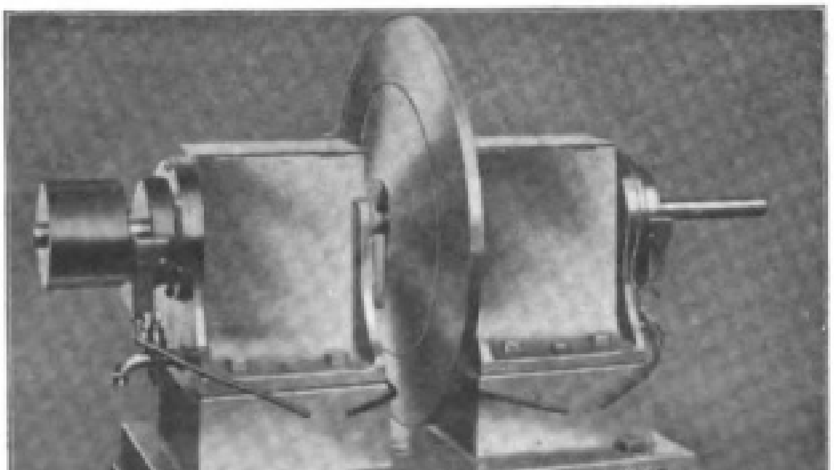
the maximum amount of energy has been transferred from it to the secondary or aerial circuit, as this will prevent the energy surging back again into the primary circuit. In the case of the ordinary fixed gap discharger the voltage to which the condenser is first charged rises to a certain value depending on the length of the gap. Up to this point the air in between the electrodes is a good insulator, so that no current flows across the gap. When this voltage is reached the air is unable to withstand the electric stresses set up and a spark passes between the electrodes. This spark ionizes the air, and also carries some metallic vapour from the electrodes into the gap, with the result that it becomes a good conductor, the resistance being very small, so that the condenser discharges in an oscillatory manner. After a time the discharge will stop, due to the fact that most of the energy stored up in the charged condenser has been used up in various ways. If the air in the gap were now to revert to its original condition before the discharge took place, then the whole process would be repeated regularly. But the ionization of the air persists to a certain extent, and therefore the condenser will become charged to a lower voltage than in the first case before the discharge takes place, and after the discharge the amount of ignition of the air in the gap will differ from the amount at the end of the first discharge, so that the third discharge will probably be at a different voltage still.

The interval of time between the discharges depends on the time taken for the condenser to charge up to the discharging voltage, and is therefore seen to be variable. The sound of the spark will not be a musical note, since this requires the sparks to take place at equal time-intervals. The energy from the aerial will be radiated at the same

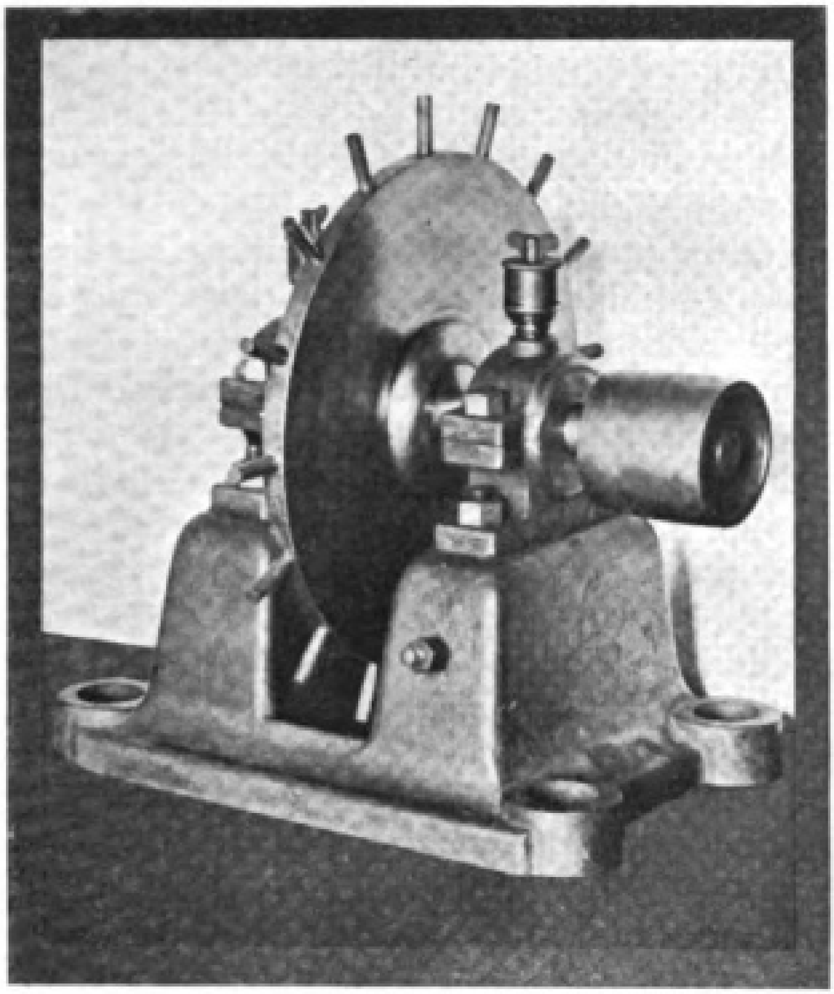


THE FIRST DISC DISCHARGER EVER MADE. THIS WAS USED IN EARLY EXPERIMENTS AT POLDHU.

intervals as the spark in the primary circuit, and therefore the note at the receiving station telephone will not be a musical one. If the electrodes of the sparkgap be set at a distance too great for the maximum voltage given by the generator to cause a spark, then no discharge can take place unless the voltage at the condenser plates rises, by resonance, to a value sufficient to cause a spark. Several alternations of the supply are necessary before this can take place so that the sparks will take place at long intervals. If, on the other hand, the gap be set at a distance much shorter than required by the maximum voltage, then there may be more than one spark per alternation, but in most cases the charging current will arc across the electrodes so that the condenser does not become charged at all, These effects contribute to making the discharge take place at irregular intervals. Now consider the action of the disc discharger. This consists of two fixed electrodes and a rotating disc provided with spokes or studs. It is so arranged that in a certain position two studs come opposite the two fixed electrodes, thus forming two short spark gaps in series. In all other relative positions the gaps between disc and electrodes are very much longer, so that no discharge can take place in these positions. The disc is provided, in the most usual case, with two studs for each pole of the alternator of the set. It is also mounted, suitably insulated, on an extension of the shaft of the alternator. In this case there will be one discharge for each alternation of the current supplied by the alternator, and, since the disc rotates in synchronism with it, the discharge takes



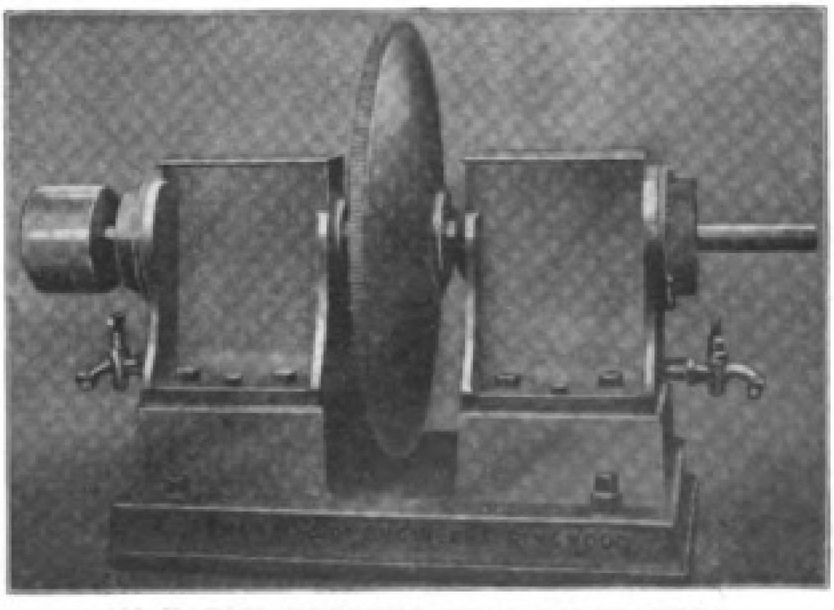
ANOTHER FORM OF SMOOTH DISC OF LATER DATE. THE BEARINGS RUN IN OIL IN THIS TYPE.



THE FIRST DISC DISCHARGER WITH RADIAL TEETH.

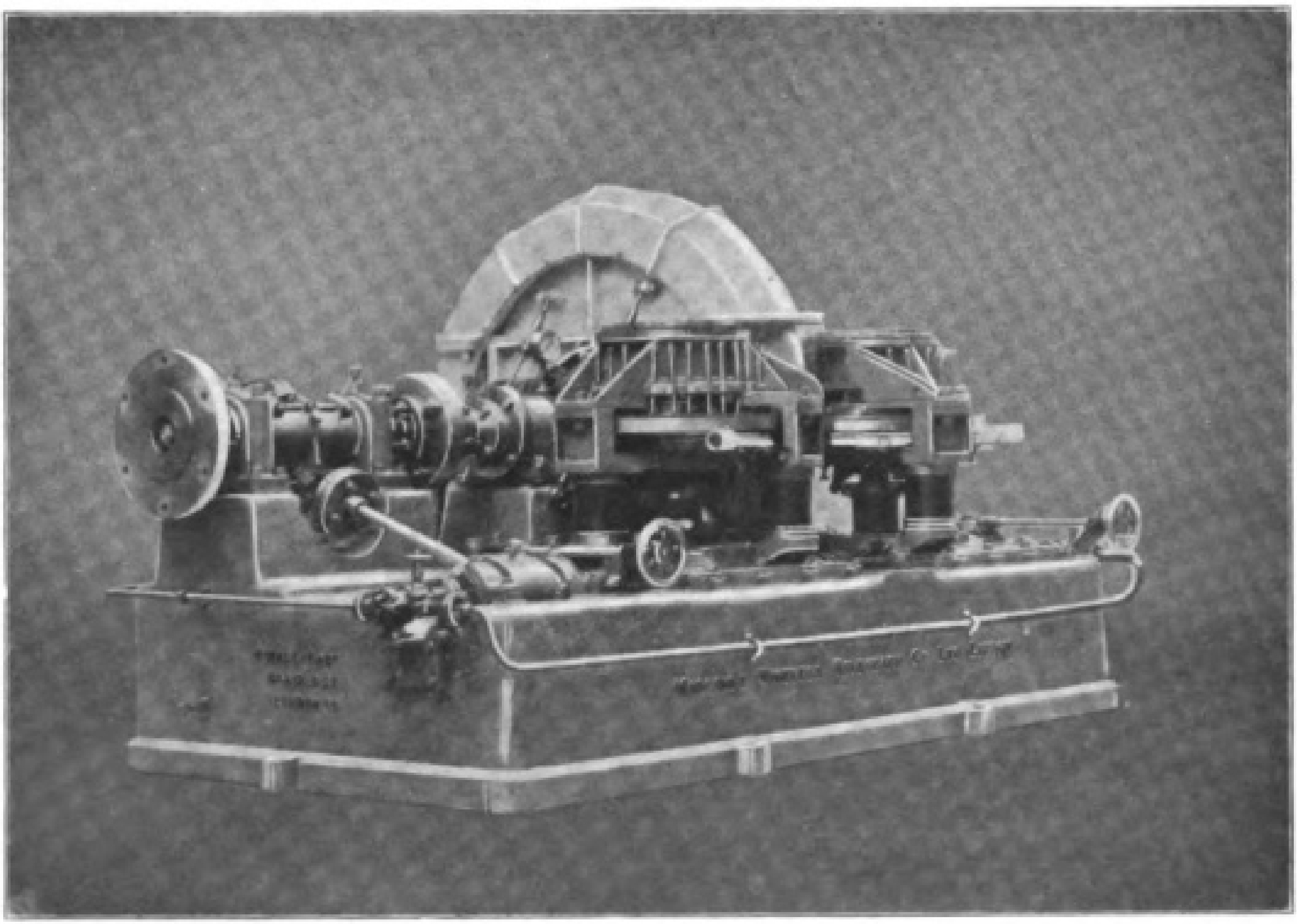
place always at the same point of the E.M.F. curve of the condenser charging current, so that the voltage, and hence the energy in the condenser, is always the same at the discharge, being independent of the length of the gap, which may be made quite small, it only being necessary to allow sufficient clearance between the studs and electrodes to prevent them touching when heated by the spark. Therefore, although there are two gaps in series, the total resistance is less than that of an equivalent fixed gap.

As the studs and electrodes separate the resistance of the gap rises rapidly, since not only is its length increased, but the air is not ionized in the extra path, so that the spark is extinguished in a definite time. If an arc of the low frequency circuit should strike across the electrodes it will quickly be drawn out and extinguished, the process being assisted by the draught created by the moving studs, which also helps to keep them cool. When the wave-length is long, as is the case for high-power stations, the spark may be extinguished after only a few oscillations of the primary circuit, with the result that the surging-back of energy from the secondary circuit is prevented. The frequency of the spark has a great influence on the ease with which the resulting signals can be received if, as is usual, a telephone method of reception is in use. A note given by a discharge of from 400 to 800 sparks per second is found to be the best for most purposes, since the ear is very sensitive to this range of frequency, without becoming so fatigued as when a higher pitch is used. Hence alternators giving from 200 to 400 cycles per second are the most suitable for wireless telegraphic purposes.



AN EARLY TOOTHED DISC DISCHARGER WITH BEARINGS RUNNING IN OIL.

In small installations, such as those used on board ships, it is usual to use an alternator of lower frequency to charge the circuit. Such machines are cheaper and require less attention to run than those of higher frequencies. To obtain a higher spark-note than would be given by one spark per half-cycle the disc may be provided with a sufficient number of studs to give two or three or even more sparks per half-cycle. The note given by a discharger which gives one spark per half-cycle is, when the set is properly adjusted, a pure musical note. In this case every spark occurs when the condenser is charged to the same voltage, and hence the energy given to the aerial and by that radiated into space is the same in all cases. When two sparks per half-cycle occur the conditions may be adjusted so that the voltage is the same for each, but when more than two occur the voltage will in general be different. When there are five or six studs the voltage may be insufficient to break down the gap for one position. Due to these facts, the note in this case is not so pure a musical tone as for the one spark per half-cycle, but it is immensely superior to the fixed gap spark for audibility. In constructing the disc discharger the fixed electrodes are often made in the form of discs which can rotate slowly so that the wear of metal caused by the spark may be spread out over a larger surface, thus reducing the alteration in length of the gap which occurs during an extended run. They are carried on a fitting by which they may be shifted round in position so as to cause the spark to occur at the precise point on the E.M.F. curve of the condenser charging current, which gives best results.



A MODERN 300 K.W. DISC DISCHARGER

Digest of Wireless Literature

Terrestrial Magnetism.

In introducing his "Kelvin Lecture" on "Terrestrial Magnetism" at the fifth ordinary general meeting of the current session of the Scottish Local Section of the Institution of Electrical Engineers, held recently in the rooms, 207, Bath Street, Glasgow, Dr. Charles Chree, F.R.S., made interesting references to the work of Scottish scientific investigators in this particular field. The scientists to whom he referred were Scottish, but the majority of them carried on their investigations elsewhere, and some of them were so successful in their work that their discoveries remain as landmarks in the development of terrestrial magnetism. In his lecture proper Dr. Chree dealt at length with the relation of Lord Kelvin to terrestrial magnetism. One of the objects of his lecture, he said, was to make clear the dependence of the practical man upon the scientific observer. Referring to magnetic storms, he pointed out that Lord Kelvin had called attention to the difficulties in the way of accepting any direct magnetic action between the sun and the earth, and expressed the opinion that Lord Kelvin did useful service in calling attention to the question of the expenditure of energy in magnetic storms. In his lecture Dr. Chree confined himself, however, to three of the outstanding problems enumerated by Lord Kelvin—the secular change, the solar diurnal variation, and the phenomena of magnetic disturbance—concluding with references to the recent notable work of Professor Birkeland and Stormer of Norway, Professor E. Hale, and Dr. L. A. Bauer. On the question whether terrestrial magnetism had any direct bearing on the problems of electrical engineering, he said that if wireless phenomena were affected—as had been suggested—by the greater or less conductivity of the upper atmosphere, one would expect them to have certain features in common with magnetic phenomena. In particular the 11-year period and the 27-day period might be expected to disclose themselves. If these periods affected wireless to anything like the extent to which they affected terrestrial magnetism there should be no great difficulty in establishing the fact if systematic observations were taken to that end. Another possibility was that means might be developed for utilising some of the power that now went to magnetic storms. This would, naturally, be most feasible in high latitudes, where aurora and magnetic disturbances were most in evidence.—(*Glasgow Herald report.*)

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Atmospheric Electrical Variations at Sunrise and Sunset.

Among the papers read recently before the Royal Society there was a paper on the above subject by Mr. E. H. Nichols. Observations were made for a period of fifteen minutes before and fifteen minutes after both sunrise and sunset, using the Wilson compensating gold-leaf electroscope for conductivity and earth-air current, and two Ebert electrometers for measuring the positive and negative electric charges. The results show a decided uniform decrease in the value of the electrical quantities throughout the sunset period, but the solar effect at sunrise is not at all pronounced. The potential curves for Kew Observatory were analysed for the years 1912 and

1914 for the 30-minute period at sunrise and sunset, and monthly means obtained for 5-minute intervals, these being corrected for diurnal variation. There is a general increase in the potential at both sunrise and sunset, being more noticeable in the winter months, but there is no evidence of any sudden change. It is possible that the electrical variations observed may be of assistance in elucidating the problems of wireless transmission.—(*Electrician.*)

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RADIUM AND AERIALS.

The following abstract of an article by E. Leimer in the *Elektrotechnische Zeitschrift*, printed recently by the *Electrician*, will be of special interest to our readers as it contains a report of some experiments on new lines.

On the results of Szilard with radium-coated lightning conductors becoming known to the author he was led to consider the possibility that radium might exert some effect upon the reception of radio-telegraphic signals. The first tentative experiments seemed to give evidence of positive effects; but as the author was obliged to discontinue them in consequence of the war he now publishes his results with a view to stimulating further research and also obtaining independent confirmation of his own conclusions.

The first experiments were made with an indoor antenna consisting of a wood rod closely wound throughout its length with wire, the rod being directed towards a sending station, FL, about 300 km. distant from it. This antenna was suspended in a room. The receiving set used comprised a galena detector, 4,000 ohm telephones, and a tuning coil 50 mm. in diameter, and having 800 turns of enamelled wire. No signals were audible from FL at any position on the tuning coil. Signals were, however, at once distinctly audible as soon as a sealed glass tube containing radium bromide of 50,000 units (and thus very weak) was brought near. The signals vanished when the shunt resistance was 220 ohms, using the shunted telephone method. The tuning was not at all sharp, and showed no maximum for any length of included wire between 80 and 120 metres. A change in the position of the radium did not produce any noticeable differences; but the orientation had a marked effect. At angles greater than $\pm$ 30 deg. the reception ceased entirely.

Encouraged by these results, the author continued his investigations in order to determine the effect of radium on ordinary antennæ. The antenna consisted of two parallel 1.5 mm. phosphor-bronze wires held 1 metre apart and 8 metres above the ground, directed towards the station FL, as was also the connection to the receiving set. For this latter the same tuning coil was employed; but an electrolytic replaced the galena detector, and in place of the telephones a special moving-coil mirror galvanometer, of 500 ohms resistance and period two seconds, was used. The signals utilised were the 10-second time signals from FL. With the best tuning and 56 metres the telephones gave 80 ohms for silence; the galvanometer showed 20–21 microamperes. With the antenna disconnected the current through the detector was 0.7 microampere. On the radium tube being brought near to the free end of the antenna the galvanometer reading was 50–53 microamperes; to reach this maximum the tuner had to be shifted from 56 to 48 metres. In this position the reception without radium was quite as mistuned as it was in the 56 metres position with radium. When the radium was fastened at the mid-point of the antenna no reception was possible, even with the telephones. With the radium arranged at the connected end of the antenna the current through the detector increased to 35–38 microamperes at the 40-metre tuner position. All the results have been definitely confirmed as a result of numerous control experiments, made under conditions as nearly similar as possible.

These experiments show that by suitably bringing up radium in proximity to the antenna the vibration image of the latter is changed in the direction of an apparent shortening of the wave; further, that a considerable increase in signal strength, as measured in the detector circuit, is occasioned by the proximity of radium, which must in any case be caused by a higher received primary current.

The proximity of radium to the tuning coil itself has, however, the effect of rendering distinctly worse the previously distinct telephonic reception, without it being possible to discern any definite mistuning, and this applies whether the radium tube be insulated or earthed. On the other hand, the radium tube has no noticeable effect on any of the other parts of the receiving equipment.

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A Wireless-Controlled Torpedo and Boat.

From time to time paragraphs have appeared in the English papers regarding the Wireless Controlled Torpedo and Boat of Mr. John Hays Hammond, Jun., a young American inventor. In an article describing this invention, the *Wireless Age* says that, as already reported, the invention has so conclusively demonstrated its efficiency as a destructive agency that the United States Government is preparing to buy the patent and to proceed with installations for coast defence. The Fortifications Bill carries an initial appropriation of $1,167,000. The inventor wants his own Government to have the benefit of his device on terms that are pronounced most reasonable. England, it is said, is willing to pay $10,000,000 instantly for it.

There is one condition attached to the acquirement of the patent rights by the U.S. Government. The torpedo must demonstrate its value before a joint Army and Navy Board.

The virtue of the wireless dynamic torpedo is explained by Mr. Hammond to be that you can take a charge of explosives or a projectile and deliver it at the target under constant control from the shore.

The torpedo, as described by Mr. Hammond, is at present of two types—one to be used above water, travelling at 50 miles an hour, and the other a submerged type, except for a short wireless mast virtually immune from gun fire, with a speed of 28 miles an hour. The surface type is a new sort of craft, called by naval experts the "sea sled." They can be made of any size desirable for the purpose in view and travel so fast as to be safe from destructive gunshot.

The experiments at Gloucester have been made with a 30-ton boat. The inventions do not cover any special type of boat, but the patents relate wholly to control and to the method of firing torpedoes from these carriers. The boat can be controlled just as easily for most purposes from an aeroplane or warship as from a shore station.

Here is a summary of some of the features of the invention, according to description:—

It can be steered by wireless in any direction.

Its engines (two 500 horse-power gasoline motors) can be started, stopped and controlled at various speeds by wireless.

It can carry a ton of high explosive.

It is more accurate, in the opinion of army experts, than the fire of big guns.

It can be operated against an enemy by a single man, who remains ashore, or on a warship, or in an aeroplane, and whose sole instruments are a telescope and an electric key.

It cannot be interfered with by adverse wireless waves because it is controlled by a system of selective transmission.

If the wave-length controlling it is discovered by an enemy, that wave-length can be changed while the torpedo is in sight.

If an enemy attempts to interfere with it by wireless, it possesses the faculty of pointing immediately in the direction of that enemy and making directly for him.

It can be operated at night as well as by day, subject to accurate control by an arrangement of tiny lights, so shielded as to be visible only to the operator. It carries a searchlight of its own, which may be turned on and off by wireless.

The surface type will cost about $47,500 each.

The submarine type will cost about $9,000 each.

The surface type has a cruising radius of 200 miles, at 50 miles an hour.

It can be guided 200 miles to sea by an aeroplane and launched against an enemy at the end of the run.

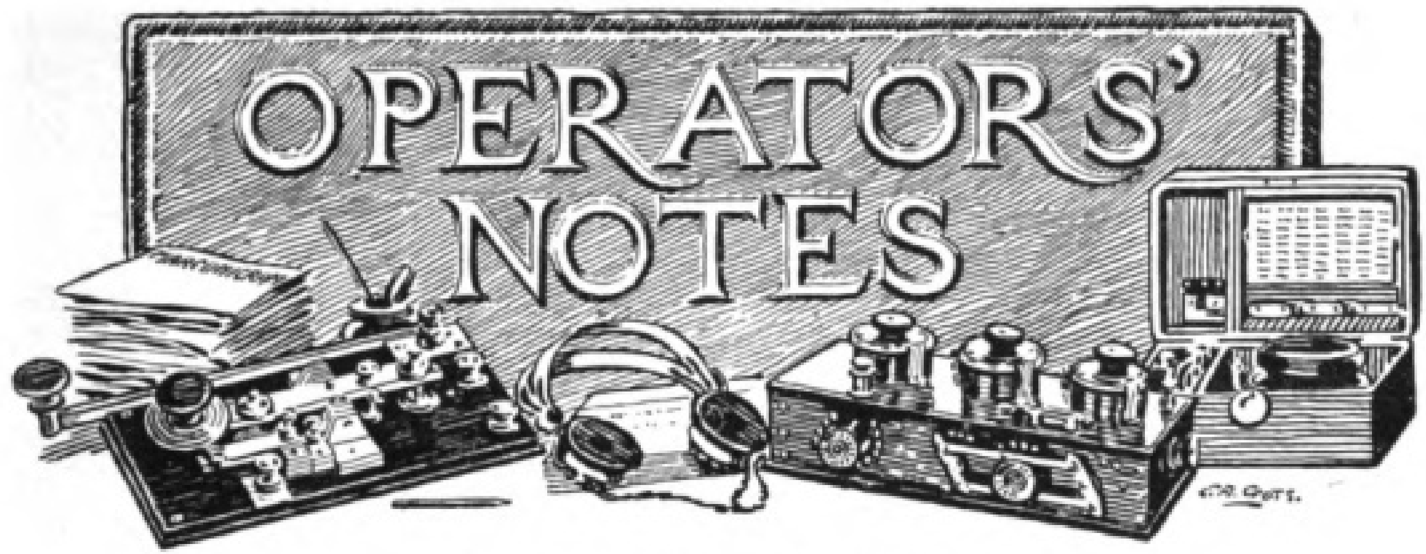
The surface type has a capacity of double attack. It carries a torpedo which, when the destroyer is in striking distance, can be launched by wireless. If the torpedo strikes, the destroyer can be turned around by wireless and sent home. If the torpedo misses, the destroyer, which carries an additional half-ton of explosive, can be sent on to retrieve the error, in which case, of course, it is itself destroyed upon impact.

The terms upon which Mr. Hammond offers to sell his invention exclusively to the United States are these, proposed to the War Department in a letter :—

He will assign all patents to the United States Government for the sum of $530,000, plus 10 per cent. of the cost of installing each radio station, whether ashore or aboat, plus $10,000 royalty for each destroyer built. This is based on an order of not less than three units, a unit consisting of one station and ten destroyers. If the Government builds only two units, the lump sum is to be $630,000. If it builds only one unit, the lump sum is to be $730,000.

In addition, Mr. Hammond will give his time and his services to the Government in installing and developing the system, so long as the War Department wants him. As an alternative proposition, in case the Government does not want the exclusive rights, Mr. Hammond will sell the manufacturing rights for the United States alone for $350,000.

THE WIRELESS WORLD is a little sceptical regarding the claims of this invention, and, after all, at the time of writing Mr. Hammond has not yet disposed of his rights to the United States Government. The capture of a single wireless controlled vessel of this type which had failed to explode might place in the hands of the enemy the whole secret and enable them to devise protective measures quite sufficient to make the boats useless for further warfare.



Using the Multiple Tuner.

Although every Marconi ship installation contains a multiple tuner, either with or without an intermediate circuit, it is surprising how few men make the best use of the facilities offered by this instrument. It is true, of course, that in many cases just as good results can be obtained on the " stand-bi " side as on " tune," but on the other hand cases frequently arise in which the " tune " side is of the greatest assistance for comfortable working.

There are five main ways in which going on to " tuned " side helps the operator. They are as follows :—

(1) By eliminating or reducing jambing.

(2) By eliminating or reducing atmospherics.

(3) By cutting out noises and interference from the converter or ship's mains.

(4) By reducing the strength of signals when these are inconveniently loud.

(5) By at times increasing the strength of signals.

In these times, when a large number of warships are on active service using their wireless frequently and on a number of different wavelengths, the value of tuning to eliminate interference is most marked. In crowded waters and at a distance of two or three miles a powerful naval installation even on a very long wavelength may cause interference to a merchant vessel, although a little farther off it would not be heard. Of course, most interference is caused by other merchant vessels and coast stations working on the usual 600-metre wave, but even in these cases advantage is sometimes found in tuning, as a slight difference in wavelength will often allow one ship to be picked out more strongly than others.

The ever-present trouble arising from atmospheric disturbances can in many cases be largely reduced by going on the " tune " side, particularly with certain types of atmospherics. In many cases, however, " X's " come in equally as strong on " tuned " side as " stand-bi," but the change is always worth trying. Where the signals are strong the operator can afford to reduce the coupling considerably, and this always gives some improvement.

On some ships, particularly at night, where the dynamo in the engine-room is mismanaged and there is much sparking at the commutator, the operator is liable to hear continual humming noises in the telephones due to induction from the ship's mains. There are cases too where the converter in the silence cabin sets up similar interference. In both of these cases great improvement will be found by working on the " tune " side, and we have known ships where the trouble is entirely removed in this way.

The point not always considered by new men, but well known to the more experienced operators, is that very loud signals from installations close at hand are most difficult to read, particularly with the magnetic detector. Our experience has been that far more comfortable working is obtained by tuning on very weak coupling, and we would counsel those who have not tried this method to give it a test.

With regard to the fifth advantage given above, it has been found that some signals come in much louder and better on the " tuned " side than on " stand-bi," particularly in the case of quenched sparks. There are theoretical reasons for this which we cannot enter into in this article. Here again we would suggest that the operator make tests for himself. In all cases it is well to keep a list of stations which come in best on " tune " side and the adjustments of the various circuits which give best results. This last will, of course, be useless for anything but the particular tuner, magnetic detector and aerial in use at the time. If a new aerial is erected or a new primary fitted to the magnetic detector, new observations will have to be made.

An occasional source of trouble and one to be carefully watched is the micrometer gap. This should be adjusted in the way that the student is taught in the Marconi School, and should on no account be opened too wide. We have found many operators who think that if sparking is occurring in the gap something is wrong with this adjustment, and they accordingly widen the space until the sparking ceases. By doing this they are endangering the tuner, for the pressure which with the small gap broke down the air space and caused the spark to earth will now be exerted on the dielectrics of the condensers and will tend to puncture them. When there seems to be excessive sparking in the micrometer gap, the main arrester gap should be inspected to see whether the space between the plates is too large. This sometimes happens when the central nut becomes loosened.

It should not be forgotten that the multiple tuner can be used as a wavemeter both for incoming waves and as a means of adjusting the transmitter after a breakdown has been repaired. For this last purpose the aerial and earth leads are removed and the A. and E. terminal connected by a loop of stiff wire. The tuner and magnetic detector should then be removed to some place out of sound of the spark and best signals obtained on the " tune " side in the ordinary way. The intensifier handle should be set at a reading not higher than 10 per cent., and the wavelength of the transmitting circuit can then be ascertained in the usual way, from the table of wavelengths supplied with each tuner.

Operators using valve or crystal receivers for the first time should lose no time in becoming acquainted with the extremely sharp tuning made possible by these instruments. Very little appreciable difference in strength of signals is noticeable on reducing the coupling from 90° to 30°, or even 20°; but, of course, at these low readings very slight alterations of the condenser adjustments will cause the signals to disappear. In some cases louder signals are obtained on a fairly loose than on a tight coupling, and in almost all cases signals come in better on " tune " than on " stdbi."

Dr. Hay's "Continuous Current Engineering." *

Reviewed by PROFESSOR E. W. MARCHANT, D.Sc.

THE progress of electrical engineering has led to the production of many books which profess to teach it; the evolution of these books has followed closely the development of the industry, and a comparison of the text-book of to-day for the would-be electrical engineer with that which served the same purpose thirty years ago is one of the most striking ways in which the development of electrical engineering can be realised. Yet the fundamental principles on which all electrical work depends are unaltered, the laws of magnetism have not changed; the difference between the books is in the point of view from which they are written. The older work was a text-book of applied physics; it described physical phenomena and apparatus on a small scale, while the later books deal with measurements and machinery on the engineering scale of practical work. Although Dr. Hay's book appeared over eight years ago the new edition has not altered so much as might have been expected, and there could be no better evidence that the author in the first instance had judged the needs of the modern student rightly, that he had justly held the balance between physics and engineering, and that he had produced a book which was of real value to the budding engineer. The present volume is not a mere encyclopædia of electrical apparatus, it is founded on the rock of sound physical principle, but it is a discriminating book, it deals with essential facts, and fundamental laws stated as lucidly as they have ever been stated in any similar text-book. In the opening chapter the definition of the electromagnetic unit of current serves as the starting-point, followed by some fundamental theorems relating to electromagnetic induction and the magnetic circuit. The way in which these general theorems are established is admirable in its simplicity, and absolutely rigid in its method. The average student should be able to follow the proofs quite easily; yet, if he has thoroughly mastered them, he will have gone a very long way in his education, for he will have laid a foundation on which the whole superstructure of his knowledge must be built. In this chapter we have, in ten pages, the groundwork of continuous current electrical engineering. In no other well-known text-book has so much been compressed into so small a space.

In the next chapter are laid down the laws of electromagnets, the definitions of the quantities that determine magnetic quality, and the methods of measuring it. In a footnote to the paragraph on the ageing of the magnets is given an approximate analysis of the best composition of magnet steel; in the next page a few data as to the most convenient size for a test ring of magnetic material, and this kind of information is given throughout the book. It is full of practical hints which will be of the utmost value to those engaged in experimental work. After a chapter on hysteresis

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* *Continuous Current Engineering.* (Second Edition.) By A. Hay, D.Sc., M.I.E.E. London, 191 . Constable & Co., Ltd. 6s. 6d. net.

and its effects follows one on measuring instruments, not encyclopædic, but containing carefully chosen examples of the best types. One may, perhaps, regret that so much space is occupied by a description of the multicellular voltmeter and the details of the Kelvin standard balances, as these instruments are now not very often found in testing laboratories; one may criticise also the figures given at the end of the chapters of the prices of the instruments of the different types. Everyone knows, nowadays, only too well, that prices are very variable quantities, which manufacturers, as a rule, are not averse from giving whenever they are asked for them. A useful chapter on the calibration of instruments follows, together with an account of some characteristic types of continuous current meters. Here, again, one may be inclined to criticise the amount of space given to a description of the Aron clock meter, which is not much used in this country, though the meter is one of the most interesting, from the scientific standpoint, that have ever been built. The chapter on the dynamo is extremely clear, and the illustrations showing the form of an element of lap or wave winding are such that they should enable the dullest student to comprehend the arrangement of these windings, a subject which is usually a thorny one for most beginners. This chapter is one of the most successful in the book. In Chapter VII. armature reaction and commutation are discussed at some length; the simple theory of commutation based on Arnold's classical work stated, and with the aid of a few simple diagrams it is shewn how sparkless operation may be attained. Not only is the theory given, but rules for the running of commutators, and some analyses of the difficulties that arise and how they may be overcome. In the next chapter the methods of exciting dynamos are discussed and characteristic curves of the chief types are shown; the corresponding curves for motors are given in consecutive paragraphs. In this way the essential similarity between the motor and the dynamo is clearly brought out; a section of this chapter deals with motor starters and another with methods of speed control. The chapter on the construction of dynamos which follows makes no attempt to deal with design, though a few designing rules are given; it is an account of the way in which the dynamo is built up. The figures, like the others in the text, are diagrammatic; there is no attempt to give working drawings and dimensioned sketches. In an elementary book this may be excused, but most engineers would have preferred to see something more like an engineering drawing than those that are actually to be found. In Chapter X. the design of a field magnet system is fully set out and the methods of calculating the field coils for a machine are given. Next is a study of the losses occurring in a dynamo and the testing of a dynamo or motor for efficiency by all the well-known methods; the determination of temperature rise and the other tests with which the electrical engineer must be familiar.

Chapter XII. contains descriptions of a strange collection of machines, the Rosenberg train lighting dynamo, a turbo-generator and a homopolar generator. It is a chapter which may well be omitted at a first reading; in fact, the book would not have suffered very much had it been left out altogether.

The remainder of the book deals with what one may call "auxiliaries," though very important auxiliaries, in electrical work. There is a chapter on secondary batteries, which includes an account of the Edison Cell, and a description, necessarily brief, of the chief types of automatic boosters for controlling their discharge. Then

" of the chronometer found. Similar comparisons over a number of days enable " data to be obtained by which not only the error may be found, but also the " chronometer rate, that is the rate at which it is gaining or losing.

" The noontime signals on the Atlantic coast are sent out through the coast " radio stations by connection with Western Union Telegraph lines from the United " States Naval Observatory at Washington, D.C. By the operation of proper " relays in electrical circuits the beats of the second of a standard clock in the " observatory are sent out broadcast as a series of radio dots, commencing five " minutes before the time of the final signal. By omitting certain dots in a series, " the comparison between the dots and the beats of the chronometer seconds can " be checked until the instant of local noon (seventy-fifth meridian time) is " reached. This is marked by a longer dot, which gives the time of exact noon. " A comparison with the chronometer time at that instant gives its error referred " to seventy-fifth meridian time. Applying the difference in longitude, namely five " hours, between the seventy-fifth meridian and Greenwich, which is the standard " meridian (or 0° longitude), the error of the chronometer referred to Greenwich " time is determined.

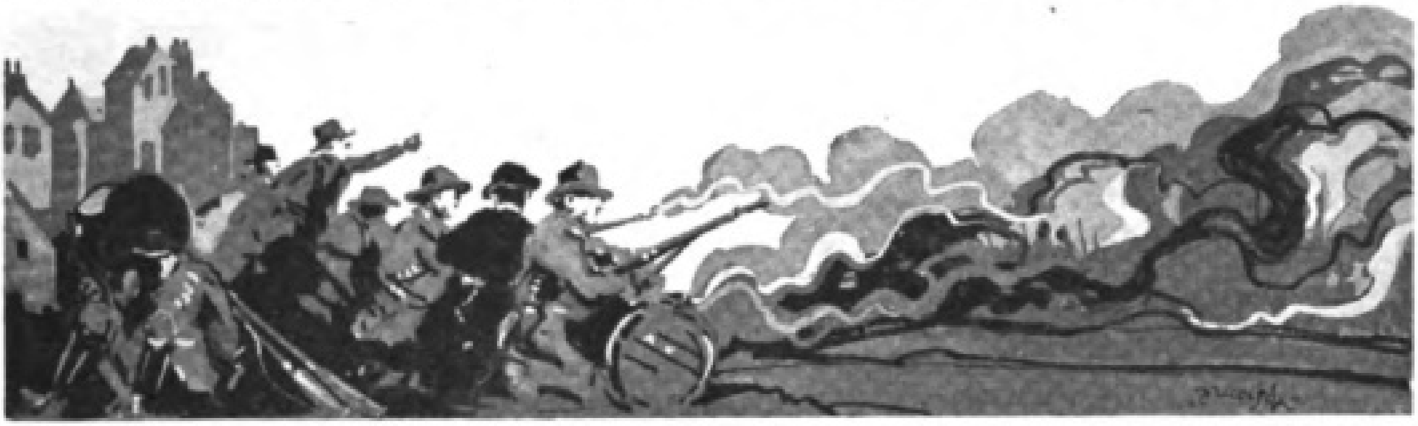
" Time signals are now sent out on the Atlantic coast only through the radio " stations at Arlington, Key West, and New Orleans. Signals from Arlington and " Key West which reach a zone formerly served by other coast stations, are sent " out every day in the year, twice a day—viz., from 11.55 a.m. to noon and from " 9.55 to 10 p.m., seventy-fifth meridian time. Time signals from New Orleans " are sent out daily, including Sundays and holidays, commencing at 11.55 a.m., " seventy-fifth meridian time, and ending at noon.

" In case of failure of the Arlington high-power station the signals are sent " out by the small set in the same station, and the stations at Boston, New York, " Newport, Norfolk, and Charleston are notified, and they each send the signals " broadcast.

" On the Pacific coast the time signals are sent broadcast to sea through " the naval radio stations at Mare Island, Eureka, Point Arguello, and San Diego, " Cal., and at North Head, Wash. The controlling clock for each station is in the " naval observatory at the Mare Island Navy Yard. Signals from Mare Island " are sent out every day from 11.55 to noon and from 9.55 to 10 p.m., one hundred " and twentieth meridian standard time. Those from North Head, Eureka, Point " Arguello, and San Diego are sent out daily, excluding Sundays and holidays, from " 11.55 to noon, one hundred and twentieth meridian standard time.

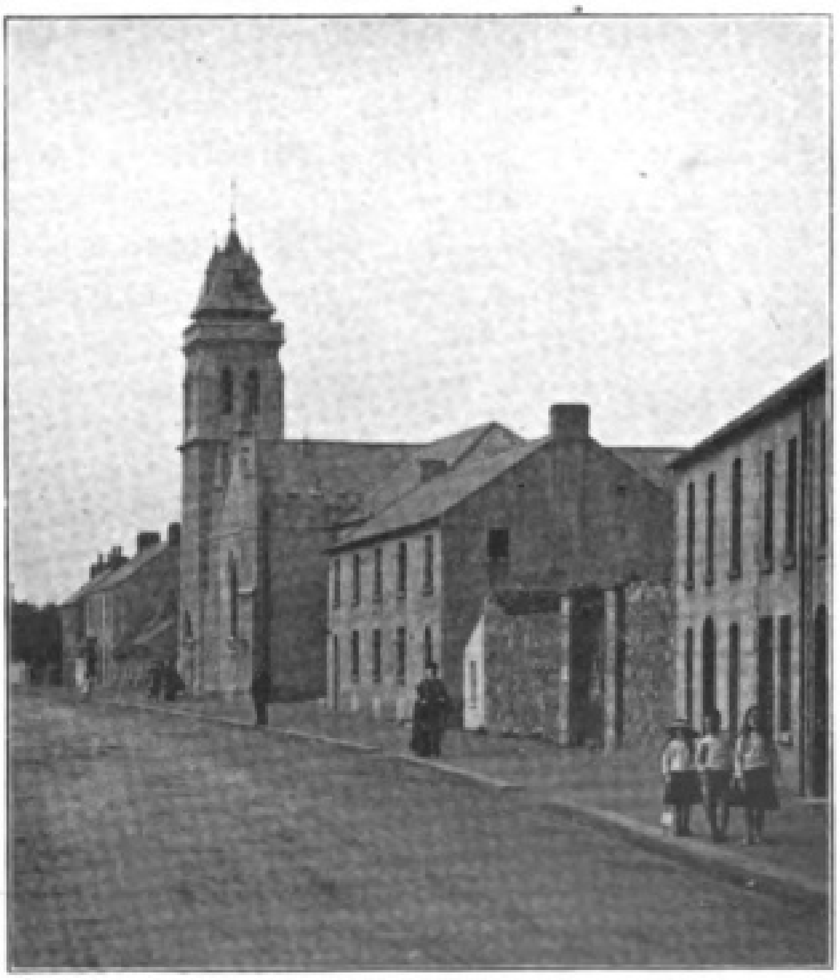
" To get the maximum clearness of signals the receiving circuit should be " tuned to that of the sending station. Arlington and Mare Island send on a " 2,500-meter wave-length, North Head and San Diego on a 2,000-meter wave " length, Eureka on a 1,400-meter wave length, Key West and New Orleans on a " 1,000-meter wave length, and Point Arguello on a 750-meter wave-length. On " the completion of the new radio station at the training station, Great Lakes, " time signals will be transmitted from that station for the benefit of shipping on " the Great Lakes, as well as the weather reports for that region, now transmitted " by Arlington after the Atlantic coast weather bulletin, following the 10 p.m. time " signals."

Sinn Fein Sedition

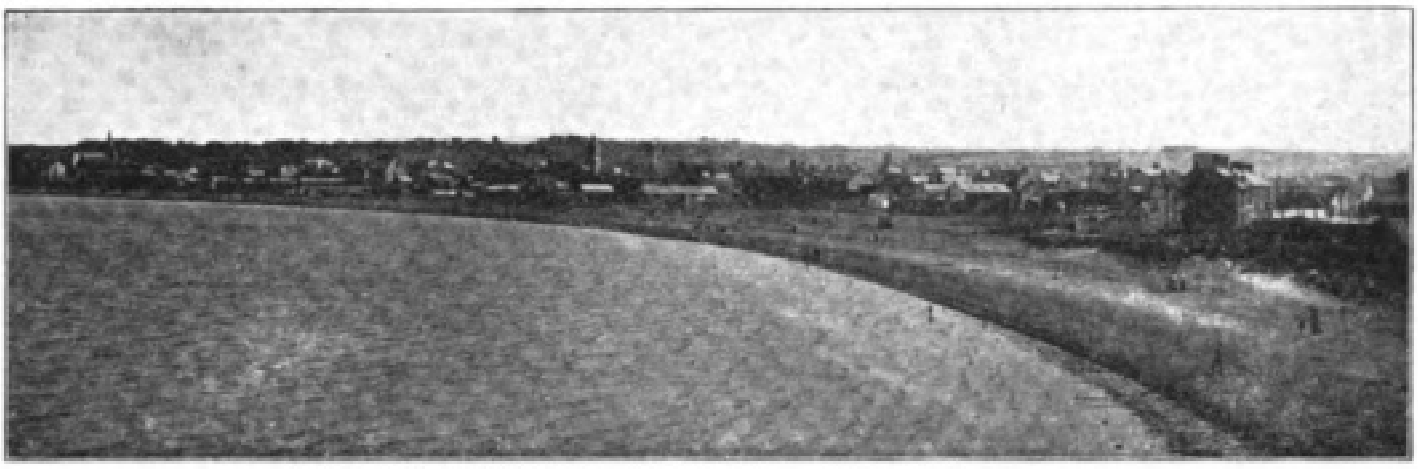


WIRELESS Telegraphy played an important *rôle* in the recent disturbances. The movements of the German vessel which landed the traitor Casement on the shores of Tralee must necessarily have been communicated through that medium.

A Dublin eye-witness of the dramatic events states that the insurgents succeeded at once in cutting the telegraph wires, with the consequence that there was no possibility of communicating with England except by means of Radio-Telegraphy. Then we have the story of the gunboat which played so important a part in preserving the Irish capital, and which was proceeding up the Liffey to refit when she received by wireless a message stating that serious trouble had broken out. The gunboat took action at once, and by its agency the quayside and Butt bridges were prevented from being overrun with the insurgents. Moreover, as soon as Connolly (who has since paid the penalty with his life) had gained possession of the wireless station at Stephen's Green, he used it for the purpose of sending out to the world the Procla-



CHURCH STREET, SKERRIES. THIS IS A TYPICAL IRISH THOROUGHFARE.



THE SOUTH STRAND, SKERRIES. THE FINE STRETCH OF SAND ADDS A PICTURESQUE TOUCH TO THE VIEW

mation of an Irish Republic. The insurgents also installed a wireless apparatus over the well-known establishment of Messrs. Reis, in Sackville Street, at the corner of Lower Abbey Street.

Perhaps the most dramatic incident, from a wireless point of view, consists of the way in which the Marconi Station at Skerries, Co. Dublin, was saved from rebel capture. The local police got word of the coming attack on Easter Tuesday. On Wednesday the rebels, after capturing the neighbouring villages of Swords and Donabate, marched on Skerries—the peaceful villagers gathering on a hill to watch the coming battle. In the nick of time a destroyer, undoubtedly summoned by the ether waves, came along at a great pace, and landed two hundred men of the South Staffordshire Regiment. These troops immediately entrenched the position, and saved the situation; for the rebels on learning of the destroyer's presence wheeled about and returned to Dublin. This latter incident forms the subject of the following poem, which is from the pen of an Irishman born close by the district which forms the scene of action :—

I see it now, as long ago,
The quaint old fishing town,
The cottages with whitewashed walls,
The thatched roofs worn and brown.

The fisher folk that come and go,
The trawlers in the bay,
And Wicklow's hills, that blue and dim
Stretch Southward far away.

Peaceful and still—yet whence those sounds
That from yon valley rise?
And whence that cloud of wrath that looms
Upon the Western skies?

It breaks with gleam of naked steel
Of bayonet and of sword,
While downward like an angry flood
Rush on the rebel horde.

The trembling villagers descry
  The terror drawing near ;
Whence shall they turn for succour now,
  In this dread hour of fear ?

Send forth the voice that pierces far,
  O'er circling sea and land ;
Tell of the perils gathering near,
  The death on every hand.

Onwards the rebels press, they know
  If once that voice be still ;
The town is theirs, and they are free
  To work their wicked will.

Call yet again ! . . . at last, at last,
  An answer faint, but clear.
From o'er the seas the succour calls,
  " Stand steadfast, help is near."

Behold on yon horizon dim
  That little cloud of smoke.
Hark ! hark ! the thunder's far away. . . .
  It was the guns that spoke.

The good ship cleaves the mists, and now
  She stands revealed in might ;
The rebel hordes in terror gaze,
  Then break in headlong flight.

* * *

Thou'rt saved ! In peace thy dreams renew,
  Old town beside the sea.
May memory of perils past
  Make life more sweet to thee.

Saved !—and oh voice whose echoes reach
  Through earth's most distant seas ;
Bring strength, bring courage unto men,
  In perils such as these.

Answering the cry of terror sent,
  Through nights of doubt and fear ;
Whispering, when death stands at the door,
  " Be steadfast, help is near."

T. Iddon.

Wireless Telegraphy In the War

"DER TAG."

OUR readers will have studied in our daily contemporaries many thrilling accounts of the great naval battle between the British and German Fleets on May 31st, and it would be undesirable for us to attempt any general description; but the part played by Wireless Telegraphy on both sides, all through the operations, was of the greatest importance, and it is impossible for us to omit all reference to the latest exploit of our glorious fleet. The first point to remember is that the encounter was not sought by the enemy. Vice-Admiral Sir David Beatty with his Battle Cruiser Squadron encountered the whole of the German High Seas Fleet in pursuit of an (unnamed) enterprise northward. Overhead the enemy Zeppelins, at an altitude probably of between 6,000 and 10,000 ft., were anxiously surveying the vast panorama spread beneath them, and maintaining constant wireless touch with the German Admiral. On the British side, as soon as Beatty realised that he could attack, he immediately sent a radio message to the High Admiral, and a narrative communicated to the Press by "one who was there" describes the arrival of that message in the following terms:

> "I shall never forget the thrill which passed through the ships of the "Grand Fleet when that inspiring message was received from the Battle Cruiser "Squadron many miles away: *I am engaged with heavy forces of the enemy.*"

We may be sure that, all through the battle, the wireless operators were kept hard at work receiving and transmitting, now announcing action on the part of themselves, or of the enemy; now issuing orders for concerted movements. It is plainly evident that the British Fleet was manœuvred with great coolness and tactical skill, which, however, did not interfere in any way with the dashing spirit of attack traditional in our naval service. Such manœuvring depends upon the accurate transference, by radio messages, of orders from ship to ship, and the naval operators concerned played their part as nobly as their comrades at the guns, or in the engine rooms. In this connection it is not without interest to observe that the German Emperor in his bombastic speech at Wilhelmshaven said in the course of his address to the sailors of his own battered Fleet: "Every one of you has done his duty. "At the gun, in the boiler room, and in the *wireless hut,* every one bent his mind to the "same end." In other words, he recognised the energies of the wireless men as ranking side by side in importance with those of the gunners and engineers. *Fas est et ab hoste doceri.*

The action was fought on the afternoon and night of Wednesday, May 31st, and the aftermath of the engagement could hardly have been over within the next twenty-four hours; in fact, it was not until the middle of Thursday, June 1st, that Sir John Jellicoe realised that there was nothing more to be done by the Fleet as a Fleet, and returned to his bases. This appears from the Admiralty report of Sunday, June 4th.

On the night of June 1st the German Admiralty made up a statement and issued it to the world, detailing their own losses and those of the British. How was that report made up? and what reliance could be placed upon its accuracy? Twenty-four hours later the British Admiralty in making up *their* first report were unable to speak with certainty regarding six of their own destroyers, and in their statement simply said, after mentioning the loss of five destroyers (which they named), "six others are not yet accounted for." Later information showed that, of those six, three returned safely to their base, whilst three were lost. It is evident then, that the British Admiralty had not received an inclusive report even of their own vessels, at a time when the German Admiralty professed to be able to speak with certainty not only about every important unit of their own fleet, but also about those of the enemy. Yet the British are at least as well served by wireless as the Germans, and the conclusion is irresistible that the German account was hurriedly and imperfectly made up in order to create the impression amongst their own people and neutral nations that the action had resulted in their favour. Germany's anxiety especially to impress America is evidenced by the fact that about mid-day on June 2nd they issued a bragging and inaccurate report by wireless *in English*. The net result is that the world at large received not only the first impression, but the first details and explanations from enemy sources. British correspondents at Petrograd telegraphing on Sunday, June 4th, state that the Russian morning papers contained "three columns of telegrams based on the announcement by the Admiralty at "Berlin, the speeches in the Reichstag, articles from the Chancellor's daily Press, "and *communiqués* issued by the Wolff Agency, but not one single supplementary "line from British official or semi-official sources. All that there has been from "our side so far has been less than half a column of Admiralty bulletins, which "appeared in last night's evening papers here." Such a result is not desirable; the Russian people do not understand the British spirit sufficiently well to realise the cautious sobriety which prevented their acclaiming their victorious defeat of the enemy's object, accompanied as we have subsequently learned, by the infliction of considerably heavier loss upon them than was sustained by ourselves. Such intelligence would surely have been of the greatest practical interest to the Russians, who had for some time past been living under a constant threat of a combined naval and military attack. These recent losses will undoubtedly seriously affect German naval operations in the Baltic.

Lord Beresford in the course of a recent interview expressed his regret that the terms employed in the first British Admiralty announcement should have been open to the sinister interpretation which was, in fact, put upon it in certain quarters, and suggested that it would have been well to publish to the world, at the earliest possible moment, the simple statement that the German Battle Fleet had been brought to action in the North Sea, and after a severe and prolonged engagement had been driven back to its ports. Such an announcement transmitted through the British Wireless Long-Distance Stations would have sent a thrill throughout the world and created an impression which the German misrepresentations would have been utterly unable to efface. As it was, Germany was allowed to create the first impression, and she seized the opportunity of heartening her dejected subjects at home, and filling the Press of neutral countries with boastful vapourings. Representations of a similar nature have poured in from newspaper correspondents in Japan, Switzerland, and Roumania.

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A TRAGEDY OF THE AIR.

NOVELISTS have many a time and oft treated their readers to pathetic death-bed scenes. Charles Dickens in particular carried this kind of dramatic writing to extremes. There is something very appealing to human sentiment in the last uttered words of our fellow-creatures just before their spirits leave this "Earthly "Tabernacle" to meet their God. It has constantly happened that friends and relatives at home have received a letter from someone abroad, written indeed in life, but only received after the writer has passed away. There is a peculiar pathos attached to such communications, but even such as these are lacking in the dramatic element which characterised some wireless messages recently received from Russian aeroplanists, making their final trial flight near Odessa. The operator at work on the field station, which was receiving messages transmitted by the aviators, learned through the æther waves that the plane, on which the unfortunate men were flying, was behaving in an eccentric and erratic manner. Within a few moments, a further message announced the snapping of a connecting stay. Closely following, the telegraphist below caught the words, "We have no power over our machine." Ere many more minutes had elapsed came the despairing cry, "We are falling to death," and—as the machine lurched earthward in headlong disaster—the æther waves transmitted the last uttered speech of the men in their death-throe, "We are perishing; good-bye!" The final words had scarcely been transcribed before the machine crashed to earth in utter ruin, and life had been mercifully reft from the shattered wrecks of humanity before their companions reached them.

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"HOW NOT TO SAY IT."

A PARAGRAPH recently appeared in the Press which runs as follows:—"I do "not wonder that Jellicoe refuses to use wireless." To quote the phrase of Mr. Punch, this is an incident of "How not to say it." The Grand Fleet's commander is one of the greatest users of wireless in the world! What the writer meant was that Jellicoe would not bother about radiating "half-baked" reports to his chiefs at Whitehall, a compliment to the Admiral's good sense—and wireless!

War Notes

Closing scenes and problems of the Kut tragedy.

THE closing scenes in the tragedy at Kut have been largely revealed to the world by wireless telegraphy. General Townshend's final radio communication consisted of the pathetic message: "I must have some food here "and cannot hold on any more." Just before his surrender a pre-arranged signal indicated that the gallant general's last message had gone through. Members of Parliament have very justly displayed considerable and persistent curiosity as to the conduct of the whole affair. The replies given by the responsible members of the Government would appear to refute the idea that the brave defender was sent against his will and despite his protests. At the same time, what does appear to await satisfactory elucidation is the failure to relieve him during the months for which he was able to hold out. The fact of his having originally issued full rations plainly indicates that General Townshend had acted on the assumption that relief would be speedy. It is noteworthy that amongst the various supplies dropped from aeroplanes during the latter phase of the beleaguerment that we find included amongst the miscellaneous items "various spare parts of wireless apparatus." Such a fact points conclusively to the importance of radio-telegraphy under such circumstances; because we may be quite sure that nothing except the most vital necessaries were transmitted by this ultra modern method.

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LORD KITCHENER

Wireless Telegraphists of every rank and in every clime pay their tribute of sorrow at the loss of the great soldier recently reft from us at the very moment when the consummation of his life's labour had been attained. Pre-eminently a worker in the highest sense of the word, the message he has left for us all may be summed up in the pithy but pregnant phrase, "Carry on."

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Russian Wireless at Trebizond.

A terse but very welcome radio message was received on the occasion of the occupation of Trebizond by the Russian Forces. The troops of the Grand Duke Nicholas, after their stupendous and victory-crowned labours, were prepared to find their advance upon this Black Sea port strenuously resisted by the Turco-Germans. Preparations had been made for the Russian Fleet in these waters to support the troops in their attack when a wireless message arrived announcing that "Trebizond is "surrendering." The Muscovite warships, therefore, instead of co-operating with the land forces, proceeded at full steam to follow the Turks, and harass their retreat along the shore. This operation was carried out in a very masterly manner and troops were landed from the ships to play a decisive role in the Trebizond drama. The Russian seaplanes appear also to have given a good account of themselves, following closely the wireless instructions issued in accordance with the general plan of the Russian Commander, Admiral Eberhardt.

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Log of H.M.S. "Bristol."

We have many times referred to the value of the wireless warning advising the outbreak of war, which enabled the German ships in various parts of the world to escape the otherwise inevitable fate awaiting them from the British Navy. But it was not only the enemy who was able to utilise this medium for war-warning purposes. An interesting set of pen pictures under the title of the "Log Series" is being published by the Westminster Press, of 11, Henrietta Street, and one of their recent issues consists of the *Log of H.M.S. "Bristol,"* contributed by Mr. Wm. Buchan, leading signalman. He describes how the *Bristol* had been ordered to Mexico, and after spending some time there, was suddenly despatched to Jamaica. On Tuesday August 4th, at 9 p.m., it was announced on board "War on Germany was declared an hour ago"; two days later the *Suffolk* sent a wireless message to say she had the enemy in sight, and the *Bristol* cleared for action. The enemy cruiser turned out to be the *Karlsruhe*, and the two vessels were soon engaged in naval combat. The *Karlsruhe*, however, speedily "got her fill," and was enabled by her superior speed to steam out of danger.

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Enemy wireless in Central Asia.

Some extremely interesting facts came out in the course of an interview granted by Lord Hardinge, ex-Viceroy of India, on the occasion of an interview granted to the London correspondent of *The New York Times*. The subject dealt with was the resistance of India and Persia to Teutonic intrigues. After referring to the general loyalty which enabled England to denude her great Eastern Empire of British troops and almost strip these vast possessions of artillery, Lord Hardinge went on to make mention of enemy intrigues in Persia and Afghanistan. With their usual foresight, the Germans had prepared for action by installing wireless stations at Ispahan, formerly the capital of the Persian people, and still the religious centre. The German propaganda in Afghanistan was equally elaborately organised, and a systematic series of caravans were despatched hither by Prince Reuss from Teheran. Up to the present there are, however, no signs of any serious headway having been made by such propaganda, aided though it undoubtedly has been by the radio-telegraphic establishments in Persia. The German Emperor's persistent attempts to impress the Mohammedan nations with his benevolent patronage of Islam has "landed" him in many awkward dilemmas in various parts of the world. "Baksheesh" is the agency responsible for any little real progress he may have made; Orientals are "case-hardened" to flattery and "Bazaar Vapourings"—even by wireless.

A Year in the Near East

Some Recollections of Wireless Service on the Egyptian State Yacht

By Percy W. Harris

With Illustrations by the Author.

WIRELESS operating as a profession will lead a man to many climes, and, although most of the work takes him on the high seas and busy transocean routes, occasionally there are positions to fill of more than ordinary interest, such as that I occupied for a period in the service of Abbas Hilmi, then Khedive of Egypt, now a declared enemy of the British, sheltering in Austria.

I often sit and turn over in my mind the experiences in that crowded year. They were many and varied, some in the winter gales of the Ægean Sea, others amid the mosques and gorgeous colourings of Constantinople; others, again, took place in the half-civilised regions of Asia Minor. As I have never yet written an account of them, and because they show that the life of a wireless operator is not all regular sailing across the Atlantic, I will endeavour to recall a few here, for the benefit of those who prefer to read of actual happenings rather than the adventures of fiction.

The Egyptian state yacht *Mahroussa*, which I joined at Alexandria in the spring of 1912, was an old vessel, dating from about 1870, when she left the yard of a Thames-side builder as a two-funnelled paddle steamer of some 4,500 tons. This was in the time of Abbas Hilmi's father, and upon the accession of the new Khedive, at an early age, he requested the Egyptian authorities to furnish him with a new and modern vessel to replace the *Mahroussa*, but for some reason best known to the Oriental mind his request was unfavourably received.

Now, although the Egyptian authorities would not provide a new vessel, they offered no objection to the proposal that the yacht should be sent to Europe for refitting, and accordingly she set sail for the Clyde, carrying with her the British commander, some four or five British engineers, and native officers and crew.

For nearly two years the *Mahroussa* lay in the Clyde, and before she returned to the sunny Mediterranean she had been completely transformed and now appeared with a single funnel, modern boilers, triple screw turbines, and every modern device known to shipping. Like the Irishman's watch, little remained of the original, and, as I happen to know that the change cost £110,000, not much can be said on the score of economy.

The most amusing part of all relates to the officers and crew, who, considered as being on foreign service, were paid what amounted to double wages for the two years they remained idle in Scotland. The engineers, mostly Scotch, fully appreciated receiving such ample remuneration for staying at home in ease and idleness, whilst the native crew explored Glasgow from end to end, much to the amusement of the inhabitants.

In the spring or summer of 1911, some time after the *Mahroussa* had returned to her old home in Egypt, the Marconi Company received instructions to equip her with wireless apparatus, and accordingly a five kilowatt battleship installation was fitted. The apparatus has already been described in this magazine (Marconigraph, February, 1913), and it will suffice to mention here that the transmitter operated from a set of 42 large accumulators and had a disc discharger. The receiver was of the valve type; a magnetic detector and multiple tuner were also fitted.

I had scarcely unpacked my trunk and inspected the apparatus when orders came to sail for Dalamon, an estate belonging to the Khedive in Asia Minor and

AN EGYPTIAN PASHA AND THE YACHT'S DOCTOR SITTING BY THE WIRELESS CABIN OF THE "MAHROUSSA."

THE COMMANDER OF THE "MAHROUSSA"

having for its port the land-locked bay shown in the heading to this article. We had on board a number of agricultural implements, and after these were landed we returned to Egypt to fetch the Khedive himself. I must confess the first sight of my princely master did not impress me greatly, for his appearance was that of a short, stout European with a double chin.

Upon our return to Dalamon my wireless duties consisted in transmitting and receiving a great volume of traffic with the station at Port Said, 350 miles distant to the south-east. The messages were usually from 30 to 300 words in length, many in secret cypher. Most of the work was done at night, and I can say without boasting that few men have worked as I did in those silent hours of darkness, with the telephones glued to my ears and a hand to the starter handle ready to give the monotonous "Rd" "K" as bell after bell sounded and echoed through the night air.

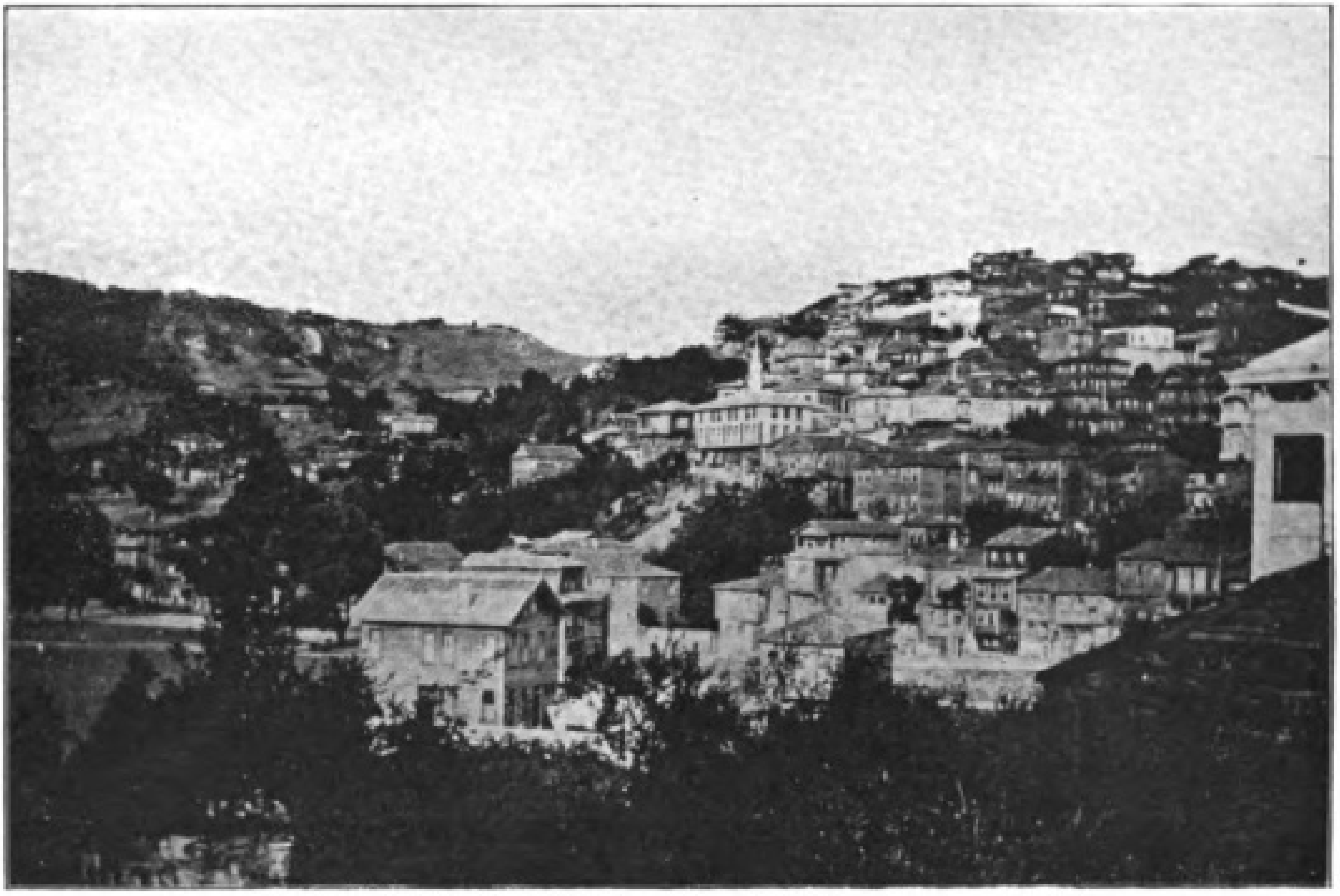
Of course, there were bad nights and good nights. The bad nights could be very bad, what with atmospherics wiping out almost everything and the jambing of the Italian battleships and cruisers in the Ægean (for Turkey and Italy were then at war).

It was not long before an interchange of courtesies in bad French with the operator of the Italian flagship at Rhodes made it fairly obvious that I was interfering somewhat, and after a while a polite telegram from the Admiral to the Commander of the *Mahroussa* requested a working arrangement. The Khedive grumbled, but after a little time it was settled, and a programme enabled us both to clear off our "stuff" without trouble.

ONE OF THE TURKISH OFFICERS.

When we left Dalamon the orders were to steam to the Dardanelles and thence to Constantinople, and the scenery as we wound in and out of the Ægean Islands was beautiful in the extreme.

We had scarcely left the shelter of Dalamon Bay and sighted the famous harbour of Rhodes when I came for the first time into contact with the realities of war. From out of a snug little hiding-place a sleek Italian destroyer with guns trained full on us came speeding across the water and signalled to our commander to stop. I may here mention that the Egyptian flag which we were, of course, flying was identical with that of Turkey, Italy's enemy, and an inspection, therefore, became necessary. After a few particulars had been given to the lieutenant on the bridge we were allowed to proceed



"OUR RESTING-PLACE AT BEICOS, A PRETTY VILLAGE SOME TEN MILES FROM CONSTANTINOPLE."

on our way, and in due course came to Tenedos and the entrance to the famous straits.

Instead of entering the Dardanelles, however, we continued up the Ægean to Dedeagatch, a port then Turkish but since acquired by Bulgaria. Here the Khedive went ashore for the purpose of finishing his journey by rail, as the Dardanelles were heavily mined and he did not relish exposing himself to the danger. As to the yacht's officers and crew, I suppose they did not matter; so the *Mahroussa* turned back, and in a few hours came again to the forts at the entrance of the famous waterway.

A day of steaming through the mined waters of the Straits and the Marmora (they were not very interesting then) brought us to Constantinople, and after a short pause off Seraglio Point we steamed up the Bosphorus to our resting-place at Beicos, a pretty village some ten miles from Constantinople itself and not far from the Black Sea. Here we anchored and lay in idleness from the end of May until the following October.

One of the first things I did as soon as we were settled was to see whether it was still possible to communicate with Port Said. On this point I had doubts, as a glance at the map showed that a distance of some 650 miles separated us, nearly a half of it being overland. Of course, in daytime such communication was quite out of the question, but at night in good conditions I found that we could get signals through quite well.

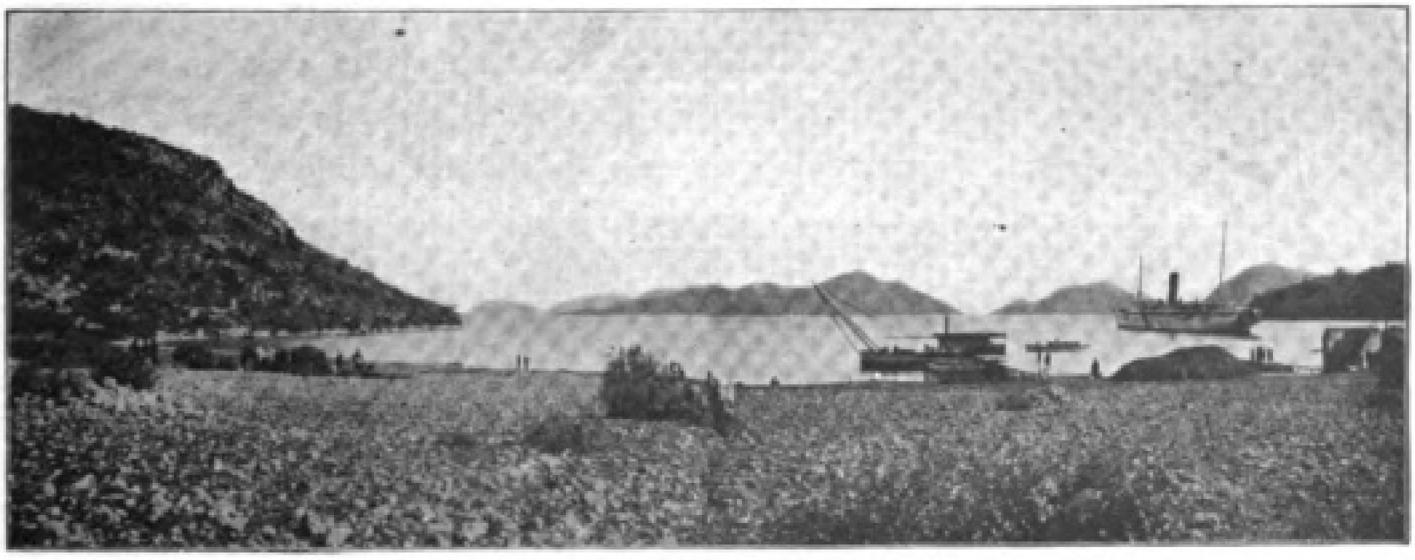
Of the happy days in Constantinople, the visit to Saint Sophia, the picnics with the British residents to the shores of the Black Sea and many other interesting events I must not speak here, for nothing less than a book would do them justice. Suffice it to say that when we heaved the anchor aboard and left again for Egypt I felt a strange wrench in parting from the loveliest district I have ever known.

We called at Dalamon on the way back. On this occasion there happened a dramatic little incident, humorous in some ways, but only saved by whim of fortune from ending in tragedy. Late one afternoon, following on a gorgeous day, I chanced to be leaning against the rail contemplating the distant scenery when a black object came in view rounding one of the islands at the mouth of the bay. Picking up my field glasses, I made out a boat, and as it drew nearer I perceived that the sole occupant was a Greek priest, patriarchal in appearance, with a flowing white beard and long black robes. Across the glassy water he rowed sturdily and rhythmically, and before long drew up alongside, an Egyptian marine running down the ladder to meet him.

From where I stood I could not hear what he said, but it was evident from the buzz of conversation which spread along the deck that something was wrong. The Khedive, who happened to be on board, was advised, and on enquiry I found that the priest, knowing the yacht to be at Dalamon, had rowed in, post haste, from a neighbouring district to tell us that the brigands had come down from the hills to raid his village. And then, as the novelist would say, all was bustle and excitement! Both steam launches were lowered and lifeboats filled with soldiers of the Khedive's Guard were hitched to them. A couple of native officers and an official or two climbed in, and off across the bay the expedition sped, leaving a trail of white foam.

We waited patiently for an hour or two, and then, after darkness had fallen and as the jackals were beginning to howl in the adjacent woods, two specks of light in the distance showed where the returning launches were rounding the islands. Everybody was on deck watching the lights as they grew brighter and nearer, and directly the returning force came within hailing distance many excited enquiries were shouted across the water. The expedition had proved a very tame affair, however, for on arrival at the village the cry of "brigands" turned out to be a false alarm. It is just as well it did, for I found just afterwards that not one of the soldiers had a single round of ammunition to put in his rifle, and there had been none on board for two years!

(To be continued.)



A VIEW OF DALAMON BAY FROM THE SHORE. THE "MAHROUSSA" IS ANCHORED ON THE RIGHT.

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To Our Readers

SENTENCES which meet the eye in the course of casual reading often institute a long and seemingly disconnected train of thought. A case in point occurred recently when our attention was arrested by a phrase in one of our contemporaries: "Wireless telegraphy possesses an unaccountable fascination for the youthful mind." The fascination is obvious, but its full realisation and significance are less apparent. In early days this applied science was largely indebted for its excitation of popular attention to the sense of mystery which surrounded it. Ordinary wired telegrams had become familiar; the fact that the visible connection of a tangible metal wire had to be established between two points before communications could pass, had done away with the original feeling of wonderment at what in the earlier part of the nineteenth century was looked upon as an electrical marvel.

Radiotelegraphy eliminated the wire and the visible connection, and fired the popular imagination by apparently casting messages away into space to snatch them back from infinity at the other end. This invisibility of connection is still accountable for a good deal of wonderment on the part of the large number of folk who are less familiar with the facts of the universe than most of us like to believe to be the case with ourselves.

A passenger goes on board one of our great ocean liners, and is perhaps fortunate enough to be allowed the privilege (very charily extended) of visiting the wireless room. Here sits a young man surrounded by various mysterious pieces of apparatus, ready to accept even in mid-ocean a message for transmission to the sender's house, perhaps thousands of miles away. The little cosmos on board is apparently isolated from the rest of the world by a vast expanse of air and water, and at first sight there seems something uncanny about the operation. The wireless room takes on the semblance of a wizard's cavern. The ocean traveller feels like an investigator of the occult who finds himself in a laboratory of some mediæval necromancer, who, surrounded by phials, retorts, cabalistic diagrams, and other paraphernalia, is bending over a glowing brazier in search of the "transmutation of metals" or distilling lustrous liquids in pursuit of the "elixir of life."

Such an allurement is, however, founded upon illusion, and the real fascination of wireless telegraphy lies in the fact that its actuality is even more imaginative and poetical than the mysticism of mediævalism. Men are to-day rapidly outgrowing the state of mind which can see no poetry or romance except in the trappings of bygone ages. Our modern artist finds it unnecessary to indue men and women with antique costumes in order to impart to them the feeling of romanticism demanded by a picture portraying sentiment. Long ago Wordsworth dared to speak in his description of a perfect woman of " the very pulse of the machine," whilst Kipling in one of his most delightful poems describes in throbbing verse the feelings of a Scotch marine engineer with regard to his engines.

To-day's knowledge affords more food for imagination and more delight for the poetic soul than all the phantasies of bygone ages. Take, for example, the cosmogony of Milton's " Paradise Lost," one of the grandest poems in the English language, and consider it side by side with the conception of the universe inculcated by modern science. Milton's " Ptolemaic System " figured the earth as the centre of a number of transparent spheres revolving one within the other " cycle in epicycle, orb in orb." This system of spheres hung " pendant at the gates of heaven," surrounded by an inchoate mass of mingled yet unmingled solids and liquids entitled chaos, whilst below stretched the gloomy abode of hell. Modern science pictures for us a series of universes kept together by no material bonds, but maintained in delicate equipoise by the action, reaction, and counteraction of diverse forces. These universes float in a limitless space filled with ether, which alone enables the waves of heat and light (and who knows what else ?) to pass from point to point. There seems little doubt as to the comparative poetic merit of the two conceptions. Perhaps the strongest and most abiding spell cast by radio-telegraphy over the human mind lies in the fact that the more its problems and effects are studied the more vivid becomes the realisation of this vast and all-pervading ether. Wireless telegraphic fascination may have started with distorted vision, but is becoming fixed and intensified by knowledge.

The Editor.

Maritime Wireless Telegraphy

Wireless Call for Aid.

When the steamship *Alamo*, which found herself in difficulties 130 miles off Cape Hatteras, sent out wireless appeals for help recently, the cutter *Onondaga* went to her assistance. It is gratifying to know that there are watchful ears ever ready to receive and act upon the calls of vessels in distress. The dangers of the seas are well known, but wireless telegraphy goes far to obviate the terrible catastrophes which have occurred from time to time.

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A Novel Marriage Proposal.

Our contemporary the *Wireless Age* prints the following paragraph, which we think may interest our readers:

A newspaper relates that a new feature of wireless telegraphy has recently had a demonstration in Connecticut. A young couple in the Nutmeg State had a misunderstanding. The young man started for the West Indies on a fruit steamer. Along came St. Valentine's Day, and the young woman changed her mind. Her sweetheart was well out to sea on his voyage. She bethought herself of the wireless, and sent through the air the statement: "I have changed my mind. This is leap year. Will you have me?" This brought a quick response: "A great valentine. Will return by next boat."

Wireless telegraphy has been useful in a great many ways, bearing messages of war, of peace, of business, of sorrow, of joy and love, and perhaps hatred, but this is said to be the first time on record that a proposal of marriage was ever made by Marconigram by a young woman, and acceptance returned by the same means.

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Medical Advice by Wireless.

"Master Frederick VIII.: Please have your Dr. state symptoms and treatment
"for appendicitis immediately.

"Capt. Banvard."

This was the message from the Standard Oil tanker *Brindilla*, which was delivered to the captain of the Scandinavian-American liner *Frederick VIII.* by his wireless operator one evening recently, while the vessels were at sea. The ship's surgeon immediately diagnosed the case and directed by wireless the treatment to be given the patient by the captain of the Standard Oil tanker. Under the doctor's instruction, Captain Banvard administered opium and applied ice bags, continuing his treatment until the ship reached port.

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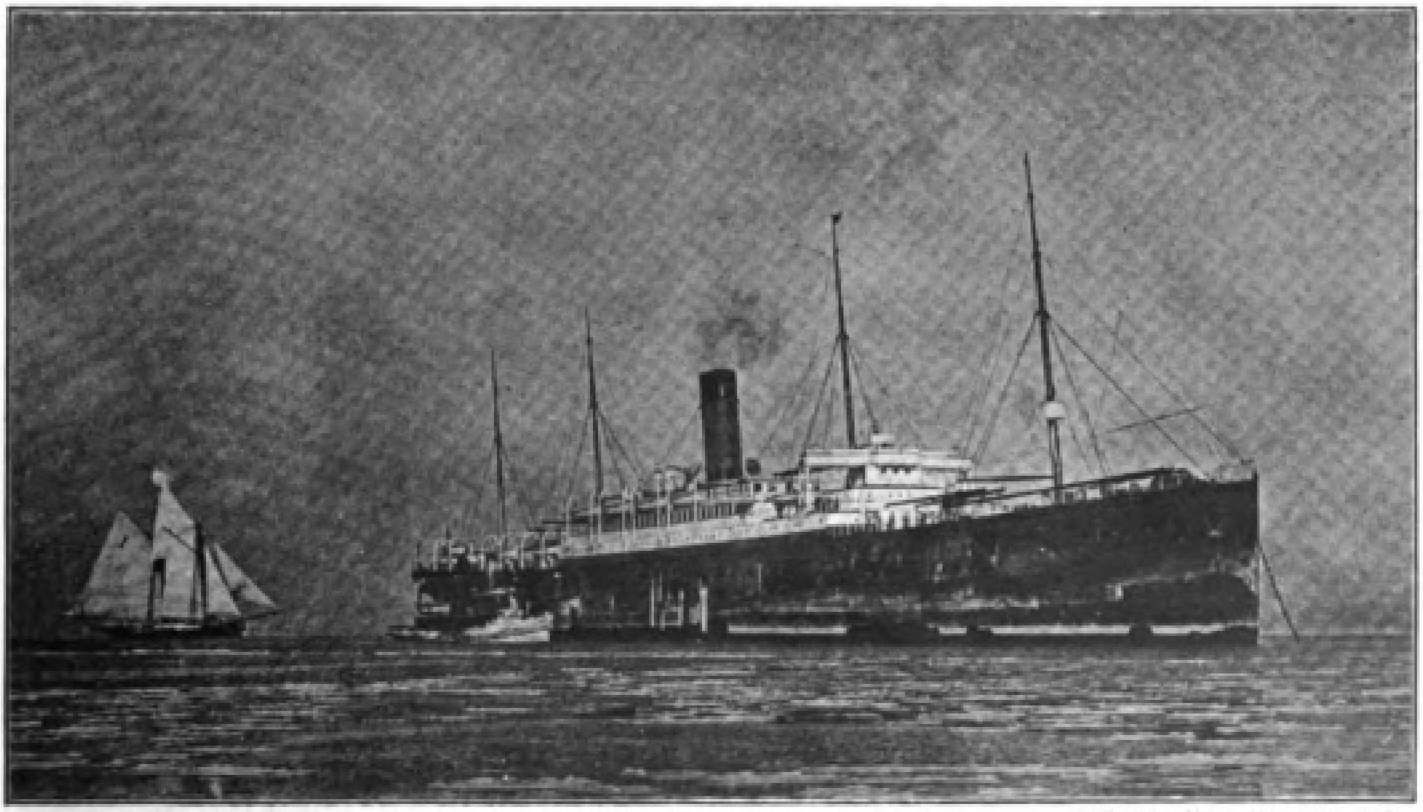
S.S. "CYMRIC" TORPEDOED WITHOUT WARNING.

According to messages from Queenstown, the White Star liner *Cymric* was torpedoed, and sank eleven hours after she was attacked. Five of the crew were killed, whilst the remainder were landed at Bantry.

The captain of the *Cymric* states that when eight days out from New York, and 138 miles from land, his ship was torpedoed without any warning. The track of the torpedo was seen by several, but the submarine itself was not seen. The torpedo struck the engine-room and went through, exploding on the far side. It blew all the skylights off and all lights out. Four men were killed by the explosion, and the chief steward was drowned while leaving the ship. The rest, numbering 105, were all saved.

All left the ship and took to the boats, but later returned and sent out a wireless call on the emergency gear. They received an answer to the effect that a rescue vessel would be sent without delay. A sloop subsequently arrived, took off everybody, and stood by till the vessel sank.

There were no passengers on board the *Cymric*, and the crew were all British,



(Photo: "Daily Mirror."

S.S. "CYMRIC," OF THE WHITE STAR LINE. SHE WAS TORPEDOED AND SUNK WITHOUT WARNING 138 MILES FROM THE NEAREST LAND.

with the exception of one Russian and two Belgian subjects. The *Cymric* had no gun of any kind mounted.

The value placed on the *Cymric* for marine insurance was about £85,000.

The *Cymric*, of which we reproduce a photograph, was a twin-screw vessel of 13,370 tons, built by Messrs. Harland and Wolff in 1898, and possessed a speed of fifteen knots.

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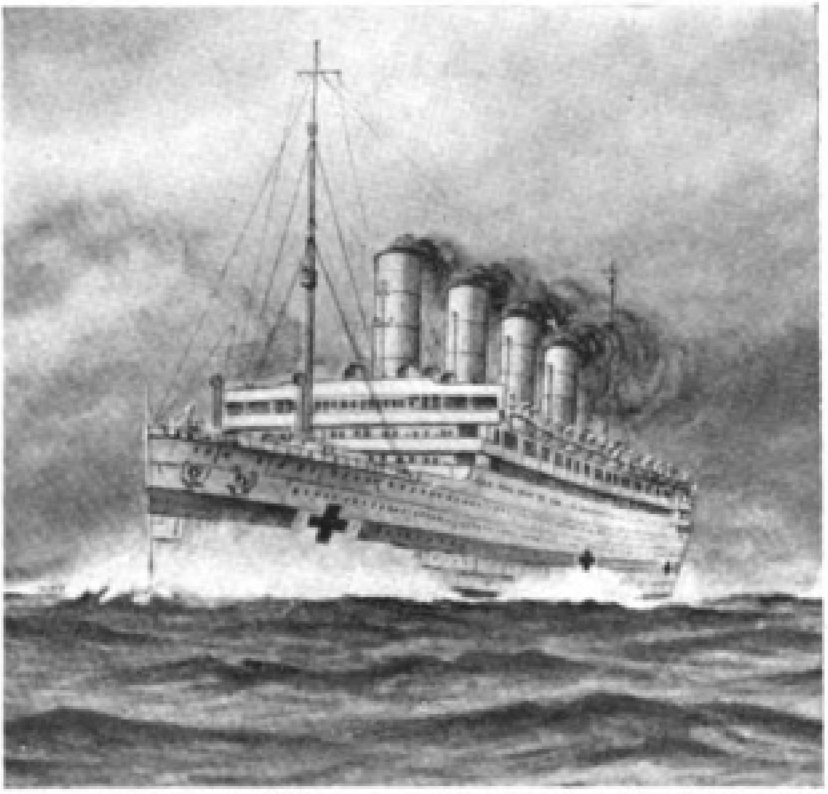
THE HOSPITAL SHIP "AQUITANIA."



Reproduced from a water-colour painting by P. Aris.

H.M.H.S. "AQUITANIA" OFF CAPE USHANT.

Since the advent of "two men" ships wireless operators have a l'ttle more leisure in which to indulge in recreation. We have pleasure in printing herewith a reproduction of a picture which Mr. P. Aris, a wireless telegraphist, painted whilst serving on board a merchantman some months ago. Mr. Aris is an artist, and when his ship passed H.M. Hospital Ship *Aquitania* one day, he thought it would form a good subject for a painting. This he executed in water colours, and our illustration is reproduced from it.

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AN ECHO OF S.S. "WAYFARER."

In the Admiralty Division of the High Court of Justice, before Mr. Justice Bargrave Deane, sitting with Trinity Masters, there has just come up for settlement a claim for salvage remuneration in respect of services rendered by the steamship *Framfield*. The help given was to the Liverpool steamship *Wayfarer* in the Atlantic Ocean. It will be recollected that while engaged on transport work and bound from Avonmouth to Malta under charter to the Admiralty, carrying troops and horses, the *Wayfarer*, a vessel of nearly 10,000 tons, was torpedoed or mined about 110 miles from Queenstown. The SOS signal was immediately sent out, as the vessel had a huge rent torn in her side. The *Framfield* happened to be in the vicinity and took the troops on board, eventually towing the transport, after a part of the crew had returned to her. His Lordship reserved judgment, remarking that it was a question whether the Admiralty's contract with the owners included salvage or not.

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AN EXCEPTIONAL DISTANCE.

While on a journey recently across the Pacific Ocean (from San Francisco to Sydney) the American steamer *Ventura* picked up wireless messages from the station at Tuckerton, New Jersey. She was 9,000 miles distant from that place. This forms in no wise a record in wireless reception, but at the same time it must be admitted that it is a very exceptional distance.

A WIRELESS WORLD!

The Special Problems of Aircraft Wireless—VII

By H. M. DOWSETT, M.I.E.E.

THE "BRUSH" OR "SILENT" DISCHARGE (*continued*).

From what has been said it is clear that the limit of safe working voltage on aircraft conductors situated in the neighbourhood of an explosive gas should be taken as that voltage at which the corona first shows itself, often called the "visual" voltage. The "visual" voltage is lowest for the sharp edges of a conducting surface and those parts of greatest curvature; for wires it decreases as the diameter gets smaller. Its value is proportional inversely to atmospheric temperature and directly to atmospheric pressure. At constant temperature and pressure the corona appears when the stress in the electric field at the surface of the wire reaches a certain definite value, called the critical stress.

For two parallel wires indefinitely far from earth:

$$R = \frac{V}{2r \log_e s/r} \times \left(1 + \frac{r}{s}\right)^2 \text{ very nearly.} \qquad (1).$$

where R = electric stress in kilovolts per cm.
V = voltage applied between the wires.
r = radius of wires in cms.
s = distance apart of wires in cms., centre to centre.

When the field is homogeneous, as between the centres of two parallel plates:—

$$R = V/s. \qquad (2)$$

This relation establishes the unit of electric stress, the "kilovolt-centimetre."

The great difference between the surface of a wire and the surface of a plate in determining the voltage which should be applied to obtain a given stress is illustrated by the following example.

Take the point marked on the curve Fig. 1 for wires of ·01" diameter (·025 cms.), and suppose the wires are 20 cms. apart, then the volts (maximum) we should have to apply to obtain the stress given on the curve would be 16·8 kv. But if we were to use two flat parallel plates 20 cms. apart we should require 2380 kv., or 143 times as much to obtain the same stress. The curve Fig. 1 represents the mean of the results obtained by different experimenters* connecting the critical stress with the diameter of the wire. The critical stress increases as the diameter of the wire decreases.

The corona indicates loss of energy in the air in contact with the wire. This loss at the visual voltage is not very appreciable for wires of small section, but it

* Ryan, Watson, Whitehead, Peek, Petersen.

suddenly increases as the voltage is raised (see Fig. 2),* the critical pressure being given by the approximate formula :—

$$E=\frac{17\cdot946\,b}{459+t}\times 350{,}000\ log_{10}\,(s/r)\times(r+\cdot07),\ \text{(Ryan.)} \qquad (3)$$

where E = critical pressure between conductors
t = atmospheric temperature °F.
b = barometric pressure in inches of mercury. .

An alternative formula often quoted is :—

$$e=308\,(1+0\cdot301/\sqrt{dn})\times r\ log_e\ s/r,\ \text{(Peek.)} \qquad (4)$$

where e = effective visual kilovolts to neutral.
d = density of the air $=\frac{3\cdot93\,b}{273+t}$
b = barometric height in cms.
t = temperature in °C.
n = number of cycles per second.

As an illustration take the case of the ·01″ diameter wire mentioned in connection with the Alexanderson test.† The critical voltage was given as 15,000 volts, which for argument we shall assume was obtained at normal temperature and pressure—60° F., 30″ of mercury. Suppose now instead of being placed 4 ft. apart the two wires were separated 10,000 ft., one being on an aircraft, the other on the earth. Then, other conditions remaining the same, the critical voltage would be increased to 25,500 volts. But other conditions will not have remained the same. At 10,000 ft. the temperature of the atmosphere—which falls at the rate of approximately 1° F. for every 300 ft. of ascent—and the barometric pressure—which falls at the rate of approximately 1″ for every 900 ft. of ascent—will also influence the critical voltage so that the value finally arrived at, instead of being 25,500 volts, would be 17,200 volts, or only 14·6 per cent. more than between wires a short distance apart and at ground level.

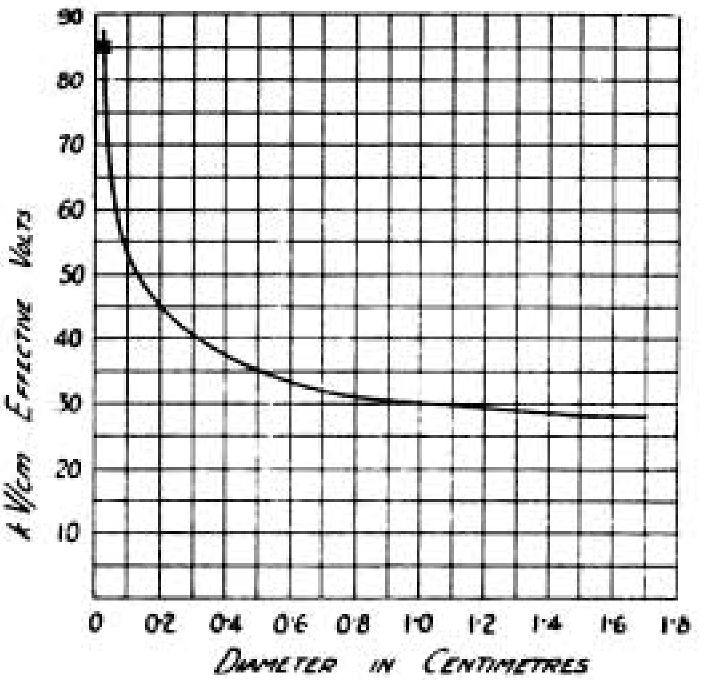


FIG. 1.

This is an extreme case, and is given to show that, provided the distance between the wires is a large multiple of their diameters, test values of visual and critical voltage obtained in the laboratory hold, when the conditions are apparently very different in mid-air.

In point of fact, it is not the height of the aircraft above earth which is of impor-

* Matthews and Wilkinson, "Extra-high-pressure Transmission Lines," *Journal Inst. Elec. Eng.*, No. 207, Vol. 46, p. 572.

† WIRELESS WORLD, June, 1916.

tance as regards the corona, it is the minimum distance between the aircraft aerial and its balancing capacity, or between any part of its high-frequency circuits and neighbouring metal work—dimensions which are practically constant at whatever elevation the aircraft may be; also it is not the potential difference between two such conductors, but the potential difference between each individual conductor and the surrounding space and the intensity of the electric field on their respective surfaces which is essential to know, as owing to differences in shape and size the stresses involved tending to breakdown may be very different.

Take as an example an aircraft aerial and its balancing capacity, which together form a circuit somewhat similar to that shown in Fig. 3, where C is an oscillating coil having at one end a pointed rod and at the other end a plate, together forming a primitive air condenser. The intensity of the electric field will be greater at the point of the rod than on the surface of the plate; the dielectric current will therefore be greater, and the fall of potential in the air near the point corresponding to this current must also be greater than near the plate. As a result, if the voltage is gradually increased, a brush discharge will be visible from the point long before any discharge shows on the plate.

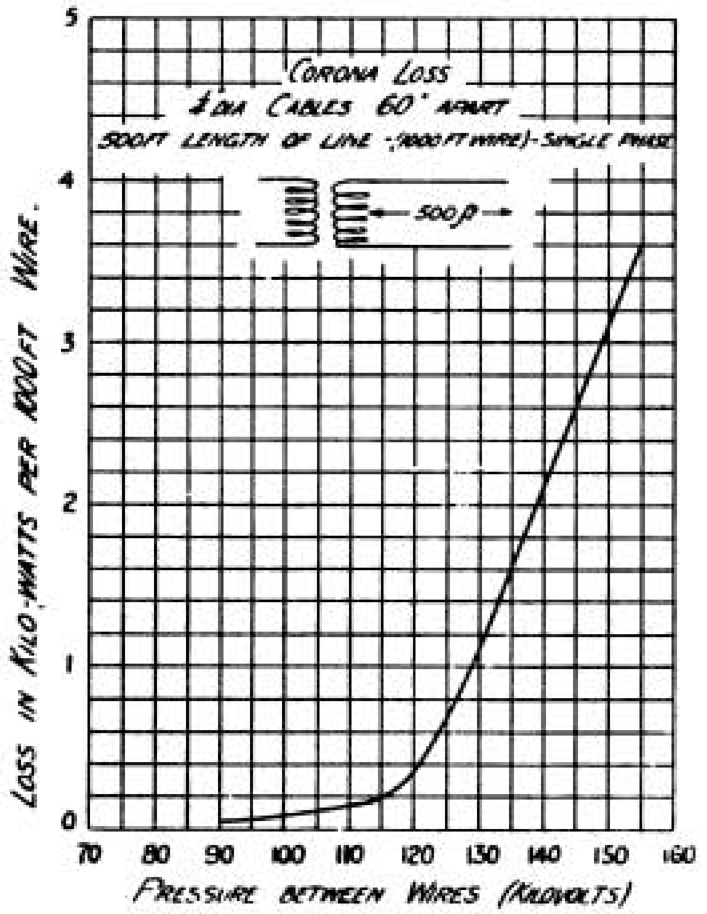


FIG. 2.

(See footnote * on page 297).

The reasons why the Zeppelin metal frame enclosing the gas bags can be safely used as a wireless balancing capacity when transmitting are mainly—

1. The very small electric stress which a given charge will produce on the frame compared with the stress the same charge will produce on the aerial hanging free in space.

2. The very high voltage which would be necessary in consequence to cause the stress to increase sufficient to cause a brush discharge on a cylinder the size of a Zeppelin.

For it has been shown * that a Zeppelin shell 525 feet in length, 50 feet in diameter in free space has 3·6 times the capacity of a No. 7/18 wire of the same length; then, if the wire is to produce the same total electric flux for unit rise of potential, it will have to be approximately 3·6 times as long as the Zeppelin. Now the intensity of this flux or the electric stress will be proportional inversely to the product "length by diameter" of each conductor, and if the Zeppelin has an intensity of 1 the wire will have an intensity of 1,158.

This huge ratio assumes the Zeppelin frame to be of sheet metal. Suppose,

* WIRELESS WORLD, Feb., 1916, p. 712.

however, the metal in the frame only amounts to 10 per cent. of the superficial area, which is a reasonable figure, then the relative intensities on wire and balancing capacity will be 115·8 : 1. But, as shown in Fig. 1, the critical stress of a comparatively flat surface like the Zeppelin frame is only ·72 that of 7/18 wire, which in its turn is only ·45 that of a wire ·01 inch diameter.

Then, if we take the visual volts for the ·01 inch wire as a basis, it can be shown that the visual volts (maximum) above neutral for the 7/18 wire will be 54 kilovolts, and for the Zeppelin 8,950 *kilovolts*. Obviously, the largest power ever likely to be used on a Zeppelin would lead to no danger of fire from the tendency to brush of the metal frame used as a balancing capacity—a P.D. of 54 kilovolts, for instance, from both aerial and balancing capacity to neutral, at 500 cycles, the capacity being taken as 2,620 cms. would represent 29 kw.—*provided all the joints in the structure were in good electrical contact*. If they are not in good electrical contact, although the structure may be incapable as a whole of brushing in free space, minute sparks may take place from the badly connected members to the frame, and also the stress may be sufficient to maintain an arc between the parts when once it has been started by intermittent contact. These contingencies necessarily place a limit on the power which can safely be employed.

The Brush Discharge Due to Induction.

Danger on a Zeppelin, however, is more likely to result from the brushing on isolated wires not connected to the metal skeleton and on which, therefore, a comparatively high electric stress develops as the result of a small charge. Such insulated conductors in the neighbourhood of H.F. circuits, whether these circuits are of the closed or open type, are subject to a capacity induction which under favourable conditions may result in a serious brush discharge. It is not necessary that the conductors should be in electrical resonance with the exciting circuits, although resonance will intensify such effects, neither is it necessary that the conductors should be very near each other.

Dieckmann,* in discussing this question in relation to aircraft, mentions having observed brushing more than 50 metres away from the inducing circuit—presumably on aircraft, using normal aircraft power, although this is not definitely stated—and the distance could only be obtained on a wood-framed airship of the Schütte-Lanz type.

Thus the exciting circuit could be in the fore gondola and the brushing conductor in the rear gondola well out of sight of the operator. If steps are taken to stop all inductive brushing a serious source of danger would be removed.

Burning Due to the Brush Discharge.

An effect of brushing which often takes time to show itself, but which may none the less lead to fatal results if allowed to develop, is that of the burning of fabrics and materials which happen to be in its path. Exhaustive tests carried out in Germany in 1909–10 using a metal-framed balloon filled with coal gas showed that small sparks on or between parts of the frame whether due to induction or not, if of short period or low frequency, did not result in burning, but if they were maintained

* *Leitfaden der drahtlosen Telegraphie für die Luftfahrt*, 1913, p. 178.

an appreciable time the balloon envelope resting on the frame commenced to burn. The gas emerged through the holes so formed, and while the burning edges slowly enlarged the gas continued to burn quietly without explosion. The ignition of gas in the close neighbourhood of ballonets made of unvarnished and rubberless cotton fabrics inflated at high pressure such as are used in Zeppelins was, however, difficult. The gas could only be set on fire by sparks of long duration.

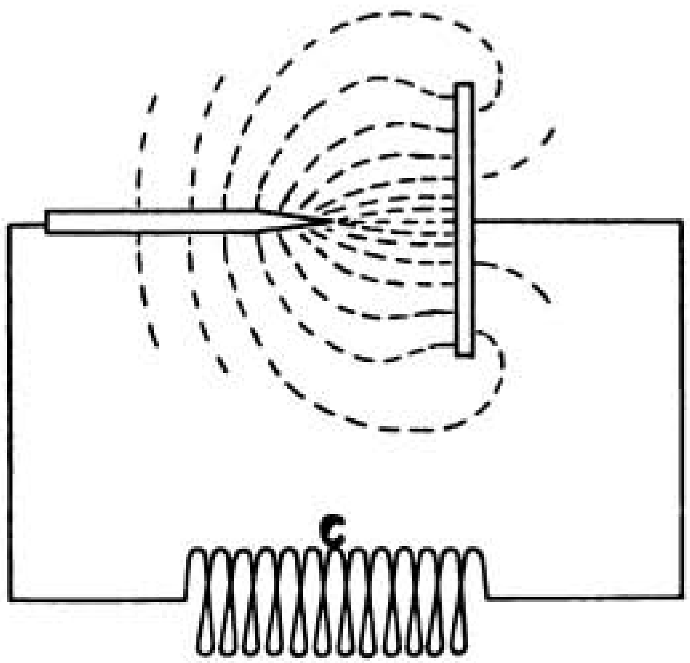


FIG. 3.

Insulating materials in the field of a brush discharge often intensify it, and they may burn or fracture as a result. Instances are given in E. F. W. Alexanderson's paper already referred to,* in which he described the difficulties which had to be overcome in the construction of an *H.T.*, *H.F.*, transformer, occasioned by the heating of the fibre spools on which his coils were wound, and the excessive losses in the varnished cambric insulation between the layers of the winding. Asbestos insulation also heated excessively. When carrying out some tests on the corona losses from thin wires, the cotton strings used to support the wires caught fire, and a porcelain insulator suspended from a cotton string which was then tried lowered the visual voltage on the end of the wire attached to it, and finally, due to the heat, broke into small pieces. This leads on to the important question of the use of insulators on aircraft.

(*To be continued.*)

"Morse Made Easy"

A NEW "WIRELESS PRESS" PUBLICATION.

Wireless students, boy scouts, Army signallers, members of volunteer training corps, and all who are endeavouring to master the mysteries of "dot and dash" will welcome the new Morse card just published by the Wireless Press, Ltd., at threepence. The system, which has been invented by Mr. A. P. Rye, enables the whole code to be memorised in a remarkably short time, and certainly far more rapidly than has ever been possible before. The system, which is simplicity itself, requires the student to learn one word for each letter, the word being selected for the long and short sounds contained in it. Thus the letter "c" (dash dot dash dot) is learnt in connection with "counterminer," the sound of which suggests the Morse construction. The word "aside" fixes the formation of the letter "a" (dot dash), and so on throughout the alphabet. Copies of the card, for which a great demand is anticipated, can be obtained from the publishers for 3½d., post free.

* "Dielectric Hysteresis at Radio Frequencies," Institute of Radio Engineers, Nov., 1913.

Correspondence

To the Editor of THE WIRELESS WORLD.

DEAR SIR,—With reference to your article in the March 1916 number of THE WIRELESS WORLD, on page 800, entitled 'Wireless to the Rescue," it may perhaps interest you to learn that I had sent to the local Press on the 31st ultimo the enclosed letter *re* Wireless on Chinese Lighthouses, and I shall be glad to see it mentioned in your valued Magazine *for the sake of the many British Lighthouse-keepers.*

I am sending a circular to all the Lighthouse-keepers on the China Coast asking them to sign a petition to back up my suggestion on their behalf.

Yours faithfully,

Shanghai, April 27th, 1916. (*Signed*) F. X. SEQUEIRA.

Copy of letter above referred to :—

To the Editor of the " North China Daily News."

SIR,—Some few weeks ago you reproduced an article from a home newspaper relating to a case of hardship and privation endured by a certain lighthouse-keeper and his family. This reminds me that in July 1913, on a voyage from Tientsin to Shanghai, the Indo-China steamer *Lienshing* saw signals of distress from one of the lighthouses. The Captain stopped the boat and offered assistance. The lighthouse-keeper, while refusing assistance from the *Lienshing*, asked to be reported to the harbour authorities immediately the steamer should reach Woosung.

Supposing that the case of the lighthouse just mentioned should be a life and death one, and the lighthouse enveloped in a thick fog for a few days, would not that poor victim who perhaps needed a medical man to save his life succumb to his illness?

May I, therefore, most respectfully suggest to the powers that be to instal wireless telegraph instruments on all the lighthouses along the China coast? Now that wireless telegraphy is made so easy and cheap, there is absolutely no reason why the lighthouse-keepers should not be provided with this all-important life-saving invention.

It may not be generally known that for a comparatively small sum of money a complete installation having a radius of several hundred miles can be erected, while as for learning to operate, it is a simple matter of a few weeks' learning—a very trivial affair when the importance of the work is taken into consideration.

The lighthouse-keepers themselves, I am confident, would be the first to appreciate the advantage of a wireless installation. These poor men generally earn a mere pittance, suffer great privations and hardships, and run immense risks of losing their lives. Surely they ought not to be called upon to run unnecessary risks when a small sum of money would place them within calling distance of help and assistance by day and by night.

The upkeep of a wireless station is small, and I earnestly appeal to the British men in charge of the Chinese lighthouses to do something in this direction for their compatriots, who have chosen the arduous and risky life of a lighthouse-keeper under circumstances over which perhaps they had absolutely no control.

In pre-wireless days the linking up of lighthouses with civilisation, telegraphically, was a very difficult affair, the submarine cables costing over £1,000 per mile, but with the advent of wireless all such difficulties are removed.

I have not dwelt on the many other obvious advantages to be derived by installing wireless on lighthouses, and I am confident that if so far nothing has been done in this direction it is more a matter of accident than negligence.

Thanking you in advance for publishing this letter.

(*Signed*) F. X. SEQUEIRA.

Administrative Notes

ARGENTINA.

ON January 14th, 1916, the authorities decreed that such radio-telegraph stations as are at work in places where there is no telegraph office will be considered as stations belonging to the nation, and the messages handled by them will be subject to the radio-telegraph charges which said stations exchange with ship's stations.

* * * * * *

JAMAICA.

The Direct West India Cable Company, Limited, which operates the wireless station at Jamaica, call letters VPH, advises that since April 1st last the Jamaica Post Office Telegraphs tax all inland messages six cents extra. The minimum charge therefore for the inland rate on messages " *via* Bowden " will be sixteen cents instead of ten cents on radio messages of ten words or less and one cent for each additional word.

* * * * * *

PACIFIC ISLANDS.

At a recent meeting of the Rarotonga Island Council, which was held early in the year, it was suggested that wireless communication should be provided between Cook Island and New Zealand, a site being already provided at Black Rock for the purpose.

* * * * * *

PORTUGAL.

All vessels wishing to enter the Tagus must approach the citadel at Cascaes in order to embark a pilot, and communicate by signals or wireless telegraphy their name and port of departure ; they must comply promptly with all orders received, and hoist such signals and distinctive marks as the pilot may prescribe. No vessel may proceed into any of the entrance channels without authorisation from the semaphore station, which will be given by means of a signal known only to the pilot.

* * * * * *

UNITED STATES.

We are informed that the apparatus has been removed from the following wireless land stations in Alaska :—Koggiung, Clarks Point, Nushagak, Naknek, Karluk, Chinik.

Among the Operators

THE LATE OPERATOR WOOLLEY.

It is with deep regret we have to announce the death of Operator Leonard Woolley, who passed away on May 12th, after an illness extending over two months. Mr. Woolley, who would have attained his majority this month, was a native of Leyton, and joined the Marconi Company's evening classes in September, 1913. After completing his training he was appointed to the s.s. *Kinfauns Castle*, on which ship he made several voyages. He then transferred to the *Cestrian*, and later served on board the s.s. *Turcoman*, *Coronado*, and *Camito*. Our sincere sympathy is extended to the late gentleman's parents.

* * * * * *

S.S. "CYMRIC."

Two operators were carried on board the s.s. *Cymric*, the White Star liner torpedoed by a German submarine. The two gentlemen in question were Messrs. W. Nicholas and P. C. Fisher, both of whom were returning to England after service abroad. Mr. Nicholas, the senior operator, has already figured in THE WIRELESS WORLD for April, when we told of the narrow escape he had in the fire on the s.s. *Bolton Castle*. Mr. Fisher, whose home is at Llanwit Major, is 21 years of age, and joined the Marconi Company's school in December, 1914, after a period of training at the South Wales Wireless College, Cardiff. Before being appointed to the *Cymric* he served on the s.s. *Moorish Prince*. Although both men were fortunately saved they had exciting experiences before reaching the shore. After the torpedo had exploded the stern commenced to settle down, and all believed the ship would founder. After a period, however, it was seen that the ship remained afloat, and the captain and Mr. Nicholas very bravely returned, repaired the apparatus, which had been damaged by the explosion, and eventually succeeded in sending out a call which brought speedy assistance. Great credit is due to Mr. Nicholas for this work, and we congratulate both men upon their fortunate escape.

OPERATOR P. C. FISHER.

WRECK OF THE "RANGATIRA."

The s.s. *Rangatira*, which was recently wrecked and abandoned off the coast of the Cape, carried one operator, Mr. Alfred Griffith Hill, of Ulverston. Mr. Hill is 24 years old, and is an ex-Post Office man. His service with the Marconi Company dates from January, 1912. In February of that year he made his first voyage to sea as assistant operator on board the ill-fated *Oceanic*, and since has served on a number of vessels. At the time of the wreck Mr. Hill was upon his first voyage on the s.s. *Rangatira*, and fortunately escaped uninjured. He, too, is to be congratulated upon his escape.

* * * * * *

OPERATOR A. G. HILL.

THE LOSS OF THE S.S. "GOLCONDA."

OPERATOR W. MILLER.

Mr. William Miller was the operator on the s.s. *Golconda* recently torpedoed by the enemy. Born in Croydon twenty-four years ago he was educated in Newcastle-on-Tyne, where he later entered the services of the *Newcastle Chronicle*. Wireless telegraphy soon appealed to Mr. Miller, and in October, 1913, he entered the Marconi Company's school, subsequently being appointed to the s.s. *Scotian*. From this ship he transferred to the s.s. *Start Point*, and afterwards sailed on the *Golconda*. His next voyage was made on the *Ellora*, and on the completion of this he returned to the *Golconda*, upon which ship he remained until the disaster. We are happy to report that Mr. Miller is safe and uninjured.

The Jutland Naval Battle

In the next issue of THE WIRELESS WORLD we propose publishing a list of radiotelegraphists who lost their lives in the Jutland Naval Victory, and shall be glad to receive photographs of these gallant wireless men for inclusion in our roll.

The Methods Employed for the Wireless Communication of Speech (iv)

By PHILIP R. COURSEY, B.Sc.

(Read before the Students' Section of the Institution of Electrical Engineers, on February 2nd, 1916.)

ALTERNATORS AND FREQUENCY RAISING APPARATUS.

OWING to the extreme difficulty, which amounts almost to an impossibility, of designing and constructing an alternator of any of the usual types which shall be capable of generating an alternating current of the frequencies required in wireless work, attempts have been made from time to time to construct " frequency raisers " which shall be capable of raising the frequency of an alternator or other source, so as to bring it within the wireless range. This branch of the subject has recently been treated very fully by A. N. Goldsmith, so that only a brief abstract of the most important features will be given here.*

Frequency raiders as a whole may be broadly classified into two main divisions:—

(1) Frequency adders,

(2) Frequency multipliers.

To the first class belong most of the machine or alternator type of frequency raisers, while under the second are included the " static " frequency raisers, etc.

The distinctions between the two classes will be more apparent after a further consideration of the different methods by which the frequency of a current can be raised.

In the case of an ordinary (single-phase) alternator, the most usual construction is to have the fixed " armature " windings on the stator and the magnet windings on the revolving rotor. The frequency of the currents generated by such a machine depends then merely on the speed of rotation of the magnet system on the rotor and on the number of poles on it. A simple consideration then shows the practical impossibility of constructing a machine of this type to generate currents of wireless frequency with any available power (see Appendix I.).

Suppose, however, that instead of supplying the rotating field winding of our alternator with direct current, as is usual, we produce a rotating field by means of alternating currents—just as in the stator of an induction motor—and arrange the direction of rotation so that it is in the same direction as the direction of mechanical rotation of the rotor (and field windings). The magnetic field will then have a speed of rotation in space equal to the sum of the speeds of rotation of the field and windings separately.

The frequency of the currents that will be generated in the stator conductors will, therefore, depend on this speed, instead of merely on the speed of mechanical rotation, assuming the same number of poles on the fields in each case. In other

* See *Proc. Inst. Radio Engineers*, June, 1915; also *Electrician*, 75, p. 461, and p. 508, 1915.

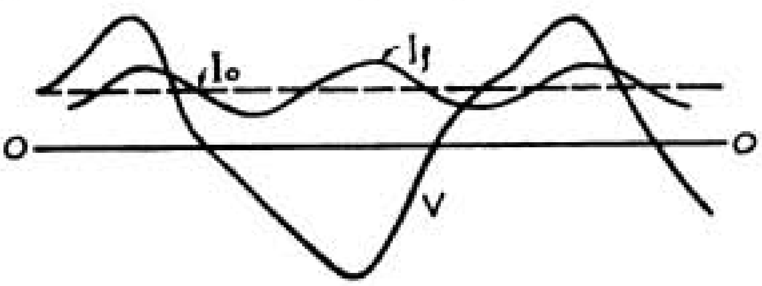
words, we have here the essentials of a machine for raising the frequency of a given supply current.

It is evident that a number of such machines could be connected in series, and the fields of one supplied from the generated currents of the previous one, and thus the frequency can be gradually raised from low values to high ones.

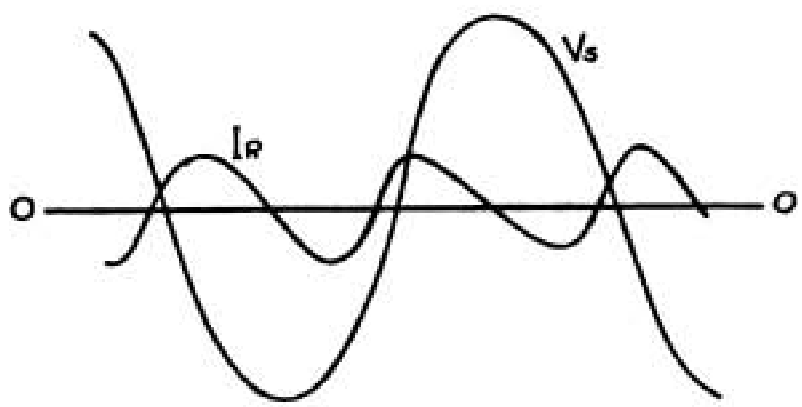
One of the best known frequency raisers which is of the alternator type is known as the *Goldschmidt Alternator* and consists essentially of an induction motor or alternator which performs the functions of raising the frequency by the method outlined above, but with the distinction that all the successive increments of frequency are arranged to take place in the one machine instead of in a number of such machines connected in series. It is well known that a single-phase alternating current can be resolved into two equal and oppositely rotating periodic quantities.

This explains the occurrence of the double frequency current observed in the rotor of a single-phase induction motor when it is driven at synchronous speed (slide, oscillogram), and also the double frequency ripple that is often observed on the field current of alternators.

In the Goldschmidt machine this double frequency ($=2n$) current is allowed to flow in a tuned circuit, and so attains considerable magnitude. By the same reasoning the field, due to this current, may be resolved into two oppositely rotating magnetic fields; as, however, the complete rotor is revolving with a speed corresponding to the frequency$=n$, one of these components has a speed relative to the stator of $2n-n=n$; and the other of $2n+n=3n$. This latter, therefore, gives rise to currents of three times the fundamental frequency in the stator windings, which can be isolated by means of a tuned circuit. The other component of frequency, n, merely augments the original currents of the fundamental frequency in the stator windings. This action can be repeated a number of times, each one giving an addition to the frequency, and being confined to its own tuned circuit, while the last is connected directly to the aerial and earth through the appropriate tuning inductances.



OSCILLOGRAM SHOWING DOUBLE FREQUENCY RIPPLE ON FIELD CURRENT



DOUBLE FREQUENCY CURRENT IN ROTOR OF INDUCTION MOTOR AT SYNCHRONOUS SPEED.

FIG. 13.

Machines have been

constructed on these lines up to outputs of about 250 kw., and have been successfully employed for Transatlantic communications over distances of about 3,000 miles, but only as yet for telegraphic purposes, on account of the great difficulty of constructing a microphone to deal with the heavy antenna currents. (See section on Microphones.) An additional feature of these machines is the possibility of modulating their output by control of the field current, which, of course, only amounts to a small fraction (=from 5 to 10 per cent.) of the output of the machine. This leads to considerable simplification of the control apparatus, but it is not as yet proved whether this method is available for the higher powers of the larger machines.

It should be remembered, however, that all machines of this type suffer from the great disadvantage that they are frequency adders, and not frequency multipliers; and hence, if the initial frequency is not fairly high compared with the final one, such a great number of stages would be required that the arrangement would hardly be of much practical value from the economic standpoint. With frequency multipliers, however, the case is very different, and a rapid increase of frequency can be much more readily obtained.

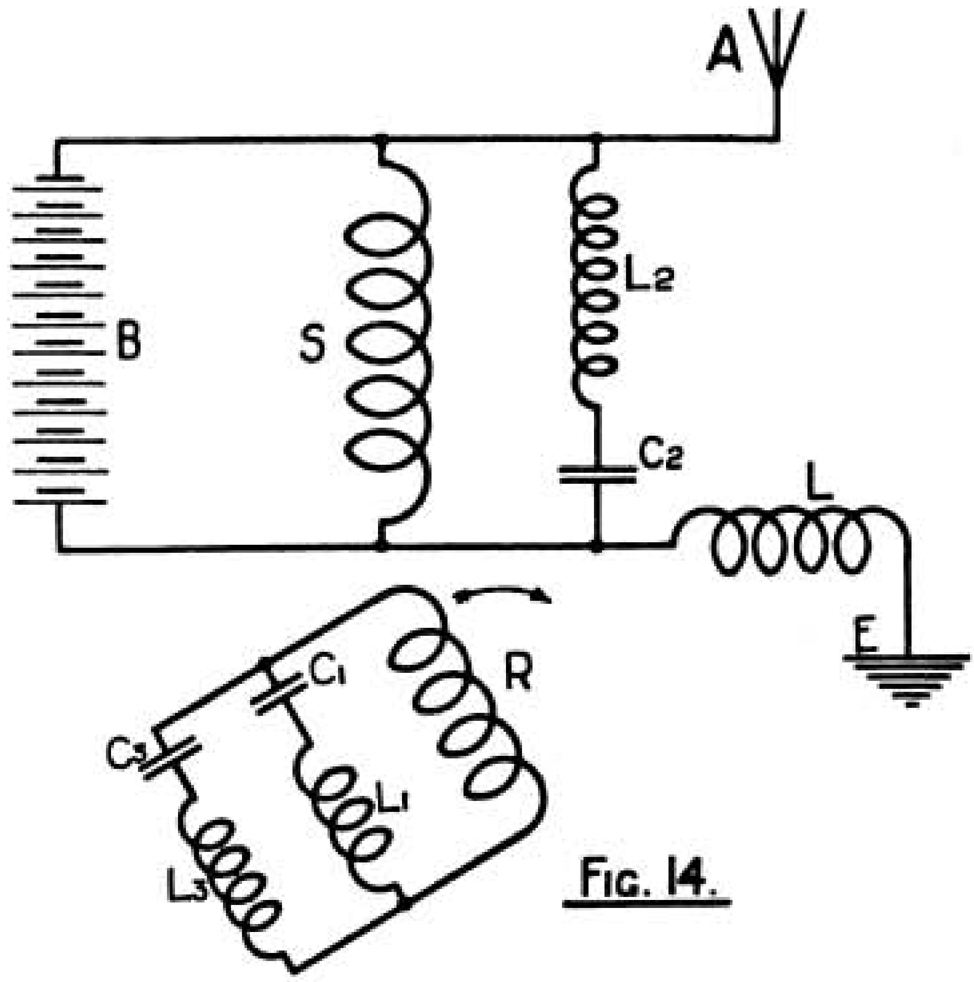


FIG. 14.

We now turn to the second class of frequency raisers—that is, frequency multipliers. The most important representatives of this class are the transformer frequency raisers, in which use is made of the fact that the magnetising current of a transformer working on a sine wave E.M.F. is generally very far from a sine curve.

The exact shape of this current curve depends on the state of magnetic saturation of the magnet core, and may be varied, within limits, to suit the requirements. The Fourier analysis of the above current curve shows that there is a prominent third harmonic present in the current wave. This will generally be found to be the case.

It is possible by suitably designed tuned oscillation circuits to strengthen this third harmonic by resonance, and therefore to obtain from a given A.C. E.M.F.

of approximately sinoidal wave form a current of three times the frequency of the original supply. This current may be utilised in a similar manner to produce another of three times its own frequency—*i.e.*, nine times the initial frequency, and so on.

Comparing this method with the frequency adders, previously described, it is seen at once that a very much more rapid multiplication of the frequency is obtained, thus three stages would raise the frequency twenty-seven times. The great limitation to this method is that it is not very easily adaptable to handling large powers, since the magnetising current of a transformer is quite small ; while if much load is put on, the current becomes more sinoidal in shape, so that the triple frequency output is diminished.

If we superimpose both an alterating magnetisation and a steady magnetisation on to a transformer core it will be found possible to so arrange matters that the flux wave becomes unsymmetrical.

This indicates the presence of prominent harmonics which may be tuned out by appropriate circuits ; or, better, two such transformers may be connected up in opposition in such a manner that the fundamental or supply frequency cancels out in the secondary windings, leaving only a double or triple frequency harmonic which may be strengthened by resonance.

Mr. A. M. Taylor* has shown that it is possible to obtain a frequency increase as much as 27 : 1 by employing special arrangements with multiphase A.C. supply.

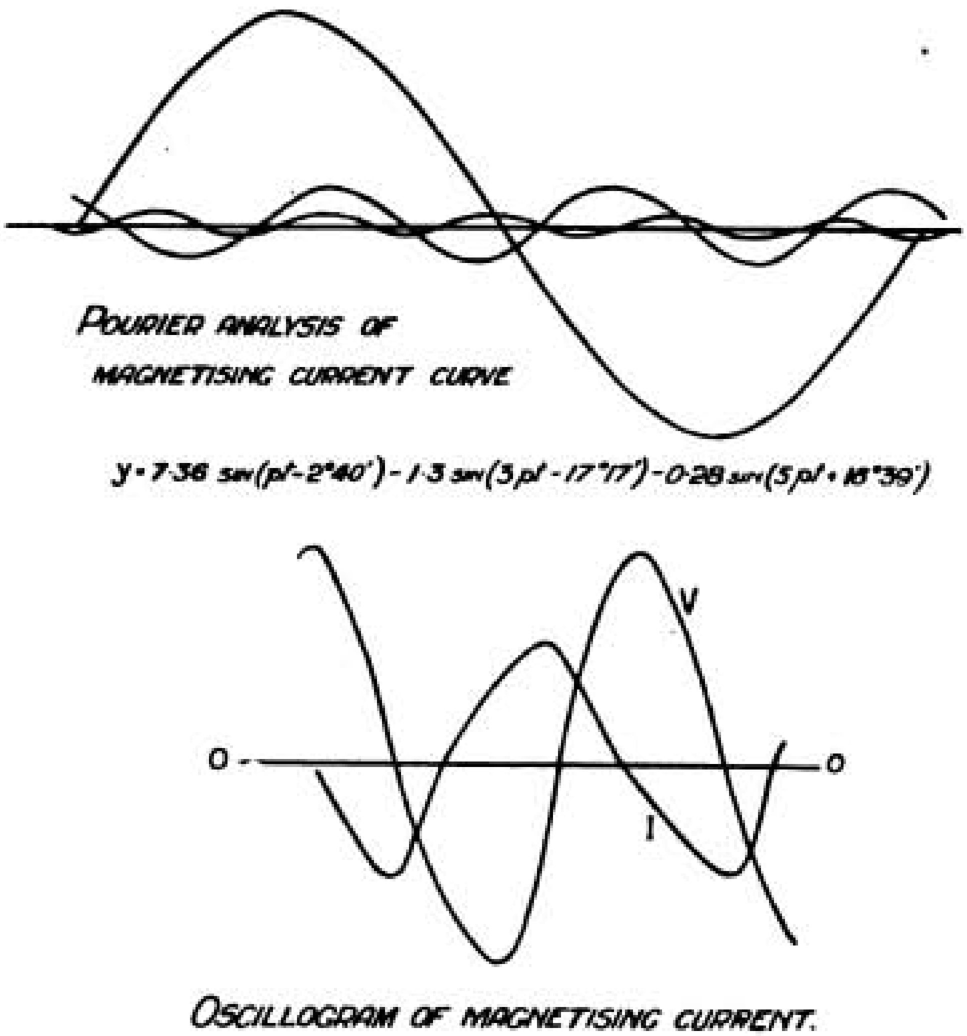


FIG. 15.

The greatest utility for these " static " frequency raisers, as they are often called, is obtained when they are used in combination with moderately high frequency alternators—*i.e.*, alternators designed for frequencies of, say, from 5,000 to 10,000 cycles per second.

Such alternators can be constructed with comparative ease, while an increase of their frequency of, say, nine times will gener-

* *Journal Inst. Elec. Engineers*, 52, p. 700.

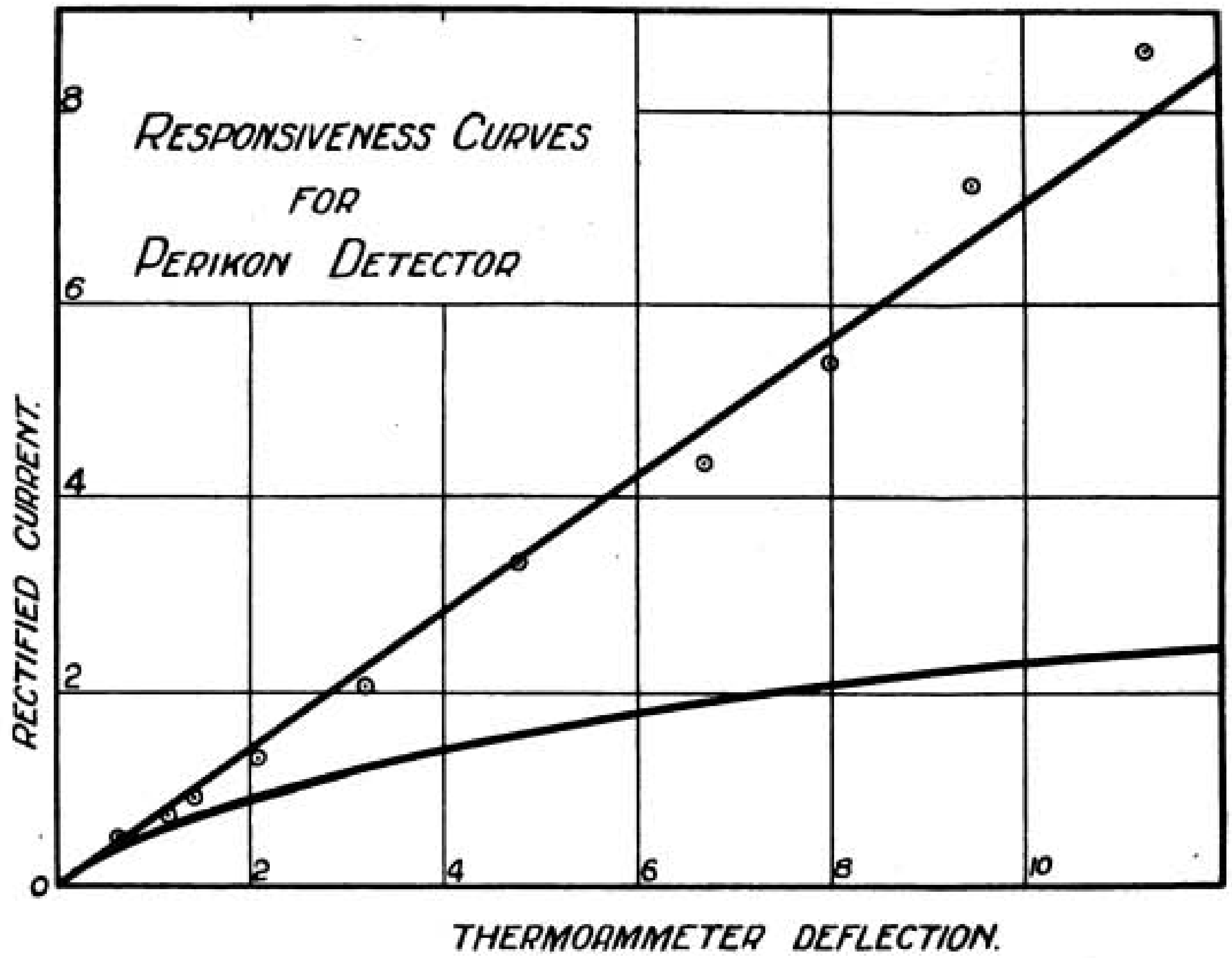


FIG. 16.

ally be found sufficient for long distance (long wave) wireless telephony; but, if necessary, a 27-fold increase, or more, may be used if desired for shorter wave-lengths.

MODULATION OF THE TRANSMITTED WAVES.

We have been considering up to the present the various means by which the required oscillatory energy may be generated. This leads us to the important question of how this energy is to be modulated in accordance with the speech waves. This is a matter that still affords one of the greatest difficulties in the development of the subject, although many attempts have been made towards its solution, some of which would seem to show considerable prospects of success.

In the first place the ordinary commercial carbon microphone is designed and constructed to carry only a fraction of an ampere, although experiments show that the commercial "solid back" type of transmitter is capable of carrying and modulating currents up to about 1 ampere or a little over. When larger currents have to be dealt with several such microphone transmitters may be connected in parallel, and arrangements made for them to be influenced simultaneously by the voice. It is generally inadvisable, however, to employ more than about five or six in this way, owing to inequalities in their operation causing the currents to be unequally divided between them, resulting in a loss in efficiency and in the purity of speech transmission, apart from the difficulty of arranging for them all to be equally operated upon by the sound waves. In any case, however, it is obvious that the ordinary carbon microphone is useless for anything except the smallest of stations in which the aerial current does not exceed a few amperes. A further difficulty arises from the fact that, because a microphone can *carry* the desired current without undue heating, it does not at all follow that it will be able to successfully *modulate* it, although when used on the ordinary telephone circuits it may be quite efficient. This arises from the different conditions of use, and, of course, applies equally to other forms of microphone as well as to the carbon microphones; as in the wireless case we have in general a much greater voltage available in the aerial circuit (than in ordinary circuits), and hence a correspondingly greater resistance variation is necessary for successful operation. Hence a low resistance microphone, with correspondingly small resistance variation (when spoken to), may be quite useless as a transmitter, although it may be able to carry the required current quite easily. Hence it is often necessary to connect more than one microphone in series to obtain sufficient resistance modulation. Another difficulty that frequently arises when using commercial microphones not specially designed for use with high frequency currents is that of capacity currents within the microphone shunting a portion (often a large portion) of the current across the frame or other parts of the instrument without their passing through the resistance material at all. For this reason it is often necessary to remount the parts of commercial microphones on insulating supports and frameworks, if the best effects are to be obtained from them when they are used for modulating high frequency currents.

An improvement may often be effected under these conditions by coupling the microphone to the antenna circuit instead of inserting it directly in the circuit, as by this means the effective voltage in the microphone circuit may be easily varied to suit circumstances, while at the same time the effect of the microphone on the aerial circuit can be controlled at will.

It is for this reason that it is generally advisable when a number of microphones are in use at the same time to arrange them so that they can be easily connected in parallel, in series, or in series-parallel, so as to obtain the best results in any particular circumstances. On account of the above limitations of the ordinary carbon microphone many attempts have been made to employ some other microphonic material which shall be capable of carrying much heavier currents without undue heating, and at the same time of successfully modifying them according to the sound waves. Attempts have also been made to modify the carbon microphone so as to render it more suitable for the work that it is required to do, and at the same time to render it possible to employ water cooling.

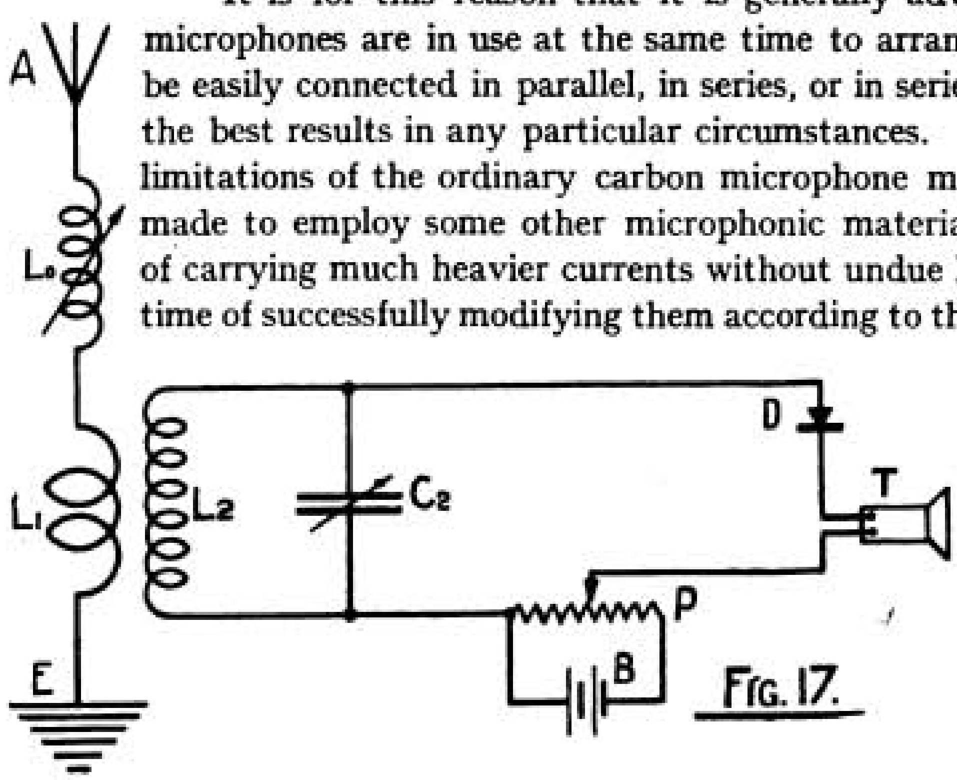


FIG. 17.

An example of a microphone transmitter of this type is furnished by Dubilier's transmitting relay microphone.

A much more successful type, however, is that employing some liquid as the current carrying medium, as it is then possible to employ a continuous circulation by which the liquid can be kept cool, and as it is only carrying the current for a short period of time while it is between the microphone electrodes. Two well-known forms are Vanni's liquid microphone and Chambers's liquid microphone.

In Vanni's microphone a fine jet of acidulated water or other convenient electrolyte is allowed to impinge on to a slanting metallic plate which forms one electrode of the microphone. Another plate carried by the diaphragm is arranged just to dip into the stream of liquid as it falls on to the other fixed plate, thus leaving a small space between them, the thickness of which is varied by the motion of the diaphragm.

This diaphragm may be operated directly by the voice, or preferably electromagnetically from a local circuit containing an ordinary microphone transmitter and suitable cells. The microphone should be inserted in the aerial circuit, or circuit coupled to it, rather than in the main supply to the arcs, or other oscillation generator on account of the reduction of electrolysis, and polarisation troubles when the microphone is traversed by an alternating current.

In Chambers's microphone the diaphragm is arranged to form one of the electrodes, while the jet of liquid impinges on its under surface. Hence the vibration of the diaphragm varies the thickness of the film of liquid issuing from the jet, and hence varies the resistance, in a manner depending on the sound waves.

It is stated that this type of microphone gives a very good speech reproduction free from resonance effects from the natural period of the diaphragm, since the liquid in contact with the diaphragm forms a very efficient damping agency preventing such free vibrations.

More recently another type of liquid microphone has been patented * in which the resistance variation is affected by varying the amount of conducting liquid admitted into a stream of non-conducting liquid flowing past the microphone electrodes; but as far as I am aware no extensive tests have been made with it to examine its capabilities.

Another rather novel form of microphone suitable for wireless telephony which has been employed for communications over considerable distances is Mazi's carbon powder microphone, in which the microphone material is carbon powder, a stream of which is passed through the apparatus so as to keep it cool.

As another method of modulating the transmitted waves mention should be here made of the condenser microphones, in which the diaphragm is arranged to vary the capacity of a condenser by means of its vibration. This condenser is connected in the aerial circuit, and hence when its capacity varies with the sound waves the wave-length of the circuit will be altered and the aerial thrown in and out of tune with the other circuits of the transmitter (and receiver), and hence the strength of the transmitted waves will be varied by the movements up and down the resonance curve. This type of microphone has apparently not been applied to stations of any

* British Patent, 7922, 1914.

but small power, so that its possibilities cannot very well be gauged, except in that one would expect that considerable difficulty would be experienced in designing such a microphone to have sufficient area and capacity to carry the large aerial currents and at the same time to have sufficient spacing between the opposite electrodes to withstand the voltage and yet be small enough for the motion of the diaphragm to have any appreciable effect on its capacity.

RECEIVING APPARATUS.

The receiving apparatus required for wireless telephony by means of ether waves differs very little from the ordinary receivers in common use for wireless telegraphy, and hence need not be considered very fully here. The circuit arrangements at the receiver are much as usual for the particular detector employed. As to the detector, the really essential feature is that its indications should be practically proportional to the energy received, otherwise the speech would be distorted. It must also of necessity be suitable for use with a telephone receiver.

The type of curve required is the straight line one there shown.

These considerations rule out practically all of the "coherer" type of detectors (apart from their relative insensitiveness compared with other forms), and we are left with magnetic detectors, crystals, and valves, and similar detectors.

Of magnetic detectors the most important is the well-known Marconi magnetic detector.

Among crystals most of the usual combinations are available, the most suitable being, perhaps, the "perikon" (or zincite-chalcopyrite), zincite-bornite, carborundum, etc. The usual connections may be employed.

In general it is found that the use of a fairly weak coupling is advisable in order to obtain purity of speech-transmission. Under the heading of valves we have the Fleming valve, the de Forest "audion," and other similar detectors.

The connections of the receiving apparatus for use with the valve are essentially the same as when a crystal is employed except for the addition of the cells for heating the valve filament.

With the audion type of detector containing a third electrode slightly different connections are required, although the main features are the same.

This brings us to a consideration of the use of amplifiers in receiving, a practice which has lately grown in favour for wireless telephone receiving, as by this means it is possible to employ very much less power at the transmitter for a given range, an important factor in the present stage of development of the transmitting apparatus.

The available amplifiers may be classified for our present purposes into :—

(1) Electromagnetic or microphonic type.

(2) Electron or vacuum amplifiers.

The former include such apparatus as the Brown telephone relay, the telefunken, and other sound intensifiers, etc., and are available only for use in conjunction with one of the forms of detector previously mentioned. The mode of operation of all the members of this class involves the employment of some form of microphonic contact or contacts (such as a carbon microphone, or the microscopic air-gap of Brown's relay), the resistance of which can be controlled by an electro-magnet through which is passed the " rectified current " from the detector.* Brown's relay, which may be taken as typical of this class, was described in a paper read before this Institution, and so need not be described in detail here.†

To the second class belong the vacuum amplifiers, in which use is made of the properties of cathode rays (streams of electrons) in a vacuum tube, as described above in connection with the vacuum oscillation generators. The " audion " and " pliotron " belong to this type. The Marconi Co. have also utilised amplifiers similar to the above in tests carried out with their apparatus by the Italian Navy in which distances of about 45 miles have been covered with an expenditure of energy at the transmitter of only 4 or 5 watts.

A Telephone System with Wireless Auxiliary

By FRANK C. PERKINS

THE accompanying illustration shows the electrical apparatus used in the wireless auxiliary to Pittsburg-Allegheny Telephone System. It is claimed that wireless is a valuable supplement to the Pittsburg and Allegheny Telephone Company as a distinct department of its business in Pittsburg, Pa.

There are eight branch stations established at points in Western Pennsylvania, Eastern and Central Ohio and parts of West Virginia, throughout the territory in which the company operates its telephone system, and trained operators, working the company's secret code, keep in daily touch with the big station in Fernando Street, Pittsburg.

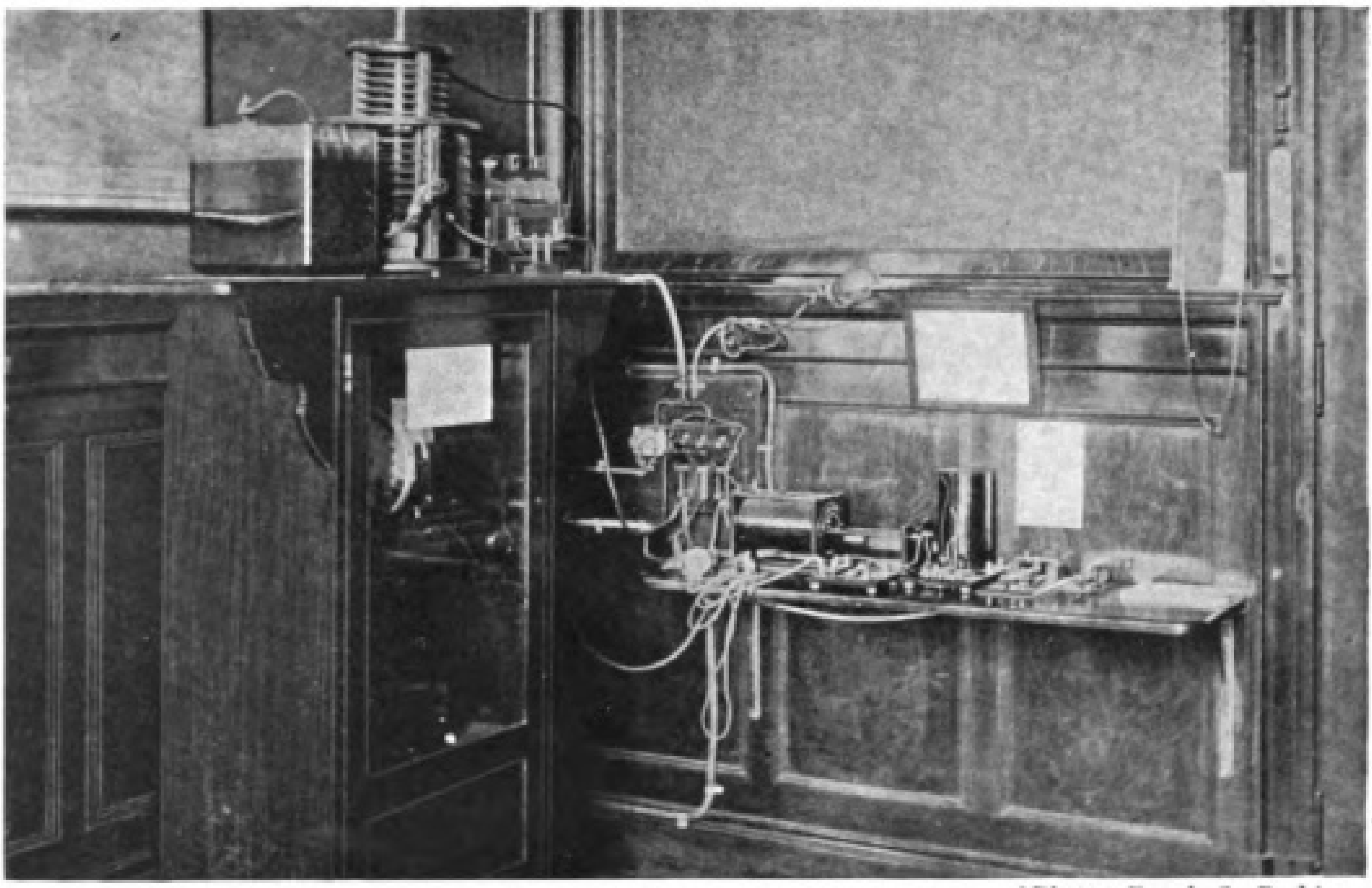
It may be stated that the most distant station in the organisation is at Erie, Pa., a distance of nearly 200 miles. The need for the wireless became apparent when a storm of wind and sleet last winter threw down poles and wires over so wide an area that Pittsburg was almost completely cut off from the rest of the world for nearly a week. The telephone companies were paralysed for several days.

In this difficulty repair gangs were sent from all the towns in the district, but with no wires it was impossible to keep in touch with any of them, and reports, orders and requisitions for materials had to be made by messengers, and these had to depend wholly upon trains to get about from place to place.

On account of the loss of wire service the work of rehabilitating the telephone service was retarded for days. The wireless plan was then adopted, and a wireless organisation was formed among the employees and equipment for the nine stations was installed.

* The term " rectified " is used in the general sense to include the current yielded by the detector, whether or not it is a " rectifier " in the true sense of the word.

† *Journal Inst. Elec. Engineers*, 45, p. 590, 1910



[*Photo: Frank C. Perkins.*

WIRELESS INSTALLATION OF PITTSBURG AND ALLEGHENY TELEPHONE COMPANY

In order to guard against unpreparedness in an emergency it was decided to keep the organisation in training by a certain amount of work every day, and the experience thus gained has been invaluable. Should another storm do the damage that was inflicted last winter the company can get into communication at once, and continuously, with every part of its system. The whole situation could be handled and directed right in the Pittsburg office and the innumerable delays of last winter obviated. Practically all the apparatus in the Pittsburg station was made in the company's shops in the Miller Building. All the transmitting apparatus, except the sending key, is enclosed in a sound-proof case.

It will be noted from the photograph that the receiving apparatus is placed on the shelf.

The Pittsburg and Allegheny wireless stations are used every night at ten o'clock to catch the detailed weather reports and forecasts sent out from the Government wireless station at Arlington, near Washington, and this wireless equipment has been of great value to the telephone system.

A Contrast in the Arrival of News of Victory.

News of the Jutland victory was published here forty-eight hours after the fight was over, and this brief delay contrasts rather markedly with the arrival of Trafalgar news, which took over a fortnight, and with that of Waterloo, which consumed four or five days in transit. The contrast between modern times with wireless facilities regularly available, and those, even of the very recent past, is marked indeed.

Foreign and Colonial Notes

Argentina.

Among the subjects discussed at the Pan-American Conference held at Buenos Aires in April last was the control of wireless telegraphy by the various Governments and connecting up of the ordinary telegraphic systems of the two continents. This is an important step, as the telegraphic services over the South American Continent have been miserably poor.

* * * * * *

Canada.

According to the annual report of the Radiotelegraphic Branch of the Department of Naval Service for the fiscal year ending March 31st, 1915, there was an increase of 78 in the number of radio telegraph stations established in Canada and on Canadian ships during that year, divided as follows:—Government ship stations, 3; licensed ship stations, 18; licensed commercial stations, 8; licensed amateur stations, 48; licensed experimental stations, 1. The total number of stations in operation in Canada at that date was 247.

* * * * * *

New Zealand.

Wireless working in general is still very quiet, but with the winter signals are improving wonderfully, and stations 2,500 miles distant who have been unheard during the summer are now audible throughout the night. According to our contemporary, the *Katipo*, the Antarctic ship *Aurora* was heard at Radio, Wellington, and the same evening at Bluff and Hobart.

* * * * * *

United States.

From the *Wireless Age* we learn that the Advanced Hamilton Radio Association of Hamilton, Ohio, has rather unusual and interesting ideas in regard to both organisation and qualifications. The Association is governed by an Executive Committee of three members. A new member is appointed at each meeting to take the place of the first member, who withdraws. There is no officer except the Secretary. Each charter member must possess the following qualifications:—Have an United States Government Wireless Licence, be skilled to send and receive at least 12 words a minute, and have at least two years' experience in wireless telegraphy.

* * * * * *

A plan is being considered in the state of Illinois to instal a powerful wireless apparatus in the State House at Springfield as part of the military equipment of the State. As suggested to the Governor, the antennæ would reach from the dome of the State House, 360ft. high, to the State power plant chimney stack when completed, which will be 200ft. high.

Instructional Article

NEW SERIES (No. 11).

The following series, of which the article below forms the eleventh part, is designed to provide wireless telegraphists, amateurs, and technical students generally, with clear and precise instruction in technical mathematics, in order that they may be enabled to read and understand the more advanced technical articles which appear from time to time.

DETERMINATION OF THE LAWS OF CURVES (*continued*).

78. The only other form of equation with which we shall deal in this way is that which may be represented by the general expression $y=ax^n$. In this case both a and n are constants.

Suppose, for example, we plot the curve of $y=3x^2$.

Tabulating :

$x=$ 10	5	0	−5	−10
$y=$300	75	0	75	300

Plotting these values (Fig. 62) we see that the curve is very far from being a straight line as, indeed, we should expect, having regard to the fact that the equation is one of the *second degree*.

Let us now modify our equation by taking the logarithms of both sides. Then, instead of $y=3x^2$ we get $\log y = \log 3 + 2 \log x$, *an equation of the first degree.*

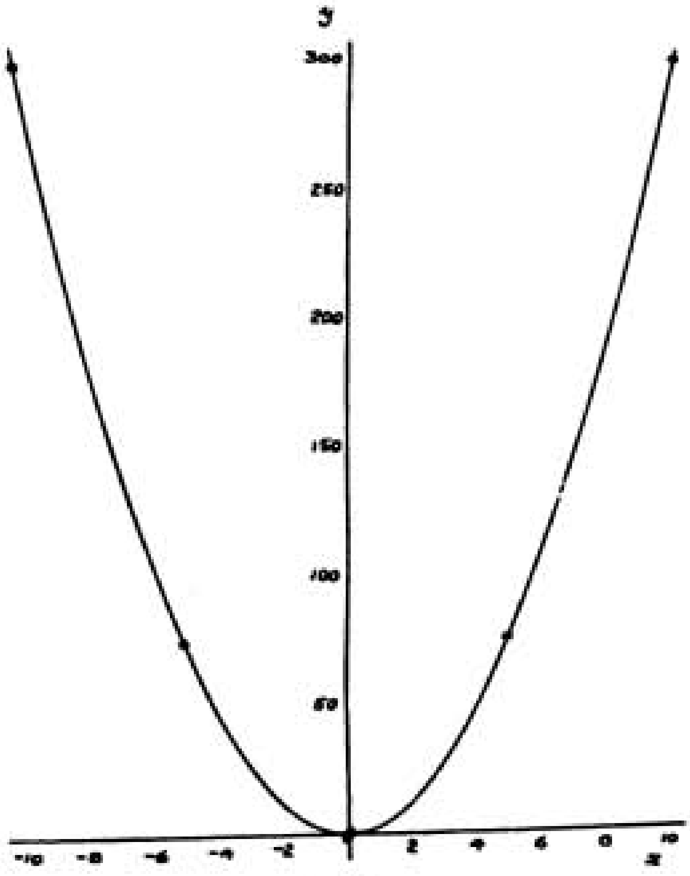


FIG. 62.

Tabulating for this new equation :

$x=$	10	8	5	2	1
$\log x=$	1	0·9031	0·6990	0·3010	0
$2\log x=$	2	1·8062	1·3980	0·6020	0
$\log 3=$	0·4771	0·4771	0·4771	0·4771	0·4771
$\log y = 2\log x + \log 3=$	2·4771	2·2833	1·8751	1·0791	0·4771

Plotting the curve connecting *LOG x* and *LOG y*, we obtain Fig. 63. The important thing to notice is that we have now obtained a *straight line* curve.

From our previous work we know that the law of this curve is $y=mx+c$; where $c=0{\cdot}4771$ and $m=\tan\theta=\frac{2}{1}=2$. In this particular case, however, since we have plotted $\log x$ instead of x, and $\log y$ instead of y, the law will be :

$\log y = m(\log x) + c$
or $\log y = 2 \log x + 0{\cdot}4771$.

Now in the case of our general equation $y = ax^n$, we have for its new form $\log y = \log a + n(\log x)$, and so, instead of c we have $\log a$, and so

$c = 0{\cdot}4771 = \log a$, or $a = 2$.

Finally, for m we have n, thus giving us $n = 2$.

Now we know that the equation

$$\log y = 2 \log x + \log 2$$

which we have found, can be changed into

$$y = 3x^2$$

by taking antilogs of both sides. Consequently, if we had started with the curve of Fig. 62 and had wanted to find its law, and we had then plotted the logarithms of x and y'

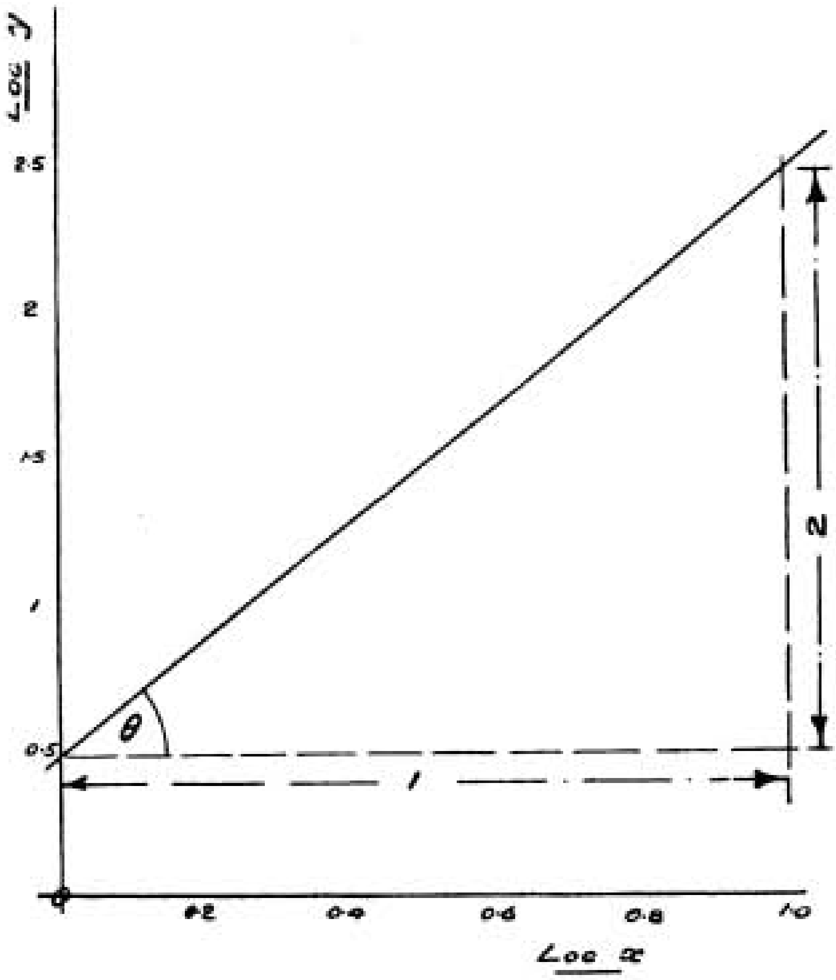


FIG. 63.

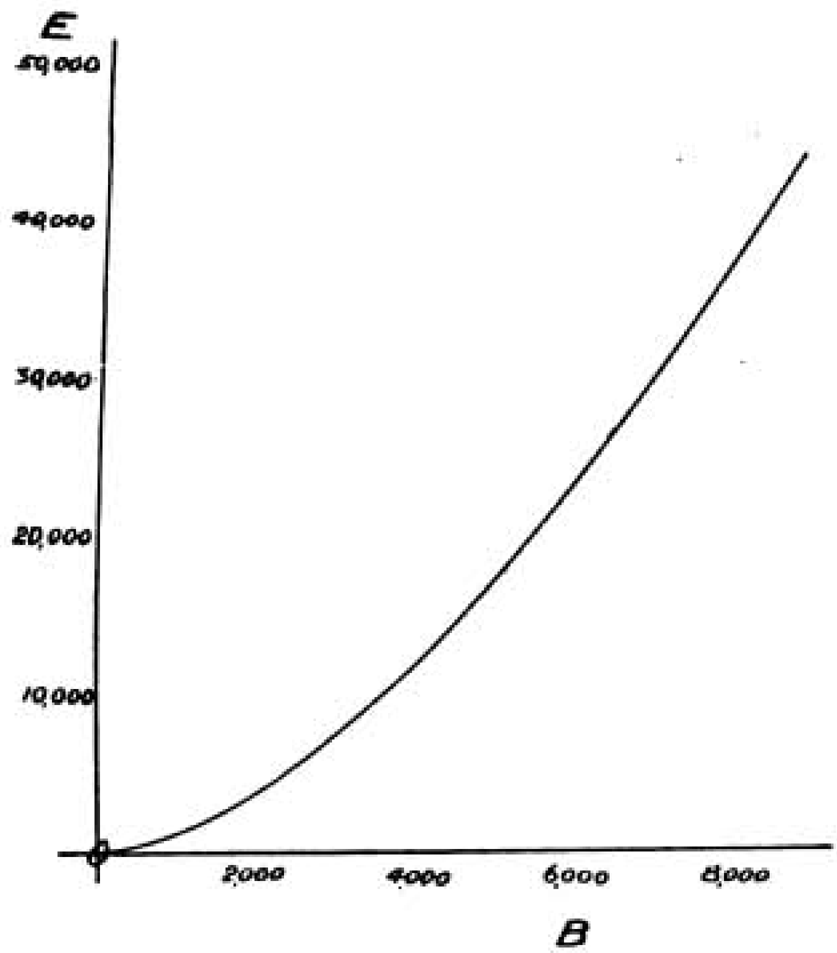


FIG. 64.

thus obtaining Fig. 63, we should in this way have found the law we required.

The situation, in brief, is as follows:

The type of curve whose law is easiest to find is the straight line. If, on plotting the results of an experiment we obtain a *curved* curve, it is worth while plotting the logarithms of the two quantities in the hopes that a straight line will result. If we do get a straight line we know then that the law is of the form $y = ax^n$, where a and n can be found from the logarithm curve.

Example.

The following table gives the hysteresis losses (E) for different values of the flux density (B) in particular sheets of transformer iron. Find the law connecting E and B:

B=1,000	3,000	5,000	7,000	9,000
E=1,262	7,380	16,600	28,400	42,400

Plotting, we obtain the curve of Fig. 64, which is obviously not a straight line.

Now tabulate the log values:

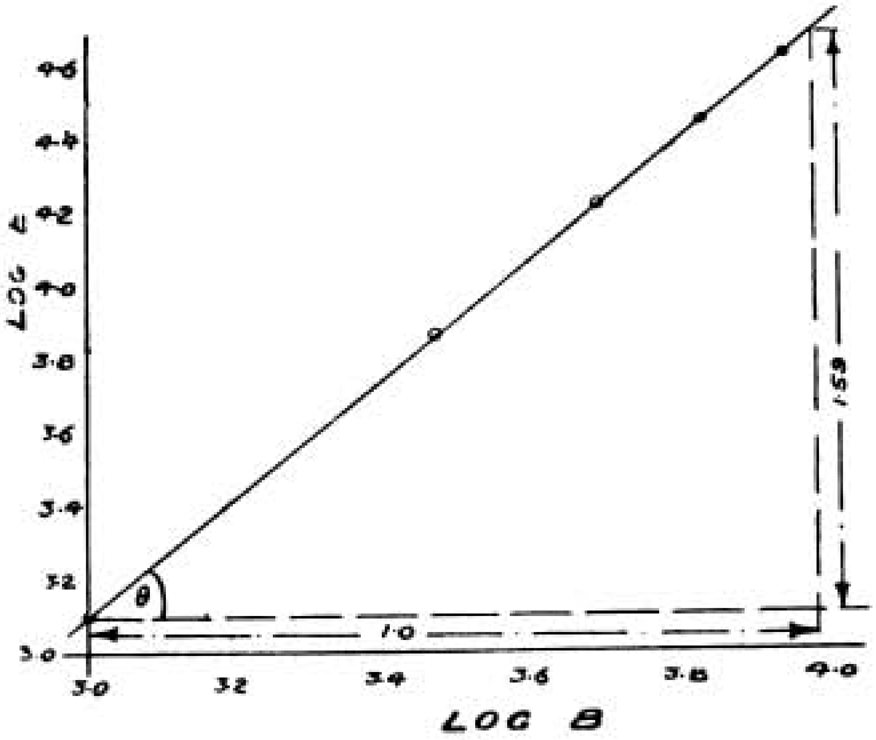


FIG. 65.

B=1,000	3,000	5,000	7,000	9,000
log B= 3	3·4771	3·6990	3·8451	3·9542
E=1,262	7,380	16,600	28,400	42,400
log E=3·1011	3·8681	4·2201	4·4533	4·6274

Plotting these values we obtain the straight line of Fig. 65. From this we get

$$m \text{ or } \tan\theta = n = \frac{1\cdot4311}{0\cdot9} = 1\cdot59.$$

Now from log B=3·9 to log B=3, the value of log E decreases from 4·5320 to 3·1011, or by 1·4311. Thus from log B=3 to log B=0 the value of log E will decrease further by

$$\frac{3\cdot0}{0\cdot9}\times1\cdot4311, \text{ or by } \frac{4\cdot2933}{0\cdot9}=4\cdot7703.$$

Therefore, the value of log E when log B=0 will be

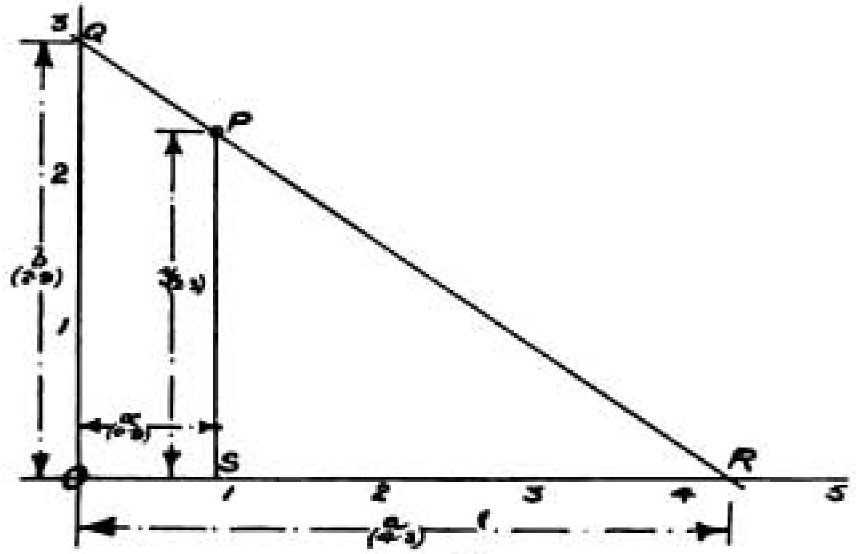


FIG. 66.

$$3\cdot1011-4\cdot7703=-1\cdot6792$$

Thus log $a=-1\cdot6792$
$=\bar{2}+\cdot3208$

From this

a=antilog ($\bar{2}+\cdot3208$)
$=0\cdot02093$.

Therefore, the law of the curve of Fig. 65 is

log E=1·590 log B − 1·6792,

and the law of the curve of Fig. 64, which is what we want, is

$$E=0\cdot02093\ B^{1\cdot590}$$

or, approximately, $E = \cdot 02\ B^{1\cdot 4}$. *Ans.*

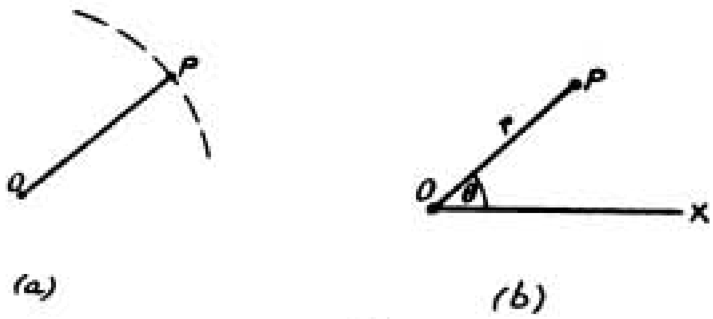


FIG. 67.

79. There is another method of dealing with straight line curves which is of interest. In Fig. 66 the straight line QR cuts the two axes at Q and R, making intercepts a and b along the x-axis and y-axis respectively, as shown. If now we take *any* point $P(x, y)$ on QR, we shall have found the law of the curve if we can find a *general* expression giving the position of the point P in terms of x and y together with some constants.

Draw the perpendicular PS as shown.

Now PS is parallel to QO, and so the ratio $\frac{PS}{QO}$ is equal to the ratio $\frac{SR}{OR}$, or

$$\frac{PS}{QO} = \frac{SR}{OR}$$

$$\frac{y}{b} = \frac{SR}{a} = \frac{a-x}{a}$$

$$= 1 - \frac{x}{a}$$

Therefore $\frac{x}{a} + \frac{y}{b} = 1$.

This expression gives the law of the curve QR in the *Intercept Form*, so called because the only terms involved, in addition to the indispensable x and y, are the lengths of the intercepts a and b.

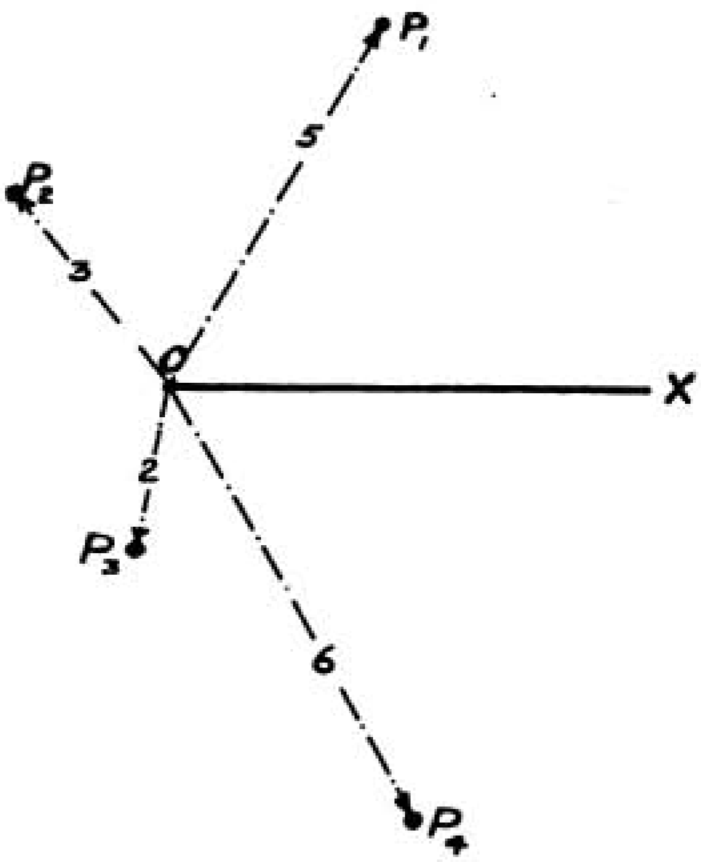


FIG. 68.

In Fig. 66 we have $a = 4\cdot 3$
$b = 2\cdot 9$.

Thus the law is $\frac{x}{4\cdot 3} + \frac{y}{2\cdot 9} = 1$.

As a check on this let us take the values of x and y at the point P. Here $x = 0\cdot 9$ and $y = 2\cdot 3$.

Inserting these values in

$$\frac{x}{4\cdot 3} + \frac{y}{2\cdot 9}, \text{ we get}$$

$$\frac{0\cdot 9}{4\cdot 3} + \frac{2\cdot 3}{2\cdot 9} = 0\cdot 209 + 0\cdot 793$$

$= 1\cdot 002$, or practically 1, which is correct to within our present limits of accuracy.

POLAR CO-ORDINATES.

80. The system of rectangular co-ordinates we have been using to plot these curves is not the only system of its kind.

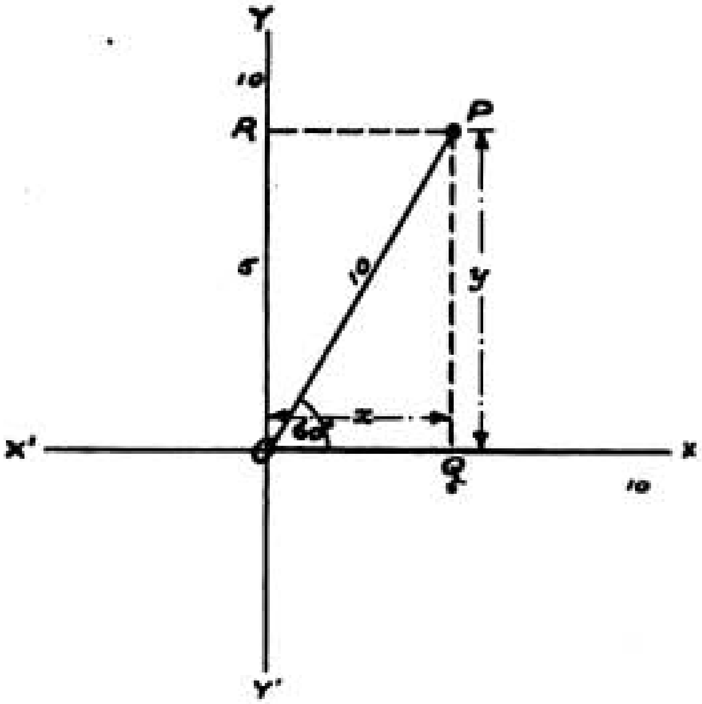


FIG. 69.

In Fig. 67 (*a*) we have a point P situated at some definite position relative to the point O.

Obviously, if we know only the distance from P to O, we do not know enough to enable us to specify the position of P. If, however, we draw a line OX (Fig. 67 (*b*)) from O, and use this as a fixed reference line, then if we know the distance OP *and also the angle* XOP we can fix exactly the position of P.

This is the system known as that of *Polar Co-ordinates*, where O is the *origin* or *pole* (as in the rectangular system), and OX the *initial line* is a horizontal line drawn from O towards the right-hand side of the paper.

OP is the *radius vector* (r), and the angle XOP is the *vectorial angle* (θ). Thus the point P can be written as (r, θ).

In Fig. 68 we have the points:

P_1—(5, 60°)
P_2—(3, 130°)
P_3—(2, 260°)
P_4—(6, 300°) as shown.

81. It is quite a simple matter to change from one system of co-ordinates to another.

In Fig. 69 we have the point P (10, 60°).

Produce XO indefinitely to X^1, and draw YOY^1 perpendicular to XOX^1, thus providing the necessary two axes for the rectangular co-ordinates.

Draw perpendiculars PQ and PR on to XX^1 and YY^1 respectively.

From an inspection of the diagram it will be quite obvious that, if (x, y) are the rectangular co-ordinates of P, then $OQ=x$ and $QP=y$.

Now $OP=10$, and angle $QOP=60°$.

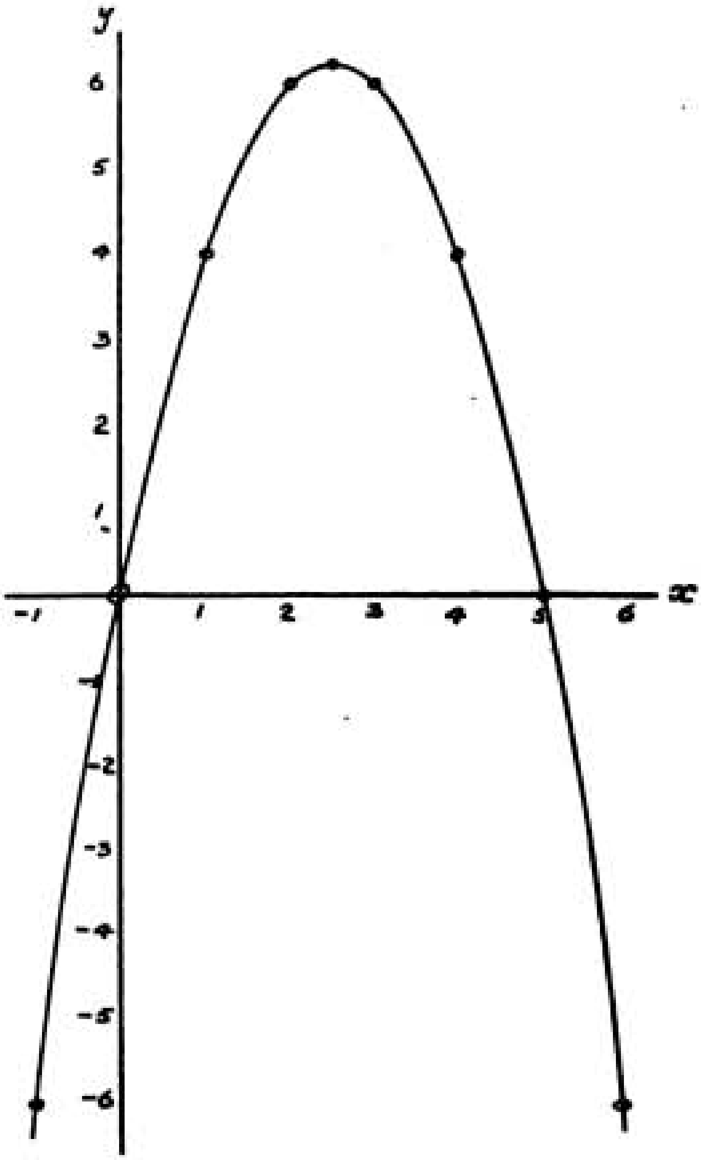


FIG. 70.

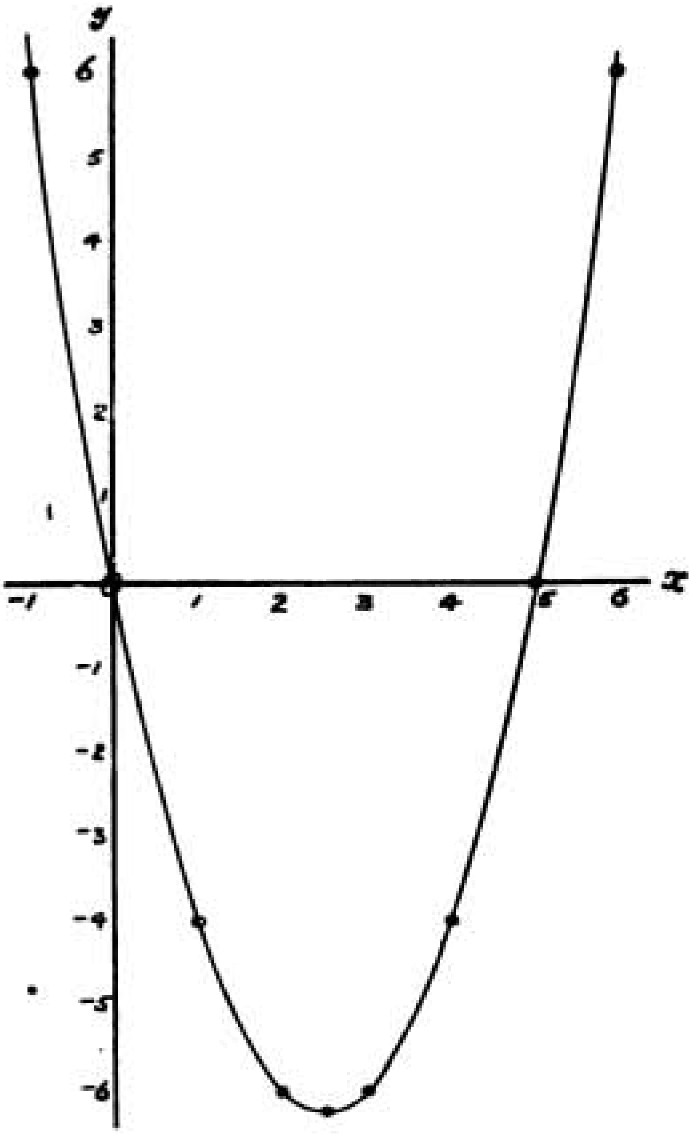


FIG. 71.

Therefore $x = OQ = OP \cos QOP$

$$= 10 \cos 60^\circ$$
$$= 10 \times \tfrac{1}{2} = 5$$

and $y = QP = OP \sin 60^\circ$

$$= 10 \times \frac{\sqrt{3}}{2} = 8{\cdot}65.$$

Thus the rectangular co-ordinates of P are $(5, 8{\cdot}65)$.

The reverse operation, that of changing from rectangular to polar co-ordinates, is equally simple.

Suppose we had been given the point P (Fig. 69 again) as $(5, 8{\cdot}65)$, then we see that the radius vector

$$P = \sqrt{x^2 + y^2}$$
$$= \sqrt{(5)^2 + (8{\cdot}65^2)}$$
$$= \sqrt{25 + 75}$$
$$= \sqrt{100} = 10.$$

Also the vectorial angle

$$\theta = \tan^{-1}\left(\frac{y}{x}\right).$$

$\left[\text{The angle whose tan is } \frac{y}{x}\right]$.

$$= \tan^{-1} \frac{8{\cdot}65}{5}$$
$$= \tan^{-1} 1{\cdot}73 = 60^\circ.$$

Thus P is the point $(10, 60^\circ)$ as we know.

Maxima and Minima.

82. Let us plot the curve for

$$y = 5x - x^2$$

Tabulating—

$x=$	-1	0	1	2	3	4	5	6
$y=$	-6	0	4	6	6	4	0	-6

From these figures, without plotting the curve, we see that y attains a maximum at the value $x = 2\tfrac{1}{2}$. At this point $y = 6\tfrac{1}{4}$.

The curve (Fig. 70) has its highest point, or *maximum*, as would be expected, at $(2\tfrac{1}{2}, 6\tfrac{1}{4})$.

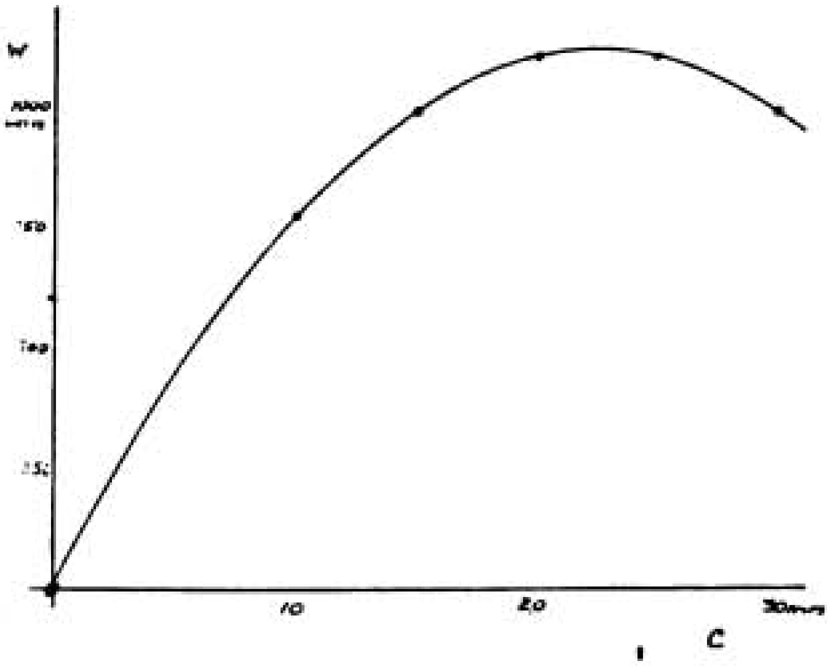


FIG. 72.

F

If now we plot $y=x^2-5x$ we get a similar but reversed phenomena (Fig. 71).

Tabulating—

$x=$	-1	0	1	2	3	4	5	6
$y=$	6	0	-4	-6	-6	-4	0	6

In this case we get the point $(2\frac{1}{2}, -6\frac{1}{4})$ as a *minimum.*

Thus, if we have two interdependent quantities, we can, by plotting their relationship in the form of a curve, find the values of each for which either is a maximum or a minimum.

Example.

The power given to an electrical circuit by a dynamo is $W=IE-I^2r$, where

W = power (in watts).
I = current (in amps.).
E = e.m.f. (in volts).
and r = internal resistance of dynamo (in ohms).

If $E=100$ volts and $P=2{\cdot}2$ ohms, find the current at which the power is a maximum.

Tabulating—

$C=O$	10	15	20	25	30 amps.
$W=O$	780	1,005	1,120	1,125	1,020 watts

The curve (Fig. 72) shows that W is a maximum when $C=22{\cdot}5$ amps., and its value there is 1,140 watts, or 1·14 kw.

83. A very important type of curve is obtained by plotting sin θ (vertically) against θ (horizontally).

Tabulating—

θ=0°	30	60	90	120	150	180	210	240	270	300	330	360
sin θ=0	·50	·866	1	·866	·5	0	−·5	−·866	−1	−·866	−·5	0

In this case we obtain, of course, the well-known *Sine Curve* (Fig. 73). The maximum and minimum values of sin θ occur at 90° and 270° respectively, the values being +1 and −1. This curve, if plotted on for values of θ greater than 360°, will repeat itself indefinitely. The positive and negative "loops" of the curve are identical in everything except sign.

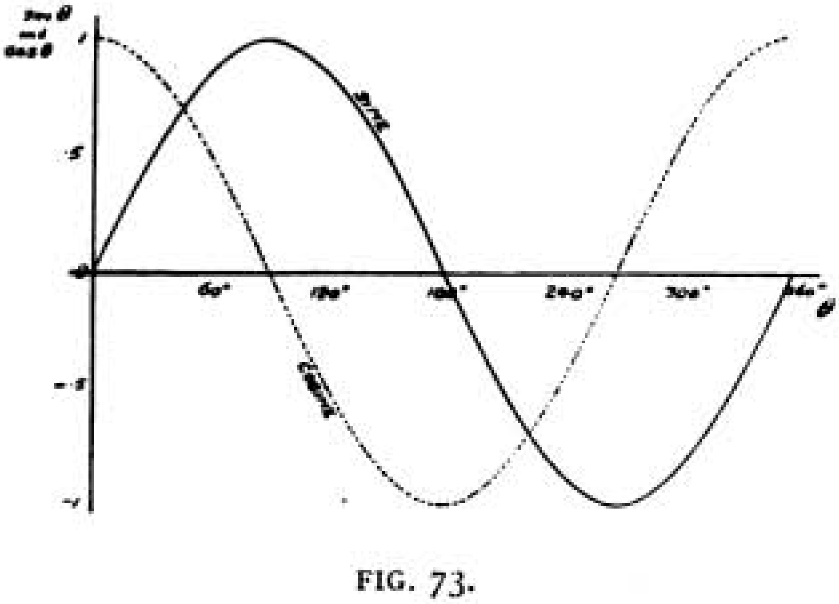


FIG. 73.

This curve is of the utmost importance in the study of alternating currents, as the alternating e.m.f. produced by the alternator (and therefore the current in the external circuit) is assumed to vary in such a way that, plotting current against time, a sine curve is the result.

This assumption is only strictly true in certain unlikely cases, but it is adhered to on account of the way in which it simplifies dealing with A.C. problems. Also it has been found that such a *wave-form* is a desideratum, and so machines are nowadays designed with such a wave-form in view.

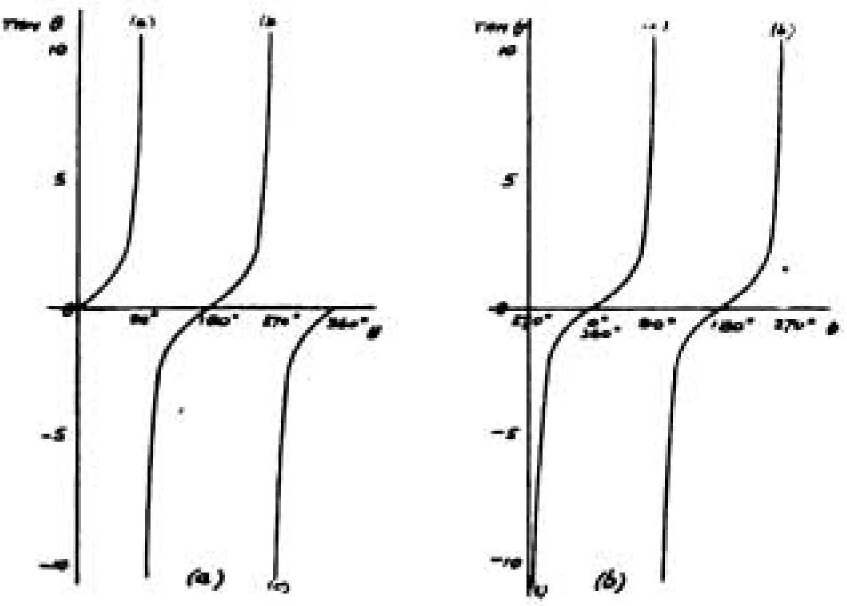


FIG. 74.

Fig. 73 shows also (dotted) a *cosine curve*. This curve is exactly similar to the sine curve, except that it is displaced horizontally through 90°. The maximum and minimum values of either curve occur at the same angles as the zero values of the other.

It should be noted that in any curve which has both maxima and minima, these maxima and minima *must* always follow one another alternately. The reason for this will be seen at once on attempting to draw a curve which has, say, two successive maxima with no minimum between.

The *tan curve* [Fig. 74(*a*)] is quite different to the sine and cosine curves. At first sight it would seem to consist of three separate parts (*a*), (*b*) and (*c*). Fig. 74 (*b*) shows, however, that (*a*) and (*c*) will join at 0° or 360°, and again the two parts (*a,c*) and (*b*) join on to one another *at infinity*, and so make one continuous curve.

Contract Note

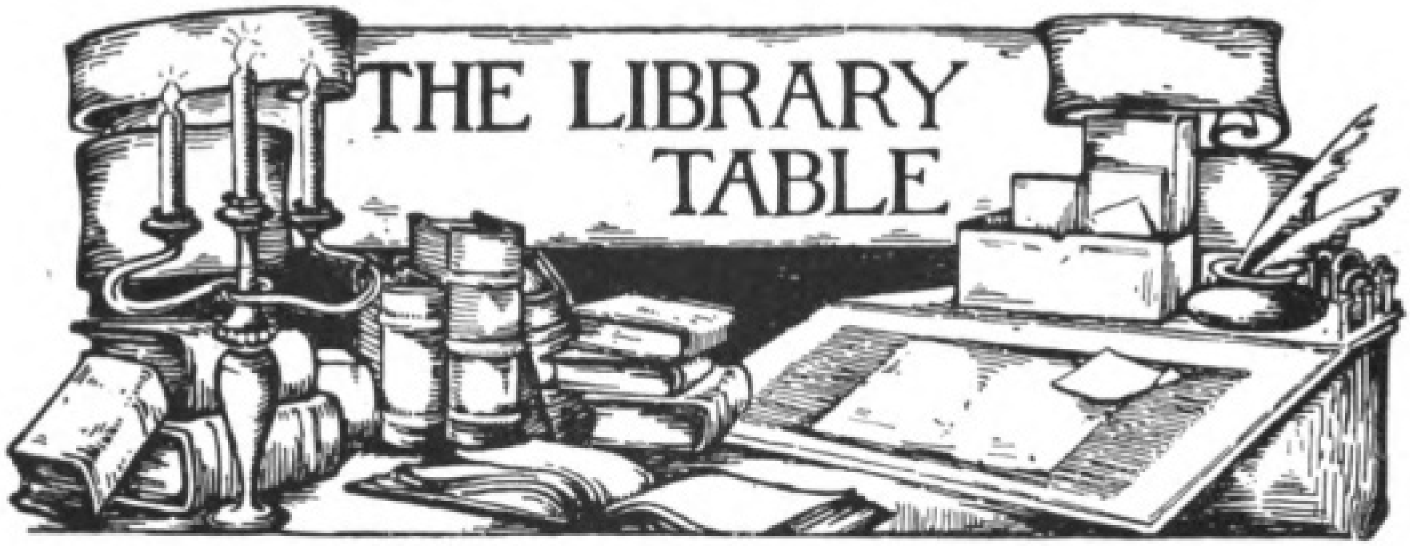
A representative of the Carranza Government of Mexico in San Francisco has closed a contract with the Marconi Wireless Telegraph Company of America for the supply of four 5-kilowatt 500-cycle quenched gap wireless sets. These are to be installed in plants which the Mexican Government proposes erecting at various points along the Mexican coast. How far this arrangement will be affected by the troubles apparently now brewing between America and Mexico, it is impossible to say.

Share Market Report

LONDON, *June 12th*, 1916.

The appreciation in share values has continued during the past month, especially towards its close, the annual report of the Marconi International Communication Co. (see p. 328) being considered most favourable. The expansion of the gross and net receipts of this shows what may be expected when the present war comes to an end.

Marconi Ordinary, £2 8s. 9d.; Marconi International Marine, £1 11s. 3d.; Marconi Preference, £2 1s. 3d.; American Marconi, 14s. 6d.; Canadian Marconi, 8s.; Spanish and General Wireless Trust, 6s. 3d.



"ELEMENTARY LESSONS IN ELECTRICITY AND MAGNETISM." By Sylvanus P. Thompson. London: Macmillan & Co. 4s. 6d.

This volume is now so well known wherever the English language is spoken that any words of praise which we might utter concerning it would be superfluous. The new edition bears evidence of considerable revision and rewriting, and, as Professor Thompson says in the Preface, progress in the development of the industrial application of electricity has been so great in the past decade, that it has been necessary to remodel the latter half of the book.

In the article devoted to the principles of wireless telegraphy, we think it would have been well if Professor Thompson had shown how much of Senatore Marconi's success depended upon his invention of the earthed antenna. It would also have been well to point out how greatly superior Marconi's coherer was to any which had previously been used. As it is, it is difficult to learn from this article by what means the great inventor succeeded in removing ether wave signalling from a laboratory into the realm of practical commercial work. We thought we had long since passed the day of the belittling of the famous Italian in such a work as this.

In the section entitled Radio Telegraphic Transmitters, it is mentioned that the aerial conductors are led down through a tuning inductance coil and through the secondary of an oscillation transformer. This being so, we think the student will be confused by the diagrams of aerials which have no inductance coil, but a spark gap in the earth leads. This is clear enough to those who understand "plain aerial" transmission, but unfortunately this is not mentioned in this part of the text.

We next find articles devoted to the Arrangement of Transmitting Circuit, Coupling, Quenched-Spark and Oscillating Arc systems, Radio Telegraphic Receivers, Detectors, Sending and Receiving, Wireless Telephony, and Other Suggestions for Telegraphing without Wires. The treatment, of course, is not intended to be at all thorough, and therefore we cannot criticise certain faults of omission. We must, however, draw attention to a sentence in "Radio Telegraphic Receivers," which reads:—"Tuning is not necessary for small installations, though it is always advisable." It is not at all clear what is meant by this.

A welcome chapter is that devoted to the Electron Theory of Electricity, a subject on which Professor Thompson is in an excellent position to write. The other portions of this famous book are so well known that we scarcely need detail them here. The new edition contains no less than 743 pages and is, as usual, well printed and admirably illustrated. As a textbook for schools, the volume is admirable, and we trust that the few points criticised above will not be overlooked in the preparation of further editions.

* * * * * *

"HOW TO MAKE LOW-PRESSURE TRANSFORMERS." By Prof. F. E. Austin. Published by the Author at Hanover, N.H. 2s. net.

In a recent issue we had pleasure in reviewing a similar work by the same author on *Making and Operating High-Pressure Transformers.* This, the companion volume, has now run into a second edition, a fact which affords us no surprise in view of the practical nature of its contents. The transformers here described are designed for use on ordinary house lighting mains, where the pressure is 110 volts, or less, and the frequency about 60-cycles. They may be used for a variety of purposes, such as bell ringing, experimenting, running small low-pressure lamps, operating sparking devices for petrol engines and a number of other uses. In the United States electric bells are frequently rung by means of such transformers, in this way avoiding the use of cells, which sooner or later exhaust themselves. In this country for some reason or other such transformers have not come into extensive use, and this little book should assist in popularising them.

* * * * * *

"THE BOOK OF WIRELESS." By A. Frederick Collins. New York and London: D. Appleton & Co. 3s. 6d. net.

We do not know whether to welcome this volume or not. It is written by an American for Americans, with the idea of teaching small boys how to build wireless stations. The type of amateur for which the volume caters is one with whom we have little sympathy, i.e., the boy with no theoretical knowledge who erects a crude wireless plant, and, obsessed with the idea of having some "fun," plays with the key from morn till night. Such experimenters are a nuisance to everybody, and are the means of bringing down upon the serious experimenter, be he youthful or of mature age, those trying restrictions which do so much to hinder real progress. In America, there are unfortunately thousands of these irresponsible dabblers, and it is lucky for the sensible investigator that they soon tire of their new toy. We tremble when we think what would happen in this restricted island of ours if in peace time boy enthusiasts were allowed to follow out the instructions given in this book for building a transmitter using half a kilowatt! Luckily the Post Office will not permit it.

The volume is divided into three parts, Part I. showing how to erect and operate a small plain aerial wireless outfit consisting of ½-inch spark coil, four dry cells, a key and aerial and earth, the receiver being merely a crude coherer in series with the aerial. It is to be remarked that the experimenter is told to build his transmitter and receiver first and to learn the Morse code afterwards!

Part II. describes what is termed "A Long Distance Wireless Set," with a crude ½ kilowatt transformer, six Leyden jars, an auto-jigger, aerial switch and transmitting key. There are no inductive chokes in series with either the primary or secondary of the transformer. Further, the safety of the set is not improved by the suggestion earlier in the book that the ground lead should be connected to the *gas* or water pipe. A small boy using a ½ kilowatt set connected to a 110 volt house main, with no protecting chokes and the earth lead connected with the gas pipe, is likely to have an early opportunity of testing the Heaviside Layer theory.

Although the young experimenter is presumed to have no previous knowledge of wireless the theory of the subject is almost ignored. Only one other portion of the book calls for special comment, and that is the list of definitions and terms on pages 206 to 214. They are not very helpful and in some cases quite wrong. We learn for the first time that " adjustable " means (1) To change by steps and (2) a word interchangeably used with *varied* ; that mica is a transparent material sometimes called isinglass ; and that " One horse-power equals 33,000 pounds, raised 1 foot in 1 minute." The user of a ½-inch spark coil run off four dry cells as described in the earlier portion of the book will be interested in the definition of " Low Pressure Circuit." This reads as follows :—" The circuits of the generator and primary coil of an induction coil or a transformer. The pressure in these circuits may range from 110 to 220 volts."

A number of errors are scattered throughout the book, and some of them should not have passed the proof-reader. Thus on page 39 the Morse characters S.N. are labelled S.B., and on page 104, figure 127, entitled " Wiring Diagram of Reception With Potentiometer " should read : " Wiring Diagram of Receptor Without Potentiometer." Figure 54, entitled " Electric Waves thrown off by Aerial," is quite inexcusably wrong.

We cannot leave this book without quoting the following gem from the preface :— " To be a wireless boy and make your own apparatus is to have the kind of stuff in you of which successful men are made—men who, if they were shipwrecked on a desert isle at daybreak, would have something to eat by noon, a spring bed to sleep on by night, and a wireless station the next day sending out S.O.S. to ships below the horizon for help. All you need to do to become a member of the great and growing army of wireless boys is the desire to own a station and the rest is easy."

Yes, it is easy, but . . . . !

* * * * * *

" AIR WAR : HOW TO WAGE IT." By N. Pemberton Billing. London : Gale & Polden, Ltd. 1s. net.

One of the most annoying characteristics of modern business and social existence is the constant necessity for enunciation of the obvious. The little volume published by Mr. Pemberton Billing, under the title of *Air War and How to Wage It*, forms a case in point. The author states in his Preface that he has " only attempted to deal with the main principles of the problem and the method of working them." That the British people were unprepared for war is obvious ; that their Government in this, as in all other respects, was—as ever—waiting to be pushed on by the people, is more obvious still. So also is the desirability of a secret service air chart and of the orders which might be founded upon it. The various other desiderata and plans outlined throughout the volume bear the same stamp. At first the practised reader can scarcely avoid a feeling of irritation at the obviousness of it all. But the question then arises :—"Is this little book, therefore, superfluous ? Should we be where we are to-day, if it were needless to enunciate the obvious ? "

NOTE.—*Any of the above books will be forwarded by return of post upon receipt of remittance covering cost of book and postage, by the Wireless Press, Ltd., Marconi House, Strand, W.C.*

Personal Notes

The following paragraph from our contemporary, *The Faraday House Journal*, will perhaps be of interest to members of the Marconi Company's staff :—

"On the outbreak of war, Captain C. E. Prince, being in charge of a wireless "section of the Westmorland and Cumberland Yeomanry, was mobilised automati- "cally. As he was the co-designer of the wireless set used by this section he devoted "himself to improving the design. When he left to join the Royal Flying Corps "several notable improvements had been introduced and the whole set was mounted "on motor cars. Captain Prince is now in charge of the technical and experimental "departments of the Wireless School at Brooklands, and his duties occasionally entail "visits to the Front. The school elects and trains the wireless flying officers, and "several Faradians have already qualified in it. In addition, the school examines "and gives the final polish to the many operators who are being instructed in London. "We are looking forward after the war to describing some of Captain Prince's many "inventions. We do not agree with him, however, that he is absolutely devoid of the "mathematical faculty. In fact, the particular faculty developed by the great mathe- "maticians overlaps very considerably that developed by great physical inventors."

* * * * * *

The Royal Humane Society recently awarded a medal to Hon. Lieut. and Quarter-master J. W. Price, R.A.M.C., for his gallantry at the sinking of the *Royal Edward* in August last, when at great personal risk he saved the Marconi operator, E. W. Dyer, who had a fractured leg and dislocated shoulder, and was powerless to help himself.

* * * * * *

Our readers will be interested to learn that at the Lord Mayor's Dinner to the Delegates to the Russian Council of Empire and the Duma, which took place at the Mansion House recently, were Sir Edward Grey, Lord Reading (brother of Mr. Godfrey Isaacs, the Managing Director of the Marconi Co.), Mr. Kipling and Senatore Marconi.

* * * * * *

A luncheon was recently given to Mr. Walter Behrens, who acted as Honorary Secretary to the Commercial Committee of the House of Commons during the Congress of the Allied Parliaments. Sir John Randles presided, and amongst other notabilities we find the names of Lord Rotherham, Colonel Pryce-Jones, the Hon. B. R. Wise and Senatore Marconi.

* * * * * *

We beg to offer our congratulations to Able Seaman J. W. H. Bollan, of the Royal Naval Volunteer Reserve, who has received the Distinguished Service Medal for gallantry. He is one of the volunteers who went to the Mediterranean on *H.M.S. Queen Elizabeth*, and offered himself for service at the wireless station at Lancashire Landing in Gallipoli, where he remained until the evacuation.

Company Notices

The Marconi International Marine Communication Co., Ltd.

Directors' Report, Balance Sheet, and Profit and Loss Account for the Year ending December 31st, 1915

It affords satisfaction to the Directors to inform you that the Company's business continues to show substantial expansion.

The net profit for the year amounts to £63,630 2s. 8d., after deducting the sum of £29,281 5s. 7d. for depreciation and debenture interest, compared with a net profit of £55,668 1s. 1d., for the preceding year. Notwithstanding the considerable decrease in passenger traffic during the past year and the necessary restrictions in respect of private messages at sea, the revenue from ships' telegrams, subsidies, etc., amounted to £208,899 14s. 2d., a substantial increase over the year 1914, when the figures were £175,021 1s. 10d. This increase is mainly due to the greater number of ships installed with wireless apparatus.

The number of telegraph stations owned and worked by the Company as public telegraph stations on the high seas increased from 875 at December 31st, 1914, to 1,008 at the end of December, 1915. The organisation of this Company, together with that of its associated companies, with a total of some 2,300 mercantile vessels fitted with Marconi telegraph stations, has continued to render inestimable service. The amount of the Profit and Loss Account now stands at the sum of £75,602 1s. 1d., including the sum of £11,971 18s. 5d. carried forward from the preceding year. The Directors have pleasure in recommending the payment of a final dividend for the year 1915 of 7½ per cent., which, with the interim dividend of 5 per cent. paid on February 1st, 1916, will make 12½ per cent. for the year, the total amounting to the sum of £38,260 10s. The losses sustained in consequence of attacks upon the mercantile fleet during the latter part of 1914, and those incurred during the year 1915, have been debited to Profit and Loss Account of the past year. Therefore the £10,000 which was placed last year to the credit of a Special Reserve Account to meet any losses arising from this cause remains intact, and it is now proposed to transfer this sum, together with the Share Premium Account, to a General Reserve Account, which will then stand at the sum of £27,639 14s. 3d.

The continuous growth of the Company's business, and the large number of additional telegraph stations on board ships, which are being installed year by year without the issue of additional capital, renders it prudent to carry forward the substantial balance of £33,841 11s. 1d., after providing the sum of £3,500 for the redemption of debentures. It will be observed from the figures given above that during the year under review there has been a net increase of 133 stations, representing a substantial capital outlay for which it would have been impossible to provide without raising additional capital had it not been for the policy of prudently husbanding the cash resources of the Company.

The balance carried forward will also serve to meet the Excess Profits Duty, which must exceed the sum of £8,095 8s. 6d., the amount payable under this head for the year 1914.

The Amalgamated Wireless (Australasia) Limited, in which this Company is interested, has paid a dividend of 6 per cent. in respect of the year ending June 30th, 1915.

The retiring Directors are Senatore Guglielmo Marconi and Mr. Alfonso Marconi, who being eligible, offer themselves for re-election.

The Auditors, Messrs. Cooper Brothers & Co., also retire and offer themselves for reappointment.

THE MARCONI INTERNATIONAL MARINE COMMUNICATION CO., LTD.

BALANCE SHEET, DECEMBER 31, 1915

Dr.

		£ s. d.	£ s. d.	£ s. d.
To Capital—				
Authorised.				
350,000 Shares of £1 each			350,000 0 0	
Issued.				
306,084 Shares, fully paid				306,084 0 0
To 6,078 5½ per cent. 1st Mortgage Debentures of £20 each				121,560 0 0
To Reserve for Repayment of Debentures				8,810 0 0
To Special Reserve for War Contingencies				10,000 0 0
To Reserve Account				17,639 14 5
To Creditor Balances				65,856 15 3
To Profit and Loss Account—				
Balance as per last account, December 31st, 1914			64,855 14 11	
Deduct—				
10 per cent. Dividend for 1914		£30,608 8 0		
Reserve for Repayment of Debentures		3,500 0 0		
Special Reserve for War Contingencies		10,000 0 0		
Additional Directors' Fees for 1914		1,000 0 0		
Excess Profits Duty		8,095 8 6		
			53,203 16 6	
			11,651 18 5	
Amount taken from Reserve to redeem 16 Debentures			320 0 0	
			11,971 18 5	
Add—				
Balance of account for the year ending Dec. 31st, 1915			63,630 2 8	
				75,602 1 1
				£605,552 10 7

Cr.

	£ s. d.
By Plant, Apparatus, Furniture and Stores	255,131 9 0
Note.—Owing to the war it has not been possible to obtain certified Inventories for Apparatus and Stores amounting to £51,154 2s. 6d. The balance, £203,977 6s. 6d., has been certified by representatives of the Company.	
By Consideration for Licence and Rights and Shares in Associated Companies	219,381 11 7
Note.—The Licence and Rights are subject to the provisions of five Agreements between this Company and five Associated Companies, under which this Company received Shares in Associated Companies for this Company's rights in Canada, Australasia, Argentina, Uruguay, and all European Countries and their Dependencies except Great Britain and Ireland and Italy.	
By Debtor Balances	60,707 11 8
By Debenture Discount	12,915 15 0
By Cash at Bankers and in Hand	45,416 3 4
By Loan against Securities	12,000 0 0
	£605,552 10 7

PROFIT AND LOSS ACCOUNT FOR THE YEAR ENDING DECEMBER 31, 1915

Dr.

	£ s. d.
To Salaries and Directors' Fees	16,062 6 5
To General Charges, Difference in Exchange and Income Tax	17,221 11 1
To Expenses of Ship Telegraph Stations, including depreciation and loss of Plant and Apparatus	105,665 12 10
To Debenture Interest	6,347 6 2
To Balance carried to Balance Sheet	63,630 2 8
	£208,926 19 2

Cr.

	£ s. d.
By Ships' Telegrams, Subsidies, News Service, Rentals and Sundry Receipts	208,899 14 2
By Transfer Fees	27 5 0
	£208,926 19 2

GODFREY C. ISAACS, *Director.*
H. RIALL SANKEY, *Director.*

REPORT OF THE AUDITORS TO THE SHAREHOLDERS.

We have audited the above Balance Sheet with the books in London and accounts from Rome. We have obtained all the information and explanations we have required, and in our opinion such Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of the Company's affairs according to the best of our information and the explanations given to us and as shewn by the Books of the Company.

COOPER BROTHERS & CO., *Chartered Accountants*, *Auditors.*

London, *June 2nd*, 1916.

Pastimes for Wireless Operators

III.—The Study of Foreign Languages.

By " REDAX."

No one questions the advantage of a knowledge of foreign languages. To the wireless operator such knowledge is particularly valuable, for it enables him to reap benefits from his travels abroad which are denied to his monolinguistic *confrères*, and affords an asset frequently realisable in hard cash.

Take six senior men, equally experienced in wireless work and all well qualified to shoulder the responsibility of a land station. Supposing a vacancy with a good salary occurs in, say, South America—a country, by the way, with vast " wireless " possibilities—which of the men will most likely be chosen ? Of course the man who knows Spanish ! Yet few operators have even a passing acquaintance with this tongue.

Most men are ambitious to tak echarge of a land station after a few years at sea ; they do not wish to remain marine operators all their lives. For this reason it behoves them to look carefully into their qualifications, to take stock of themselves and sum up their chances in the competition which invariably arises when good positions go vacant. Technical knowledge, skill in operating, business ability and tact all count, but the accomplishment which most often turns the scale in the favour of the successful candidate is an acquaintance with the language of the country in which the position is offered.

The two languages of the greatest use to operators are French and Spanish. French because it is practically an international tongue, and Spanish since it is the language most widely spoken in the great South American continent, where, as we have hinted above, wireless is destined to play such an important part in the future.

French, of the two, is perhaps the most generally useful, and should be acquired even at the sacrifice of the greater portion of one's spare time for a year or two. Abroad, where languages are studied with a seriousness only rivalled in this country by the devotion of our public schools to sport, no man considers his education even tolerably complete until he is able to converse fluently in this tongue. Even in Turkey, where one would scarcely expect to find a high level of education, the railway booking clerk and the wayside café proprietor invariably speak French, or at least can understand the gist of a conversation.

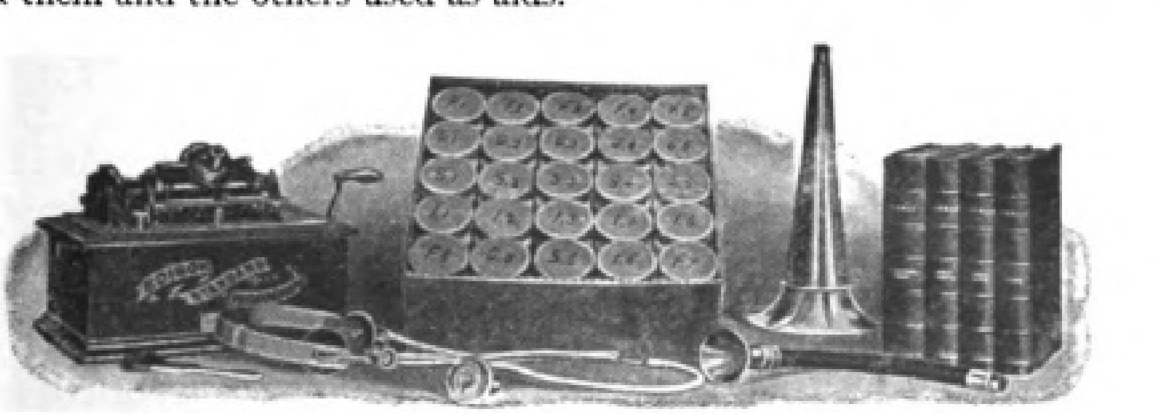
As a " stepping-off point " from which to progress to the study of other foreign tongues French is without a rival. Once it has been mastered, Spanish, Portuguese and Italian will lose their formidable appearance, and the operator will be well on the way to become a linguist. The social advantages accruing from the knowledge of this language are also not to be despised.

Much of what we have written is perhaps obvious—or should be—and thus often we find that, awaking to the advantages of linguistic knowledge, an operator will purchase a French or Spanish grammar. But of a hundred who start in this way scarcely ten achieve their aim, for enthusiasm soon evaporates and after all hard work is seldom voluntarily undertaken.

In the teaching of languages we in this country are unfortunately far behind our Continental friends, although of recent years considerable improvement has manifested itself. With a tenacity unintelligible to those acquainted with modern methods we cling to the unnatural and stultifying grammatical method, with the result that whilst a boy on leaving school knows more than a Frenchman himself about the moods and tenses of the verb "to give," yet he can scarcely give orders to a *cocher* to drive across Paris from one terminus to another.

By far the easiest and most practical method of learning any language is to follow closely the line taken by a child in acquiring its mother tongue. The toddler in the nursery never worries its head about nouns, adjectives and verbs, but simply keeps its eyes wide open and learns to attach simple names to beings and objects with which it comes into contact between waking and bedtime. "Mummy" and "daddy" come first, then perhaps "nanny." Next sundry bumps and tumbles bring such words as "head" and "nose" within the baby's ken, together with little phrases such as "Baby tumble," "Baby want mummy," and so on. Here we have the secret of the success of such methods as the Berlitz, in which no word of English is spoken from the commencement of the course. The teacher simply points to a picture or an object, at the same time pronouncing its name, which the pupil repeats after him so as to acquire a correct accent. As soon as a number of names have been learned the teacher passes to simple phrases and sentences of action, such as "I shut the door," "I lift the book," carrying out the action whilst speaking. It is wonderful how readily pupils acquire fluency by this method.

Operators on board ship can follow out a similar method by purchasing a phrase book and learning the words and sentences contained therein, not forgetting to pronounce aloud from the phonetic rendering provided. The excellent "Self-Taught" series published by Messrs. Marlborough can be strongly recommended, even for difficult Eastern languages such as Arabic, Turkish or Persian. A dictionary of the "both ways" variety (French-English and English-French, for example) is a necessity, and used in conjunction with the phrase book will enable the student to extract quite a lot of sense from a foreign newspaper. Of course books of the grammatical variety are also useful and there is no harm in having two or three different volumes on hand at the same time, provided some definite line of study is followed in one of them and the others used as aids.



PHONOGRAPH AND WAX CYLINDERS ON WHICH ARE RECORDED FOREIGN WORDS AND PHRASES.

It is most important to read aloud when studying without a teacher. The ear will in this way become accustomed to the sound of the language, and the student will then be able to profit from a day ashore in a foreign port with the strange language spoken all around him. Great courage is required to make one's first attempts at speaking, but the step need not be dreaded, for nobody abroad dreams of laughing at a foreigner endeavouring to master a new language. Englishmen are strangely sensitive to ridicule, and this is largely the reason why so many people never attempt to speak a foreign tongue. A method introduced within recent years and followed out with success by many students is that of utilising a phonograph and wax records. In this system the student listens to words and sentences on the phonograph, repeated again and again until he is perfectly acquainted with their exact sound and meaning. The records, having been made by a native, are of course without fault in pronunciation, and to a considerable extent take the place of a human teacher. When finished with, they are returned by post to the International Correspondence Schools together with cylinders on which the student has recorded his own pronunciation. This enables criticisms to be made and progress noted. An illustration of one of the phonographs and records will be found above.

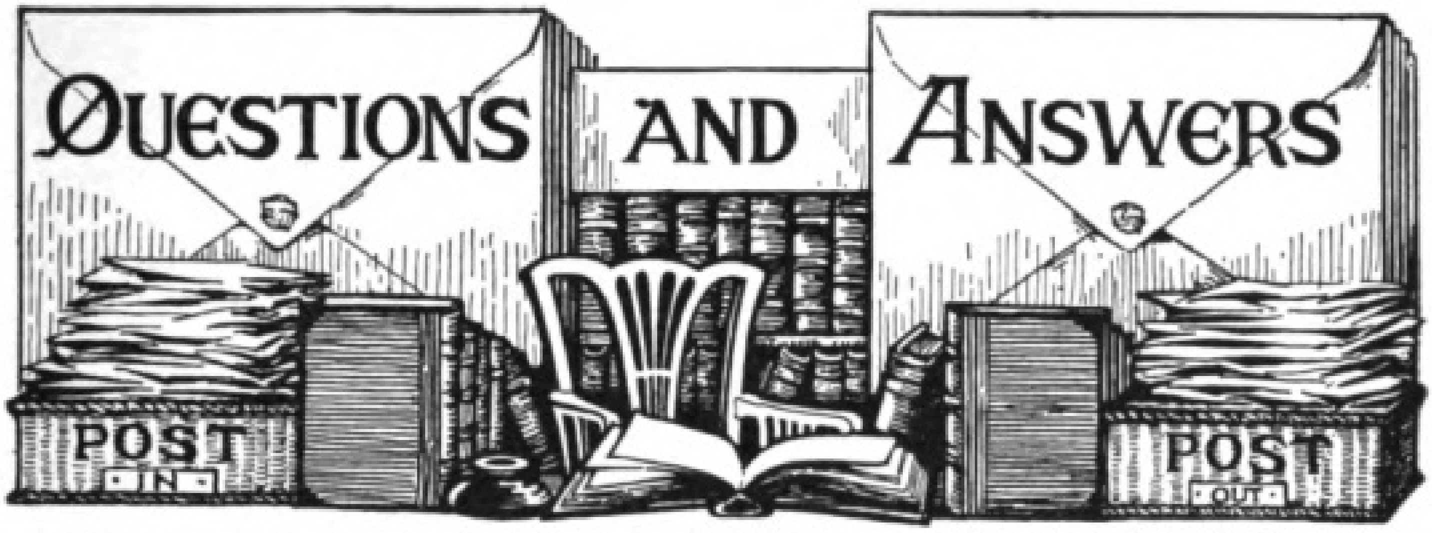
Disc records (" His Master's Voice ") for use on gramophones and containing French conversation are also obtainable. These are most useful for imparting a correct accent.

Whatever system is adopted, no success will be obtained without patience and perseverance and a great deal of " dry " uninteresting hard work. A keen operator with his head screwed on the right way will find many opportunities in the course of his travels, and after a year or two should have learnt sufficient to speak quite fluently in at least one foreign tongue.

Lastly, when a good grasp has been gained and simple conversations no longer present difficulty, a study of grammar will be found really useful and necessary. But it always should be borne in mind that the goal to aim at is to be able to *think* in the language ; when you are able to do this, progress will thenceforth be made quickly and without effort.

Monsieur Emil Frey.

DURING the present European war Mr. Emil Frey, the Director of the International Cable and Telegraph Union, has been working like a Trojan. The Bureau is situated at Berne in Switzerland, of which country Mr. Frey is a former President. The work of Mr. Frey and his *personnel* consists of cable and telegraph tariffs, the adjustment of disputes between countries over rates and procedure, preparation of cable, telegraph and wireless maps and printed volumes, embracing every part of the world that can be reached by any of the modern methods of quick transmission. At the present moment it is Wireless Telegraphy which is making the most rapid strides, and Mr. Frey finds it difficult to keep up with the progress of this new medium of communication.



Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor,* THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered: and it must be clearly understood that owing to the Defence of the Realm Act we are totally unable to answer any questions on the construction of apparatus during the present emergency.

NOTE.—*In view of the large number of questions which now reach us from readers, we regret that we cannot undertake always to answer queries in the next issue following the receipt of letters. Every endeavour will be made to publish answers expeditiously.*

A. McK. (B.E.F., France).—Thanks for your letter. It is very difficult for us to advise you in the circumstances, but we would suggest that you renew your application, setting forth your qualifications and mentioning what happened before.

O. C. (Crewe).—Write to the East London Telegraph Training College advertising in this magazine. They will probably be able to give you particulars.

T. T. (Charlbury).—The demand for operators on English land stations is strictly limited, and such positions can only be held by trained and experienced men. There is a far greater demand for wireless operators for service in the mercantile marine, and to obtain such a position you would have to undergo a course of training. Your writing and spelling need attention if you wish to take up wireless telegraphy.

P. R. (Barrow).—The formula for the capacity of a plate condenser is:

$$C_{mfds} = \frac{AK}{4\pi d \times 900{,}000}$$

where

K = specific inductive capacity of dielectric
d = thickness in centimetres
A = area of one of the metal plates in contact with the dielectric.

The capacity worked out in the instructional article on p. 666 of Vol. II. WIRELESS WORLD is correctly calculated by this formula. The formula on p. 601 is quite correct, but is perhaps less clearly put. Referring to Fig. 2 on the same page, there are six sheets of dielectric but only three metal plates on one side and four on the other in the condenser shown.

Hence to obtain the capacity either use the formula for a single sheet condenser of the same dimensions and multiply by the number of sheets of dielectric or else multiply it by *twice* the smaller number of metal plates.

It is evident that

$$2\frac{NAK}{4\pi d} = \frac{NAK}{2\pi d}$$

where N = smaller number of metal plates.

To avoid confusion it is as well to consider the number of sheets of dielectric in the condenser and not the metal plates.

Owing to pressure on our space, the answers to your other questions must be held over.

"Radio" (Harringay).—Yes, we believe there are excellent chances of such promotion for men who take a keen interest in their work. R.N. operators have to pass an examination much more searching than that for the P.M.G. certificate. Regarding the transfer you mention it might be arranged, but we do not think it would be possible until after you have joined up. Then apply to the Commanding Officer.

M. B. (Paris).—Your question is quite clear. The apparatus at Poldhu is duplicated, one set being used one night and the other the next. In this way both sets are kept in good condition. There is a slight difference in power between the two sets.

A. E. W. (Southend).—The Admiralty.

F. G. G. (Ruddington).—Consult the advertisements in THE WIRELESS WORLD for schools of wireless in London. Any of them will send you particulars.

L. D. (Nice) writes: "Referring to the use "of the earth arrester, I fail to see how a large "amount of current does not pass through the "multiple tuner while transmitting, for the "multiple tuner is generally tuned to receive "a 600-metre wave while the wave transmitted "is also 600 metre."

Answer.—A considerable current does pass through the tuner, and in fact often sparks across the micrometer gap of the instrument. Nevertheless it should be remembered that the path across the arrester gap and down the earth lead is, once the spark had occurred, of a very much lower resistance. The tuner, therefore, is shunted by a low resistance path which takes most of the transmitting current. There is no such shunt during reception and the whole of the aerial current then passes to the receiver.

E. J. (Cardiff).—Study the *Elementary Principles of Wireless Telegraphy*, by R. D. Bangay, obtainable from The Wireless Press, Ltd. (1s. 2d., post free). You should also study the construction and design of portable wireless apparatus. This, with the knowledge of surveying you possess, should greatly assist you in obtaining a position in the Royal Engineers.

A. McC. (Glasgow).—The wireless apparatus on board ship is under the care of the operator-in-charge, who is responsible to the commander. The operators hold the position of honorary officers. An operator at sea can rise to the position of travelling inspector, the salary depending upon his length of service. On shore he may become a resident inspector or take up a special position which happens to be vacant. Naturally vacancies for the highest positions but seldom arise. It is impossible to answer your question as to whether the "wireless profession is as good as the engineering profession." Wireless telegraphy is largely a branch of electrical engineering, and cannot be separated from it. Therefore one cannot speak of "wireless" as one profession and "engineering" as another. Your fifth question had better be put to the Admiralty. In reply to the sixth, good eyesight and general health are required for wireless operating, but the fact that the applicant wears glasses does not debar him from acceptance in the Marconi service.

Robt. E. B. (Hexham).—We have communicated with some people who will write you in due course, and we hope good may come of it. Let us know what happens. Thanks for kind appreciation of our magazine.

W. B. (Kentish Town).—Messrs. Graham & Latham, Ltd., will be able to give you information on the subject if you write to, or call at, their office, 104 Victoria Street, Westminster.

A. J. W. (Walsall).—See advertisements of wireless schools in our advertising section. Any of the colleges will send you particulars on application.

F. X. S. (Shanghai).—Thanks for your suggestions, which will receive consideration in preparing the second series of records. The following is the form of preamble of a telegram from coast to ship:—

Commencing sign—Prefix (if any)—Radio—Name of office of origin—Number of telegram—Number of words—Date and time of handing in—Service instructions (if any)—Break sign—Supplementary instructions (if any)—Break sign—Address, etc. Thus:—

— . — . — Radio Calcutta, 4, 6, 12, 9.35 m.
— . . . — Jones *Olympic* Landsend, etc.

The ship to coast station is similar.