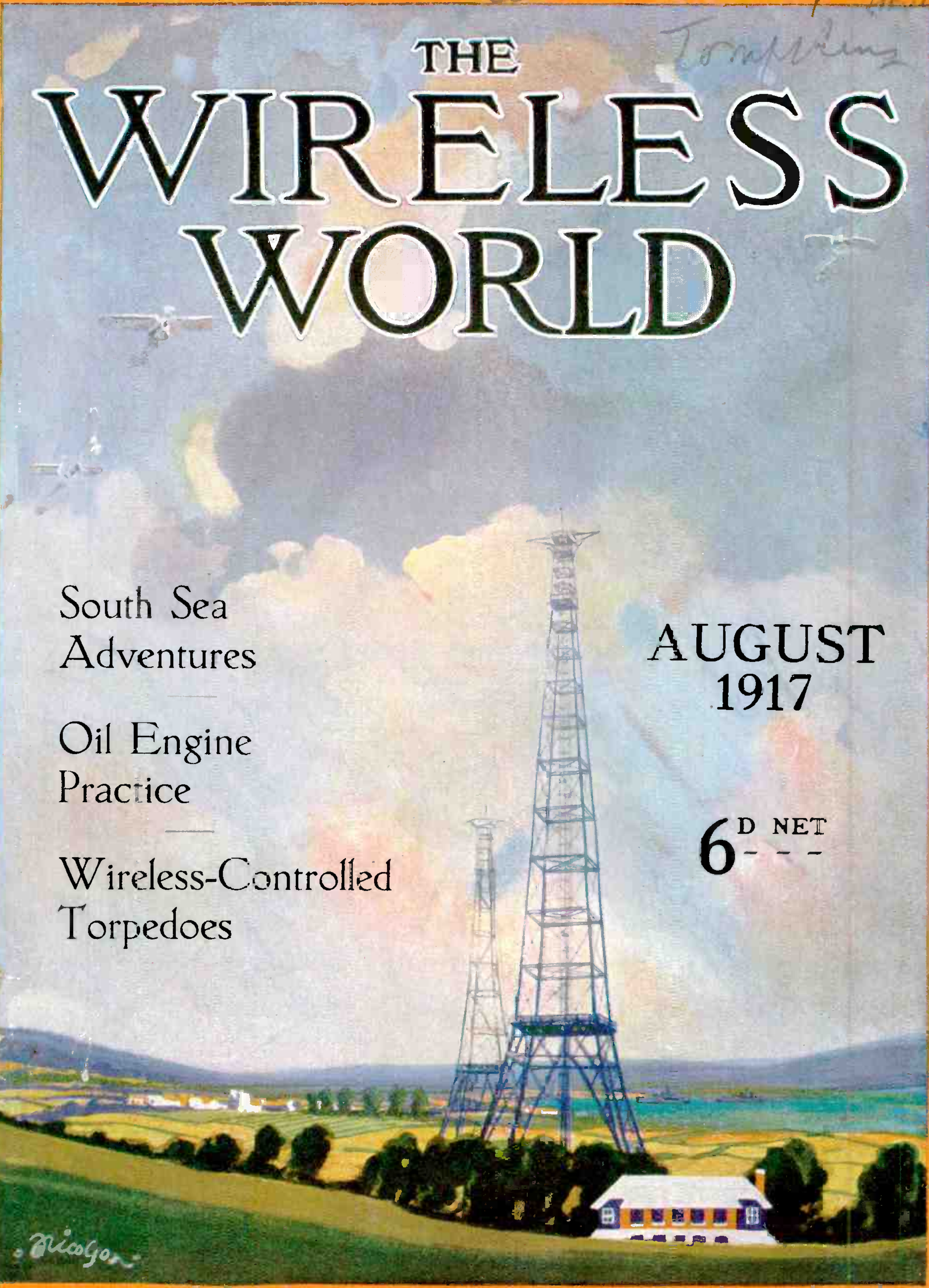
THE WIRELESS WORLD



South Sea Adventures

Oil Engine Practice

Wireless-Controlled Torpedoes

AUGUST 1917

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INDEX TO ADVERTISERS.

THE WIRELESS WORLD

With which is incorporated "The Marconigraph."

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WIRELESS WORLD

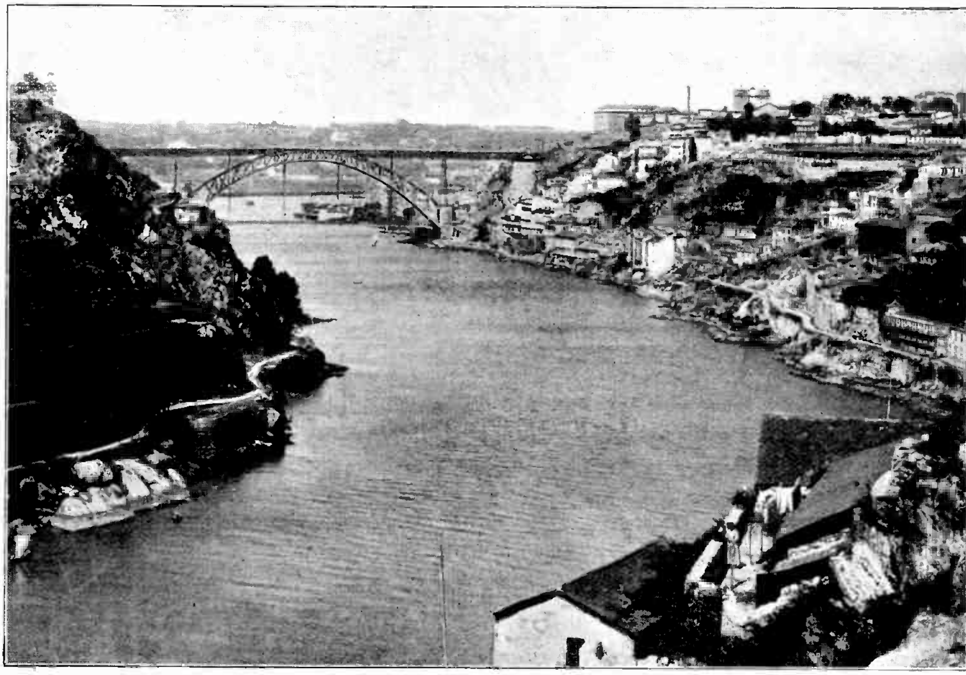
Volume V. No. 53. AUGUST, 1917.

In Sunny Portugal

The Wireless Progress of Our Gallant Ally

JUST prior to the outbreak of war a scheme was under way for providing a series of stations for the purpose of linking up the Portuguese possessions of the Azores, Madeira and Cape Verde Islands with the mainland and with one another, and much of the preliminary work had already been carried out. The large and powerful station near Lisbon was to be erected sufficiently powerful to communicate direct with any of these possessions, whilst stations on the more distant islands were to communicate, not direct, but through one another to the mainland.

The outbreak of European hostilities, however, had the effect of holding up the scheme for the time, although we have no doubt that when normal conditions return the scheme will be carried to completion. It will mean much for Portugal, as considerable trade is carried out with these islands and is likely to be extended when better means of communication are provided. This, of course, is in addition to the invaluable uses of such a wireless system in the defence of the country and for other strategic purposes. However perfect the cable system may be in connecting groups of islands with the mainland, it is always liable to be cut by the enemy in times of war, a risk which is non-existent in the case of radiotelegraphy.

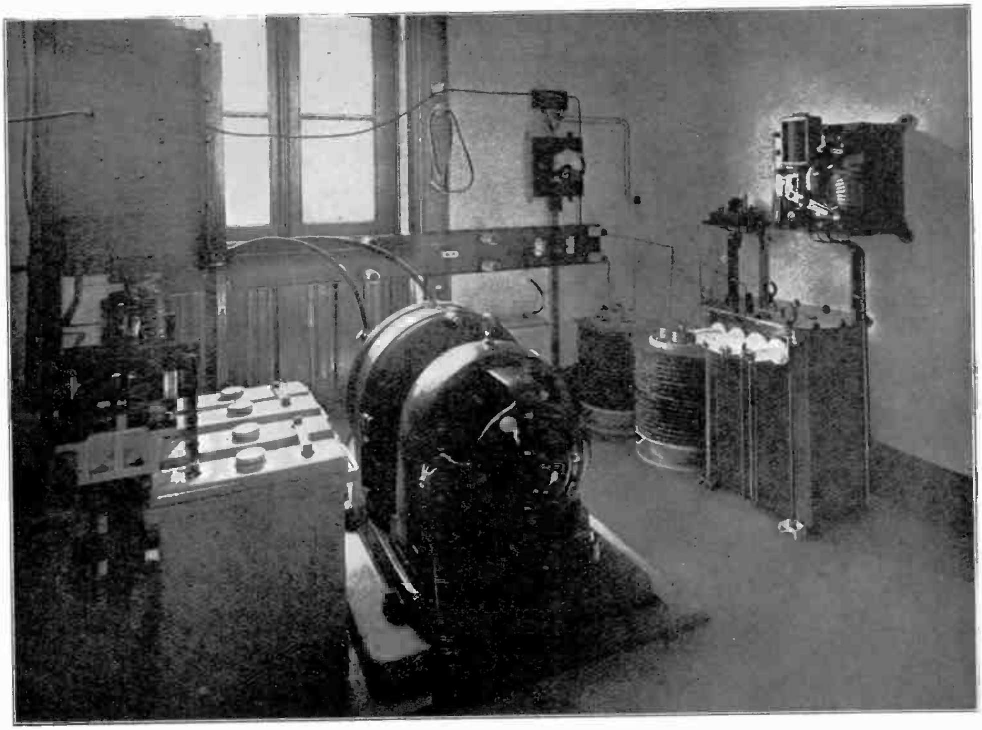


OPORTO AND THE RIVER DOURO.

Although the war has held up this important scheme, it has not prevented the erection of a powerful station at Leixões, near Oporto. This, the second city of Portugal, derives its name from O Porto (the port) and stands on the steep rocky right bank of the River Douro, some three miles from the sea. Writing of this beautiful city Mr. Oswald Crawford has said the houses, as they rise confusedly from the river's edge, seem painted in strong reds, blues or greens, some left whitewashed and the majority retaining the granite grey of the stones they are built with, making up a very strange beautiful panorama, ringed as the city is by the encircling pine-covered mountains. A good idea of the appearance of this city can be gathered from the illustration on this page, which shows the River Douro crossed by the steel bridge reputed to be one of the finest ever built. The bridge spans a horizontal distance of 549 feet, and its centre is no less than 203 feet above the level. Across this structure runs the railway to Lisbon, some 200 miles away.

On the right bank stand a number of monastic buildings, which, however, no longer serve their original purpose One is a citadel, another the exchange, a third a barracks, and so on. Oporto possesses some fine public buildings, including a polytechnic academy, observatory, medical school, a fine arts academy and a library of over 200,000 volumes and nearly 10,000 manuscripts.

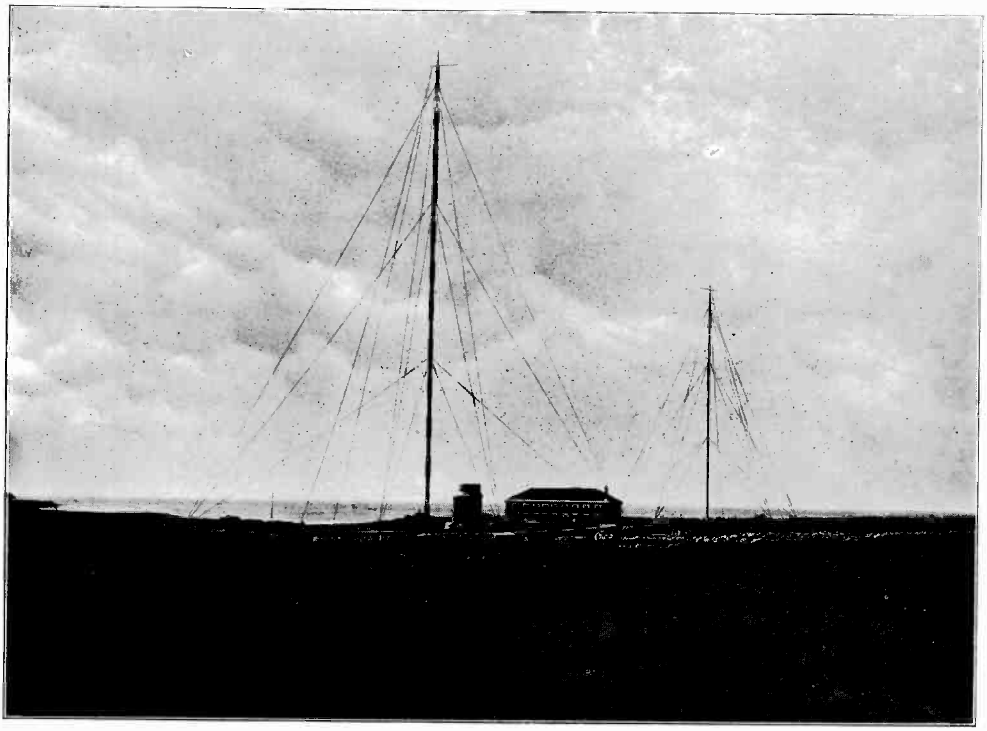
Among the many exports from this prosperous city, the first which will occur to the minds of our readers will be port wine, which of course derives its name from Oporto. Other exports include cattle, oranges and other fruit, cork, copper, onions, meat, hides and wool. The total value of all exports averages roughly four million pounds.



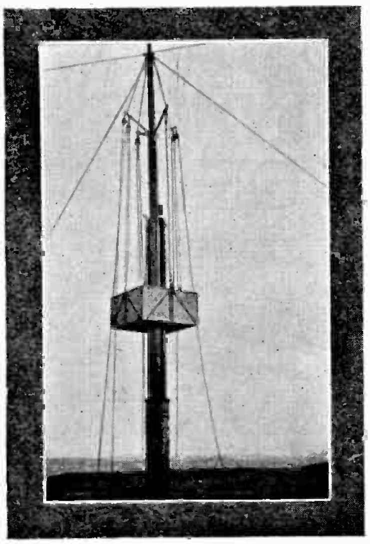
ABOVE, THE OIL ENGINE AND SWITCHBOARD, LEIXOES. BELOW, THE TRANSMITTING APPARATUS.

An excellent view of the wireless station, which stands on the sea-shore, a few miles from the city, will be seen on this page. The aerial is supported by two lofty masts of the well-known tubular steel pattern, the wires being led down to the station building, which is placed centrally between the two. The method of working the masts can be well seen from the two small photographs on page 297. After a suitable concrete foundation has been provided, the lowest sections of the mast are bolted together and to the foundation, and the remainder of the mast built up piece by piece. The method adopted is to insert a wooden mast in the sections already standing, and by means of pulley blocks to haul up a kind of working cage as each new section of the mast is bolted together. Step by step the wooden mast is placed in a higher section and piece by piece the steel sections of the mast are hauled up. In this way very high masts can be erected on very restricted sites, which would not be possible had the whole mast to be assembled on the ground and hauled up into position by a jury mast.

The station buildings are commodious and well designed, providing not only accommodation for the apparatus but also for the necessary operating staff and engineers. A 5 kw. set is installed, the prime mover being a Gardner oil engine, which drives a direct current dynamo. This engine is well shown in the upper illustration on page 295, which also depicts the main switchboard with its switches, fuses and indicating instruments. The D.C. dynamo can serve two purposes, (*a*) that of charging the large accumulator battery shown on page 295, and (*b*) that of driving



THE WIRELESS STATION AT LEIXOES, OPORTO.



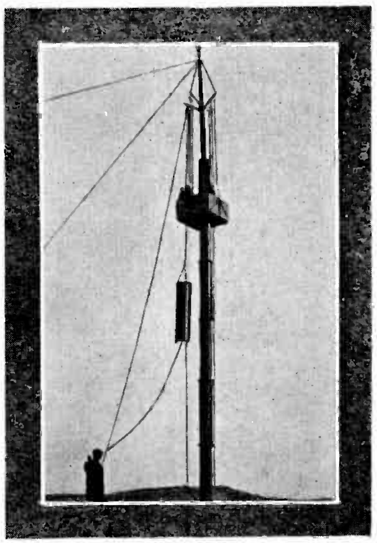
ERECTING THE MASTS: THE CAGE.

the motor generator connected to the transmitting apparatus. Normally, however, the accumulators provide the necessary current for the motor generator, which is seen in the centre of the lower illustration on page 295.

In the same illustration, mounted on the wall to the right hand side, will be seen the automatic starter, controlled by a push button from the operator's desk. This starts up the motor of the motor generator when it is required to send. In the operating room a transmitting key controls the alternating current which passes through the transformer which will be seen immediately below the automatic starter. The high tension current from the transformer passes through the secondary tuning inductances (see on the floor to the left of the transformer) and thence to the condenser, which it charges. These secondary inductances are made variable for the purpose of giving low frequency resonance. The condensers of the primary oscillating circuit, immediately to the left of the motor generator, are held in glazed ironstone containers filled with oil and discharged through the primary of the jigger, the variable high frequency inductance and the rotary spark gap. This rotary gap is of the synchronous type and gives a pure musical note which can easily be read through interference and atmospheric disturbances.

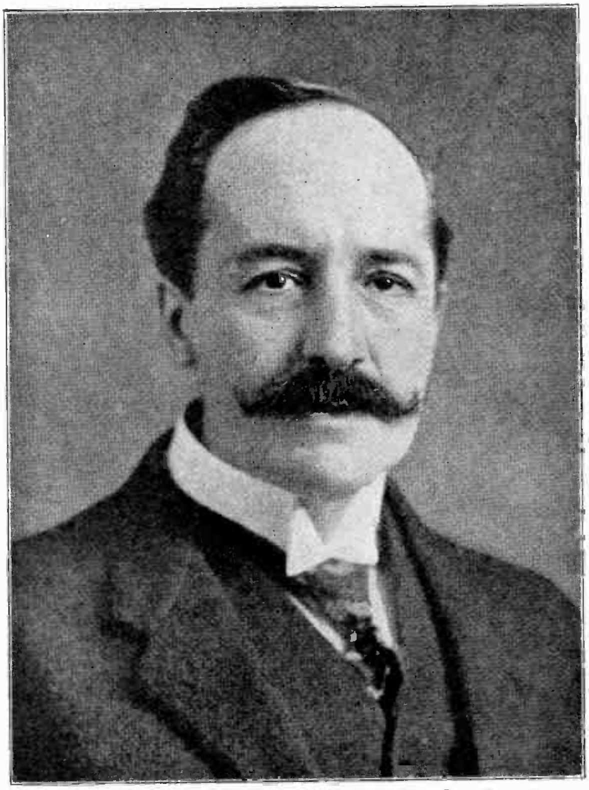
The coupling of the jigger can be varied by means of a screw adjustment so that a weak or strong coupling may be used as desired. The earth lead from the jigger, which will be seen running from the top right hand terminal, passes to the earth arrester gap mounted on the wall, immediately above the aerial ammeter seen on the further wall. The two leads from the top and bottom plate of the arrester gap to the receiving instruments can be clearly seen, and pass through the wall to the operating room immediately on the right. The aerial lead from the jigger will be seen to pass out from the picture on the extreme left.

The station has now been working for some months, and we understand is giving excellent service. On the completion of the larger project, which will link up the Atlantic Islands, Portugal will be in possession of a wireless system on which she will have every reason to congratulate herself.



ERECTING THE MASTS: HAULING UP A SECTION.

PERSONALITIES IN THE WIRELESS WORLD



MR. J. H. LAUER.

POSSIBLY some of our readers do not grasp the full significance of the activities of the Marconi Wireless Telegraph Company of Canada, and fail to realise the fact that at their office in Montreal is controlled a wide-spread system of British wireless stations of all grades, to say nothing of an important wireless manufacturing industry.

The General Manager of the Company, whose portrait figures on the opposite page, hails from the "Old Country," having first seen the light at Croydon, in Surrey, one of the prettiest and best known of our London suburbs. He is the son of Peter and Frances Lovat Lauer, and received his education at the local collegiate schools, afterwards proceeding to Cambridge University.

His business career started by his acceptance in 1880 of employment in the East Indian produce trade, and it was not until July, 1893—thirteen years later—that he crossed the ocean to Canada. He acted as Secretary and Manager of the Master Builders' Association, Montreal, from 1905 to 1912, and during that period organised the National Association of Builders' Exchanges. Mr. J. H. Lauer entered on the duties of his present post in 1912, and was elected member of the Institute of Radio Engineers (New York) in December, 1916. His experience and knowledge of labour matters has resulted in his having been appointed on many occasions arbiter in labour disputes and in his selection to serve on various Boards of Conciliation. A member of the Montreal Board of Trade and director of St. George's Society, he is particularly well known in shipping and Masonic circles throughout the Dominion. Besides the keen interest which he takes in his industrial and civic duties, Mr. Lauer has devoted a good deal of leisure to the development of Church music, and his abilities have been so effectively recognised by the Church of England in Canada, of which he is a loyal member, that he has been chosen to sit in the Provincial Synod as one of the Lay Delegates.

On September 29th, 1902, he married Miss Kathleen Crawford, daughter of Mr. Dougall Crawford, by whom he had four sons.

His residence is at Montreal West, Quebec, and he is a member of the Canadian and Reform Clubs, Montreal.

The Damping of Oscillatory Circuits

By W. GORDON-CAMPBELL, R.E.

ALTHOUGH this subject is one of great importance to the efficient working of a wireless station, the writer feels that it is not all operators who fully understand either the part it plays or the conditions that affect it.

It is with hopes to clear up the point that this article has been written. The subject is viewed broadly, and as little mathematics as possible has been introduced.

For the purpose of this article let us bear in mind a simple oscillatory circuit such as that shown in Fig. 1, where T_1 and T_2 are the terminals of a high-tension transformer. C is a condenser, G is a spark gap, and I_1 and I_2 are the primary and secondary windings respectively of an oscillation transformer.

We charge up our condenser, C, from the transformer terminals, T_1 and T_2, till the potential across the spark gap, G, is sufficient to break down the insulation of the air between the balls. The condenser then discharges itself through the inductance coil, I_1, and gap, G. Now, if the discharge circuit possessed neither resistance nor inductance, the condenser would discharge itself in a single dead-beat movement. However, as there is both the resistance of the circuit and the inductance in the coil, I_1, the condenser current oscillates to and fro for a number of times before finally coming to rest. These "beats" or periodic swings may be represented graphically as shown in Fig. 2.

When the condenser commences to discharge itself, the current rises to a maximum value, a, which depends upon the charge in it, and then falls to zero; only to rise again to a maximum value in an opposite sense, which again falls to zero.

This cycle of operations is repeated until all the energy having been dissipated, the oscillation dies away.

Each wave is called a period, and is represented by the sign $\sim$. This sign, it will be noticed, takes the shape of the wave it is intended to represent, and is equal to that part of the curve that lies between A and B in Fig. 2. The maximum value of each wave is less than the one preceding it, as shown by the lines a, b, c, d. The extent to which each wave decreases or, to give it its proper name, its "decrement," is a definite value which can be calculated out.

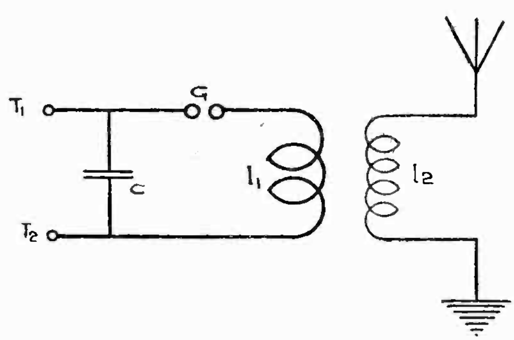


FIG. 1.

The amplitude of each wave bears a definite ratio to the one preceding it. As this is very important, let us work out in detail the example shown in Fig. 2.

It will be seen that the first wave rises to a maximum positive value of 100, while the second wave only rises to a maximum positive value of 80. Now the difference or decrement between the first and second wave is 100 – 80 = 20. It is now easy to see that the second wave has an amplitude of ·8 of the initial wave, and that the decrement in relation to the first wave is ·2. The third wave will now bear the same relation to the second as did the second to the first. Thus, its amplitude will be ·8 of 80, which equals 64, and its decrement which equals ·2 of 80 is 16.

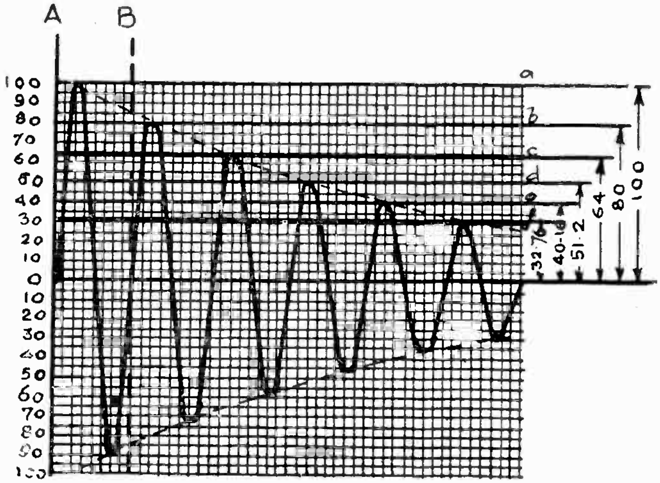


FIG. 2.

Therefore it will rise to 64 and will fall short of the wave preceding it by 16. This relationship holds good throughout the oscillation. As each wave is a definite fraction of the one preceding it we say they are in geometrical progression.

In Table I. the first six values have been worked out, and from these Fig. 2 has been plotted. Now let us find the naperian logarithm of these values. Column "A" is the amplitude of the wave; column "B" is the ordinary or common log, and column "C" is the naperian log. This log, usually shown by "Log._ϵ," is obtained by multiplying the common log to base 10 by the factor 2·30259. However, for all practical purposes 2·3026 is near enough.

TABLE I.

Amplitude. A.	Common Log. B.	Naperian Log. C.
100	2·0000	4·6052
80	1·9031	4·3820
64	1·8062	4·1588
51·2	1·7093	3·9356
40·96	1·6123	3·7124
32·76	1·5153	3·4892

Decrement of $\text{Log.}_\epsilon = \cdot 2232$

If we examine these values (shown in column "C") we find them to decrease by a constant value of ·2232 each step. Therefore we say they are in arithmetical progression, and this figure is the Logarithmic Decrement of the wave, usually abbreviated into Log. Dec.

As each wave bears a certain relation to the one preceding it, the oscillation—theoretically speaking—will never absolutely die away. For all practical purposes, however, we consider the oscillation to be at an end when the final wave has reached an amplitude equal to 1 per cent. of the initial wave. From the known factors we can now calculate the number of waves per train; this may be done by means of the following formula :—

$$M=\frac{4\cdot6052+\delta}{\delta}$$

Where 4·6052 = Log._ϵ of 100.

The Greek letter Delta = Log. Dec. per semi-period, and "M" = the number of half-waves or semi-periods in the oscillation. Now our log. dec. = ·2232 per period, and therefore is ·1116 per semi-period, thus :—

$$M=\frac{4\cdot6052+\cdot1116}{\cdot1116}=42\cdot2$$

By dividing the answer by two we arrive at the number of complete waves per train of oscillation :—

$$M=42\cdot2\div2=21\cdot1$$

Therefore we say that the oscillation has died away after about 21 or 22 complete waves. It will be noticed that the decrement may be referred to as either per "period" or "semi-period," being, of course, twice as much in the former case as in the latter.

This decrement is not a fixed quantity, but varies in different cases according to the amount of energy dissipated in the circuit. Now the only properties of the circuit which absorb energy are its resistance and inductance. The high frequency resistance of any conductor is greater than that for a steady current owing to skin effect. The extent of this increase is a difficult value to calculate accurately, but a reliable formula quoted by Professor Fleming in his "Manual" is :—

$$\tfrac{1}{2}\sqrt{K}+\tfrac{1}{4}, \text{ where } K=\frac{n.c.^2}{p}$$

"n" = the oscillation frequency; "c" is the circumference of the wire in centimetres; and "p" is the steady current resistivity of the material expressed in C.G.S. units. As an example, let us consider the case of the primary winding of a jigger where the wire, which is made of copper, is 3 cm. circumference, the circuit being tuned to 300 metres; "p" = 1600 for copper. Our formula thus becomes :—

$$\tfrac{1}{2}\sqrt{\frac{n.c.^2}{p}}+\tfrac{1}{4}=\tfrac{1}{2}\sqrt{\frac{10^6\times3^2}{1600}}+\tfrac{1}{4}=37\cdot75$$

Thus we find that the resistance of such a coil, when the frequency is in the nature of 10^6 is 37·75 times the value of its steady current resistivity. Supposing its D.C. resistance equalled ·001 ohms, then its H.F. resistance would equal ·03775 ohms when $n=10^6$.

As the calculation of inductance is a subject frequently dealt with in these columns it need not be detailed here.

The value of damping—that is, the log. dec.—is equal to $\frac{R_1}{4\,n\,L_1}$ where R_1 is the H.F. resistance of the whole discharge circuit, and L_1 is the inductance, n being the frequency.

In reckoning the resistance of the circuit we must not forget the spark, which is a part of the circuit, and possesses a very definite amount of resistance in itself. Its resistance varies with the length of the spark, the amount of current passing,

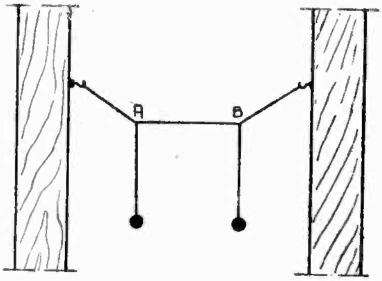


FIG. 3.

and even with the material employed as the electrode. It will vary from the fraction of an ohm in the case of a fairly long gap to perhaps 2 or 3 ohms for a fairly short one—say about 1 or 2 millimetres. Its resistance decreases as the length increases till it attains a fairly steady minimum value.

As distinct from arc systems, there are two methods of spark excitation: the ordinary spark, such as is obtained from the usual fixed discharger, and the quenched system. The meaning of the word "quenched" will be seen later on. This type of gap is sometimes constructed by placing a number of flat copper discs next to each other and face to face, with an insulating ring between so as to separate them and give the proper sparking distance. The disadvantage of this method of construction is that the spark is liable to keep at the one spot and thus cause uneven pitting of the electrode faces. For this reason it is usual to make the electrodes revolve, the objects being, even wear due to sparking, to cool the spark and to prevent "arcing" from the transformer. This type of gap permits the condenser to discharge itself in a very few waves—perhaps about three or four. Thus it "quenches" the primary oscillation very rapidly.

A circuit where the oscillation dies away in about three or four waves is said to be highly damped, but in the case of an ordinary spark gap we may have as many as 100 waves before the oscillation dies away. Then we say it is feebly damped. The extent of the damping of the oscillation in the primary of the jigger has a very marked effect on the current induced in the secondary winding.

A very interesting experiment showing, by means of a mechanical analogy, the transfer of energy from the primary to the secondary winding may be done as follows:—

Tie a piece of string about six or eight inches long between two hooks, as shown in Fig. 3. Suspend from near the centre and at about two inches apart two pieces of string, each having a small weight tied at the loose end; they will now hang like pendulums. We cause one of them—say "A," to start swinging, and imagine it to be an oscillation in the primary circuit. In a very short space of time "B" will start to swing and "A" will come to rest. That is analogous to the secondary circuit having received the energy from the primary. But a constant reversal will keep on

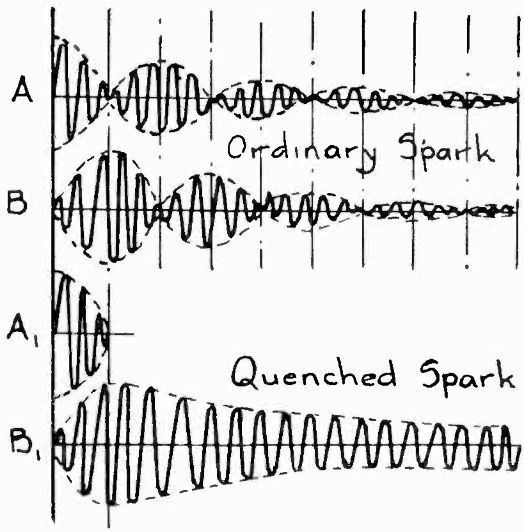


FIG. 4.

taking place. Each time one of the pendulums is at rest the other is swinging at its maximum, and then vice versa. This is shown graphically in Fig. 4, where " A " is the primary oscillation and " B " the induced secondary oscillation.

In a quenched gap the primary oscillation is arrested as soon as it reaches zero after the first swing.

Let us try this with our pendulums.

Set " A " swinging, it will then cause " B " to swing and " A " will come to rest. Now, then, lift " A " up so as to take all the strain of the top string, and it will be found that " B " goes on swinging freely for a long time before eventually dying away. This is shown in Fig. 4, where " A_1" is the primary oscillation of a quenched gap circuit, and " B_1" is the secondary oscillation.

It will be noticed that while the log. dec. of the primary circuit is very great, there being only three waves in it, that of the secondary is very small.

The secondary circuit can therefore oscillate freely, as all the energy is dissipated in itself, none being imparted to the primary circuit. The effect of a quenched discharger can readily be seen by looking at Fig. 4.

We may summarise this article by saying that the greater the damping of the primary oscillation circuit, the greater the value of the current in the secondary circuit, with a corresponding increase in the efficiency of transmission.

Correspondence

A " BLIND SPOT " IN THE GULF OF MEXICO

DEAR SIR,—I notice in your July edition, on the " Questions and Answers " page, a reference to a spot in the Gulf of Mexico, twenty miles square, where long-distance communication can take place (by Radioson, Zanzibar).

I served eighteen months on a ship in the Gulf, and, as I mentioned in a letter which you were good enough to publish in your August, 1916, issue, I found a spot where I could get 1,000 miles easily with a ½-kw. set. The spot to which I refer is Tampico. I cannot say anything about the twenty miles square, but sometimes when we were a short distance out I could not get this distance. The puzzling part was, I could get east and west, but could not raise Galveston, approximately 400 miles north. Tampa Florida (about 1,000 miles east) several times told me to wait as I was jamming his working to ships in the Atlantic, and I received " time rushes " from ships in the Pacific to retransmit to Galveston (if I could). The latter station could hear but could not raise the Pacific ships.

" Atmospherics " are very bad in the Gulf at night-time, quietening down about 3 a.m. Even then it was seldom that I could not raise Tampa. Other operators who trade in the Gulf experienced the same thing. It was a matter of great discussion amongst us, but we could never come to any satisfactory reason for this phenomenon.—Yours, etc.,

F. P. MORRIS.

Digest of Wireless Literature

A Dummy Aerial for Testing.

The Electrical World notes that when electrical engineers test a dynamo machine they are not likely to disturb engineering operations in other buildings, or even in other parts of the same building. When, however, they test a radio plant of considerable power they are likely to disturb the ether for hundreds of kilometres in all directions. A need arises, therefore, for a dummy antenna, or a radio load for testing radio generators, which shall not seriously stir up and vex the ether in the vicinity. The problem is to load the generator but to suppress the output beyond a short range. This is a problem in radio inefficiency, and is just the reverse of the ordinary problem of the radio engineer, which is to load his generator as efficiently as possible, so that the effects may be manifested at a great range.

A dummy antenna is then described which consists evidently of a bed of horizontal galvanised iron wires in five layers, so arranged as to be capable of forming an air condenser of adjustably variable capacitance up to about one-thirtieth of a microfarad. With such a capacitance carrying 250 amp. at 20,000 cycles per second, the voltage, neglecting all losses, would approximate 64,000. Sixty-four kilovolts driving 250 amp. in quadrature would develop 16 megawatts of reactive power. An active power rating of 200 kw. would thus only demand a little more than 1 per cent. of dissipation factor.

* * * * * *

High Frequency Resistance of Multiple Stranded Wire.

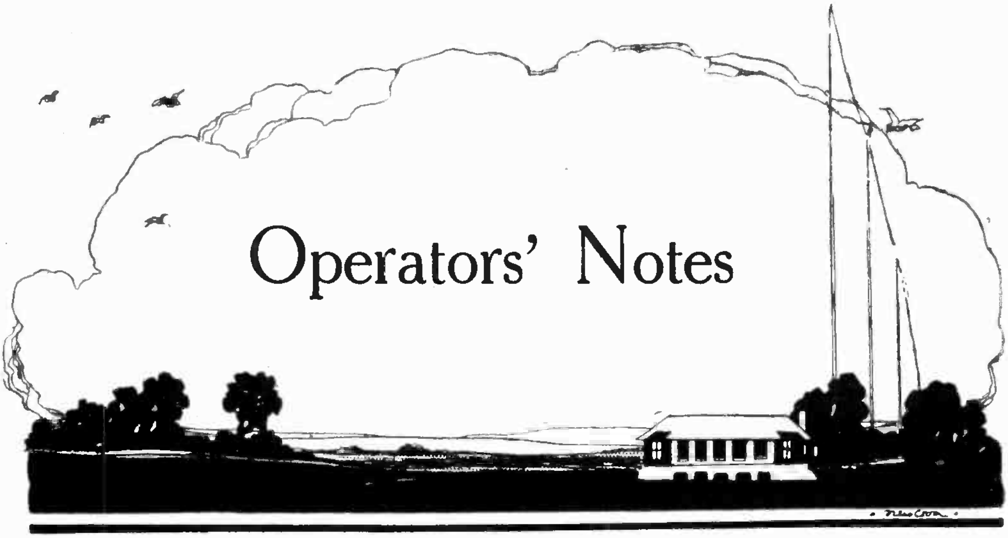
At a recent meeting of the Royal Society a paper on this subject was read by Professor G. W. O. Howe. The conductors employed in radio-telegraphy are frequently made up of a large number of fine wires separately insulated and stranded or plaited together in such a way that every wire occupies in turn the same relative position in the multiple conductor. In this way the total current is forced to distribute itself equally between all the wires, even at high frequencies. The object of this is twofold, viz., to make the inductance independent of frequency and to reduce the resistance at high frequencies. It is shown in this paper that the second object is rarely achieved because of the eddy currents induced in the wires by the magnetic flux within the conductor. It is shown that the loss due to this cause is so great that the effective resistance of the stranded conductor is, in many cases, greater than that of the solid wire which could be put in its place. In the first part of the paper formulæ were deduced on the assumption that the eddy currents in the fine wires do not appreciably affect the distribution of the magnetic flux within them.

In the second part this assumption was not made, and formulæ were deduced which took into account the screening effect of the eddy currents. It was proved, however, that the assumption is permissible in nearly all the cases considered. A number of tables were given in this paper showing the ratio of the high frequency to the continuous-current resistances of straight and coiled conductors of different sizes made up of fine wires of three alternative diameters. These formulæ and tables enable one to see at once if any advantage is to be gained by using such a stranded conductor in any given case, and, if so, the best number of wires and space factor to employ. The paper showed conclusively, however, that the extended use of such conductors in radio-telegraphy for the purpose of reducing the resistance has no scientific justification.

* * * * * *

KNOWLEDGE NECESSARY FOR RESEARCH WORK.

In an illuminating article by Mr. Raymond F. Yates in our contemporary, the *Electrical Experimenter*, the author emphasises the necessity for careful study in conjunction with experimental work. Contrary to the general opinion possessed by experimenters, it is next to impossible to enter successfully into research work without an elementary understanding of the fundamental principles of radio-communication. It is indeed a deplorable fact that 70 per cent. of the radio experimenters in the United States cannot thoroughly explain the theoretical basis of operation of one of their instruments. True, they can tell you that a variable condenser is used to tune with and to reduce "static," but the real "how" of its operation is hopelessly beyond them. These statements do not necessarily infer that to enter research work it is imperative that one be a radio expert or graduate engineer. Quite to the contrary. It is only necessary that one be familiar with elementary theory under which the various elements of radio receptors and transmitters operate. This knowledge is absolutely essential, and even then it is not necessary to go real deep at the start. It is not necessary to be able to explain in theoretical detail the unilateral conductivity of crystal rectifiers or the mathematical physics of the expanding hot-wire meter. One should be familiar, however, with inductance, capacity, resonance, damping, resistance, impedance, etc. One should know why a variable condenser will alter the wave-length by changing the capacity of the circuit; why the inductance of a tuning transformer has the same effect, and why the quenched gap has a tendency to set up sustained oscillations. It is surprising how many suggestions present themselves when a working knowledge of the various instruments is acquired. Ideas then come fast and numerous. The moral here is—study! Read every article and book you can get hold of. If you don't understand it the first time, read it again. It would probably take you several years to work out the law of $W.L.=\sqrt{L\times C}$, but by reading the up-to-date magazines on the subject and elementary books, you can learn just why, for a given wave-length, that when C is decreased, L must be increased, etc.



The Four-Stroke Oil Engine.

By W. D. LACEY.

In view of the increasing diversity of the conditions under which wireless telegraph installations are now being operated, very often in places where an electric supply is unavailable, the present-day operator may be called upon to have some knowledge of prime movers. In any case he may never know at what time, or under what circumstances such a knowledge may prove invaluable. In certain large liners one or two lifeboats are equipped with apparatus, and although a member of the ship's engine staff usually attends to the motor, circumstances might arise where the operator could render invaluable assistance. Again, on some vessels an oil engine is used to drive a generator for the purpose of providing emergency deck lights and W.T. current.

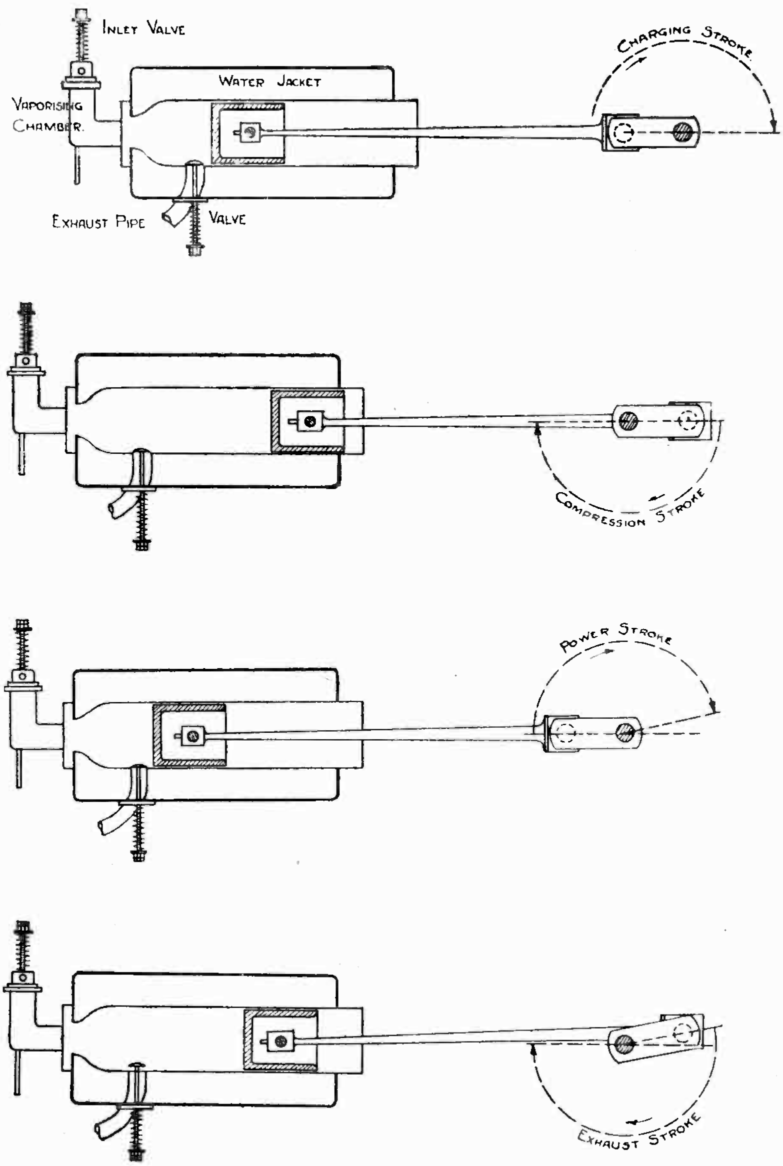
This article sets out to give the operator only a general idea of the principle of operation of an oil engine.

Most oil engines are constructed to work on petroleum, having a flash point (open test) of 100° to 130° Fahrenheit and a specific gravity of ·7 to ·8. Generally speaking engines run satisfactorily on any commercial lamp oil, sold under various trade names such as "Royal Daylight," "Whitelight," "Rocklight," etc. For any particular grade of oil in use special valve and compression adjustments must be made, and will be described in a subsequent article.

Most oil engines are constructed with the most extreme simplicity. There are only two valves in use, and usually only one of these is mechanically operated, the other being automatically worked by the creation of a vacuum in the engine cylinder during part of its working cycle.

A general idea of the operation of the engine can best be given by a description of its working cycle. (See illustration on the following page.)

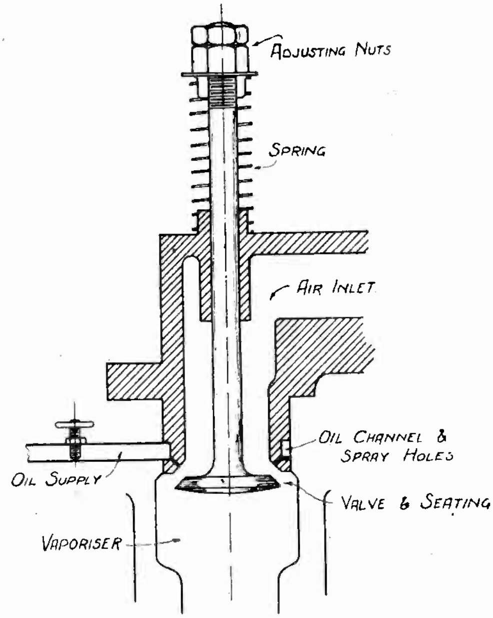
Previous to starting, a heating lamp (primus style) is used to heat a vaporising chamber. When this is sufficiently hot (5 to 8 minutes), the engine is turned so that a vacuum is created in the cylinder. This causes the atmospheric pressure



THE FOUR STROKES OF AN OIL ENGINE.

acting through a passage, to press open the inlet valve in opposition to a spring, and allowing a small quantity of oil to flow through a spray into the heated chamber.

The oil as it enters is vaporised and this vapour mixes with the air which is admitted with it. The mixture is highly explosive, and under pressure becomes more so. The next half revolution of the engine drives the piston back, thereby compressing the gas into a small space at the back of the cylinder, and into the heated chamber. If the vaporiser is correctly heated, the explosion takes place just at the moment when the piston is at the end of its stroke, and therefore drives the piston forward with great force. (Power depends upon area of back end of piston.) This is the "power stroke."



Inlet Valve Open

During the next backward stroke of piston the exhaust valve is opened mechanically by a cam, driven on a "two to one" gear, depressing a lever which in turn compresses the exhaust valve spring. The burnt up gases are forced through this valve by the backward drive of the piston, and into the air through an exhaust pipe.

From the foregoing it will be seen there are four strokes—viz., charging, compression, power and exhaust. Each of these strokes represents half a revolution, and the complete cycle two revolutions. The charging stroke automatically opens the inlet valve, and the exhaust is mechanically opened in the last half of every second revolution. Reference to diagrams will make this clear.

The valves most commonly met with are plain lifting, and are very simple in construction. Mounted on a steel stem is a flat disc of steel having a bevelled edge.

By the action of a spring this disc is held into another bevel in the valve chamber. This is called the seating, and whilst the two bevels are engaged is perfectly air-tight.

The bevelled seating of the inlet valve is pierced with four or six very fine holes communicating with the oil passage, so that each time the valve opens a spray of oil enters the vaporising chamber.

In order to prevent the speed accelerating when on a variable load a governing arrangement is necessary. The most usual governor is the mechanically operated centrifugal acting. It consists of two heavy metal spheres with inwardly projecting arms, mounted on a spindle in such a manner that their centre of gravity is at an angle of about 45° to the spindle. In rotation the centre of gravity tends to increase its angle to 90°. The projecting arms therefore move through an arc and act as levers to press against a spring; the amount of pressure depending upon the force exerted by the spheres, which again depends upon their velocity.

When this spring is compressed it moves forward a tripping piece, which engages with the exhaust valve lever and keeps the valve open. This prevents the formation of a vacuum in the cylinder, and the inlet valve does not operate, thereby depriving the engine of fuel until its speed has decreased. The decrease in speed causes the force exerted by the governor to lessen, the spring disengages the trip, and the engine resumes its normal cycle.

Owing to the great heat generated by the explosions in the cylinder, arrangements must be made for radiating it away fairly rapidly, or otherwise severe stresses will take place, and the piston block may possibly "seize," through the heat robbing the oil of its lubricating properties. The particular cooling arrangements will vary with the conditions under which the engine is being used. If in a permanent position water tanks and pipes can be used, but where space is valuable other methods must be resorted to.

In the case of small motors air cooling is used, in which case radiating flanges are fixed at right angles to the cylinder. These flanges offer a large area exposed to air, and the heat is carried off either naturally, or by a fan bowling through the spaces between the flanges. The water cooling system works upon the principle of specific gravity as explained below.

The cylinder is enclosed in a jacket to which is connected two pipes leading to and from a tank. The specific gravity of water decreases with a rise in temperature, so that if there is a complete water circuit the heated water naturally rises, and cooler water takes its place. The water in the engine jacket becomes heated by contact with the cylinder, and therefore rises through a pipe to the top of the tank, whilst cold water takes its place through the bottom pipe. Where running water is available the tank can be dispensed with.

Lubrication.—Owing to the heat generated in the cylinder the oil used to lubricate the piston must be of the best quality only, and not liable to carbonise at high temperatures. Other bearings should be well lubricated with a good quality oil. In many types of engine the supply of oil to the piston is automatically pumped through a feed, so that the correct amount reaches the piston at each stroke. The crank head, being a rapidly moving part, cannot be lubricated whilst the engine is running, so that during a long run the supply in the cup may become exhausted. To overcome this difficulty a drip feed causes oil to drop into a ring attached to the side of the crank, and by centrifugal action forces it through a channel cut into the bearing, thus maintaining a constant supply.

New Japanese Director of Communications

WE learn from the *Journal Télégraphique* that M. Kenzo Nakagawa, who until recently was Director of Communications of the Southern Region, has been nominated Director-General of Posts and Telegraphs in place of His Excellency Jiro Tanaka.

This announcement will prove interesting to wireless telegraphists in view of the fact that the supervision of radiotelegraphy lies in the hands of the Minister of Communications. The Japanese, with their usual habit of being up-to-date in everything, have paid great attention to ether-wave communication, and our readers will recall that an extremely valuable article by Dr. Wichi Torikata, the Chief Government Wireless Engineer of Japan, appeared in our April issue, pages 10–15. Only last month we printed a description of their new giant radio equipment at Funabashi, under the title of "In the Land of the Chrysanthemum."

Radiodynamics, the Wireless Control of Torpedoes and other Mechanisms

By B. F. MIESSNER

(Reviewed by Dr. J. A. FLEMING, F.R.S.)

THIS book has a rather ambitious title and one that might easily lead the uninitiated to suppose that the chief experimental problem had been effectively solved, whereas all that can truly be said is that certain promising but incomplete experiments have been made. Moreover, in his desire to make his book appear complete the author has introduced unnecessary historical matter, not always very accurate, and much sketchy and imperfectly explained descriptions of apparatus which has nothing to do with his main subject. Considering the large number of excellent books, large and small, now available on wireless telegraphy, the first 77 pages of the book under review are quite unnecessary. The writer has also a bias which leads him to attribute to American inventiveness far more than its due.

His historical account of the growth of wireless telegraphy is a remarkably unbalanced performance. He devotes many pages to the electrostatic telegraph, as he calls it, of Dolbear, and leads readers to suppose it was a practically operative system. Mr. Miessner does not appear to know that in one of the early patent suits in the United States, in which an attack was made on Senatore Marconi's fundamental patent, this Dolbear system was put forward as an anticipation. But the Dolbear experts utterly failed to get any transmission of intelligible signals over any short distance. Then, again, Tesla's vague suggestions or ideas in 1893 are treated as if they were practical inventions. After a very brief and sketchy mention of Hertzian waves and Popoff's detector for atmospheric electricity, Marconi's epoch-making work is accorded *nine lines* of mention.

Then we are treated to the astonishing statement on page 32 that Lodge and Braun introduced the Tesla high-frequency transformer for coupled circuits in place of the direct spark-excited antenna of Marconi. Has Mr. Miessner ever heard of Senatore Marconi's British patent No. 7777 of 1900? Does he or does he not know that after extensive litigation this patent, and its United States equivalent, was upheld in the Courts as the master patent controlling all so-called coupled transmitters and syntonised transmitters and receivers? Mr. Miessner would do better to leave the historical treatment of wireless telegraphy to those who know something about the subject.

The first 70 pages of his book contain also much imperfectly explained matter which is therefore of little use to the reader. For example, pp. 36-39 are nearly filled with four process blocks illustrating Fessenden's appliances for sound signalling, but there is not a single word of lucid explanation to show any reader how it is done or what is its practical value. Two short chapters are given to infra-red rays and to ultra-violet rays, but the reader will find that the author flits rapidly from one topic to another without much careful or consecutive treatment.

Even when we arrive in Chapter IX., p. 77, at the main subject of the book, there is a great deficiency of clear explanation, the absence of which cannot be compensated by a liberal display of process blocks. We have, for instance, no explanation of the details of Tesla's Hertzian wave directed boat, said by the author to have been patented by Tesla in the U.S.A. in 1898.

In Chapter XIII., p. 92, we begin to get into more satisfactory contact with the subject, beginning with the early attempts made in England and in Germany to control motor boats by Hertzian waves from a distance, and in Chapter XIV. we are presented with an account of the work done in this direction by the author in the radio laboratory of Mr. John Hay Hammond, Jnr., at Gloucester, Mass., U.S.A. This and the following five chapters really cover the valuable and interesting part of the book, because it gives us the results of actual experiments.

Without going into minute details it may be said that the problem involved is that of starting and stopping mechanism placed on board a boat which shall steer the boat as required and start, stop, or change her speed. The power necessary for this control is generally drawn from storage cells on the boat, and the Hertzian waves are employed merely to operate relays which shall close certain circuits as desired. The boat must therefore carry one or more antenna wires, and the currents set up in these must affect detectors and these again must move relays. The earliest experiments involved the use of the coherer as a detector, because by its means it is easy to operate a relay. Nevertheless, the capricious behaviour of even the best coherers renders them unreliable for this work.

On the other hand, more certain detectors, such as the valve or crystal detectors, pass so little current that they cannot be used with many types of relay possible on board a motor boat. The author appears to have found the Lodge Robinson and Muirhead steel wheel in mercury auto-coherer a useful appliance. In any case we have to design arrangements which shall enable a wave detector to actuate relays so as to set in motion machinery which will throw over the helm to port, starboard or straight as required, and, if need be, start and stop the machinery driving the screw propeller.

One difficulty is that of finding a suitably sensitive relay which can operate in a motor boat. Mr. Miessner seems to have employed a modified form of Weston ammeter. Even when the necessary mechanism for steering has been elaborated there still remains the difficulty of making the Hertzian wave receiver proof against deliberate attempts of the enemy to mis-steer the boat by sending out jamming waves. The problem of interference prevention is dealt with in Chapter XIX., and the reader who is also a radio-telegraphist will recognise the difficulties of the problem.

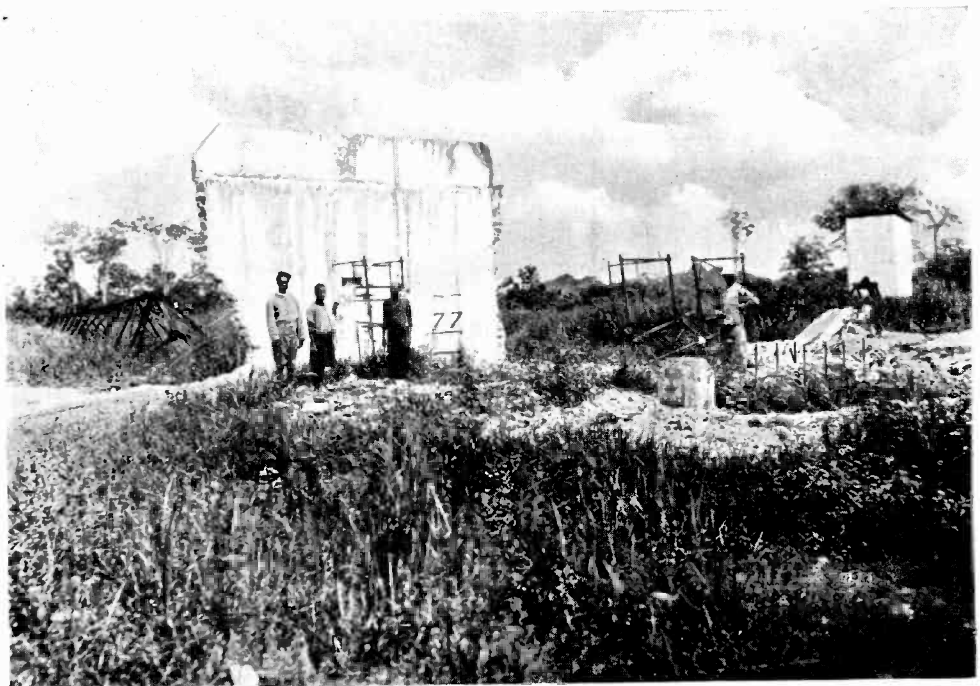
Although much successful experimenting has been done it can hardly be said that the Hertzian wave controlled torpedo is at present a practical weapon of war. The interest and importance of these experiments at the present time is very great, and doubtless ingenuity will continue to be expended upon the problem, but it will be like the battle of the armour and the guns, each step in advance in connection with the Hertzian wave guided torpedo will be met by fresh ingenuity in upsetting the control of the boat on the side of the attacked party. The book under review concludes with a short chapter on the "electric dog," a perambulating mechanism which is guided by a beam of light thrown on two artificial eyes, the sensitive organ of which is a selenium cell. The author thinks that sound waves can be made to act in the same manner as a directing agent. The utmost that can be said is that there are possibilities in the idea.

Taken as a whole this book contains, however, much interesting matter which may serve as a guide to those who are experimenting in the same direction.

In any future edition the author would, however, be well advised to take for granted that his readers are acquainted with the simple facts of radiotelegraphy and Hertzian wave phenomena and utilise the space so gained for more complete descriptions of actual experiments in guiding distant machinery by electromagnetic radiation.

Also, he should steer clear of historical matter until he has bestowed a good deal more attention to the history of wireless development than he has done. His remarks on vacuum detectors or thermionic detectors, as they should be called, need revision in the light of the decision of Judge Mayer and of the U.S. Court of Appeals in the case of the Marconi Wireless Telegraph Company of America *v.* de Forest Radio Telephone and Telegraph Company on the valve action. The names of Prof. E. Branly and of Prof. Elihu Thomson are misspelt on pp. 105 and 168 respectively.

A Hun Relic in Africa



[*French Official Photo*

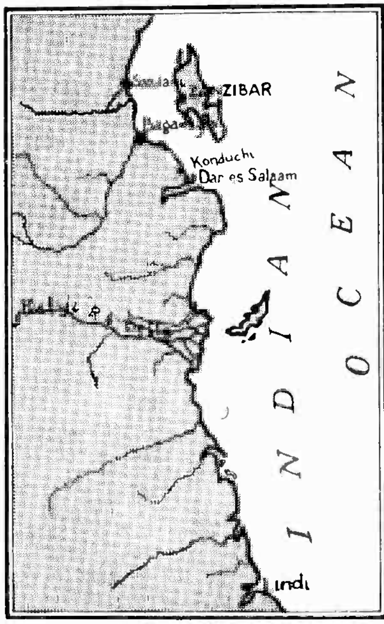
The above photograph and its companion picture on page 346 show all that now remains of the German Wireless Station in Duala, which was destroyed on September 29th, 1914. *For the story and further pictures see* WIRELESS WORLD, *Volume III., pages 92 to 95.*

Wireless Telegraphy In the War

WIRELESS IN COMBINED OPERATIONS.

THERE is one kind of fighting operation in which the British have shone for many centuries. This variety consists of the combined naval and military expedition. A Supplement to the *London Gazette* issued on Friday, June 15th, includes a despatch from the Commander-in-Chief, Cape of Good Hope Station, addressed to the Admiralty, Whitehall. It comprises, couched in official verbiage, as vivid a sketch of a combined naval and military expedition as any which has occurred in British history. All this is strictly in accord with tradition. We read here of men belonging to all arms and grades who have displayed the gallantry of their forebears; we have our enthusiasm stirred by the individual initiative of the officers, a quality which seems inherent in the British race from their schoolboy days, and we see instance after instance of the "good luck" which so frequently attends such a combination of individual initiative and gallantry. The narrative demonstrates in every line that the national psychology of to-day embraces the same characteristics as it did in the "Spacious times of good Queen Bess" or the glorious epoch of Nelson and his contemporaries. There is one outstanding item of novelty about it all, and that new feature consists of the introduction into the scene of wireless telegraphy. I have used the phrase "introduction "into the scene," but we might almost go so far as to say that the part played by radio-telegraphy was that of *Deus ex machina* rather than any subordinate rôle. Let the story speak for itself.

It was judged necessary during the recent British operations against the Germans in East Africa that the important town of Dar-es-Salaam should be occupied. Our Teutonic foes, well aware of the importance of this centre, had lavished such elaborate preparations that the officers commanding the British Expeditionary Forces judged a direct assault likely to prove too expensive. The supreme commander therefore directed his chief naval subordinate to occupy the town of Saadani with forces drawn from the fleet, assisted by a detachment of the Zanzibar African Rifles. In pursuance of these instructions detachments were landed about a mile to the north of the town, the landing being covered with the guns of the men-of-war. After a short sharp tussle the position was won and Saadani occupied. The next step was to make an assault upon the enemy force at Bagamoyo, a town held—according to the account rendered to the British commander—by about ten Germans and forty Askaris. Rear-Admiral Charlton undertook the task, landed his men, and found " the intelligence very much at fault, the enemy was in possession of one " 4·1 inch gun, one five barrel pom-pom and two " maxims, their total force being more numerous " than my landing party." The awkward situation, brought about by the inaccurate intelligence supplied, was met with the resourcefulness characteristic of British naval officers. Their skilful arrangements neutralised the advantages possessed by the Teutonic foe to such effect that his big gun was rendered useless and his pom-pom raked by a cannonade from the sea, whilst " the enemy was completely " deceived as to the point of landing." Finally, the position was stormed in the face of superior numbers and heavier armament. The official comment of the gallant officer commanding speaks for itself: " Its capture was, in my " opinion, a most remarkable piece of work, " reflecting the greatest credit on the boats and " the attacking section." The retirement of the discomfited foe was advised simultaneously by wireless telegraphy from three quarters: (*a*) from a party manipulating a kite balloon, (*b*) from a portable wireless set ashore, and (*c*) from the aerials of a scouting seaplane.



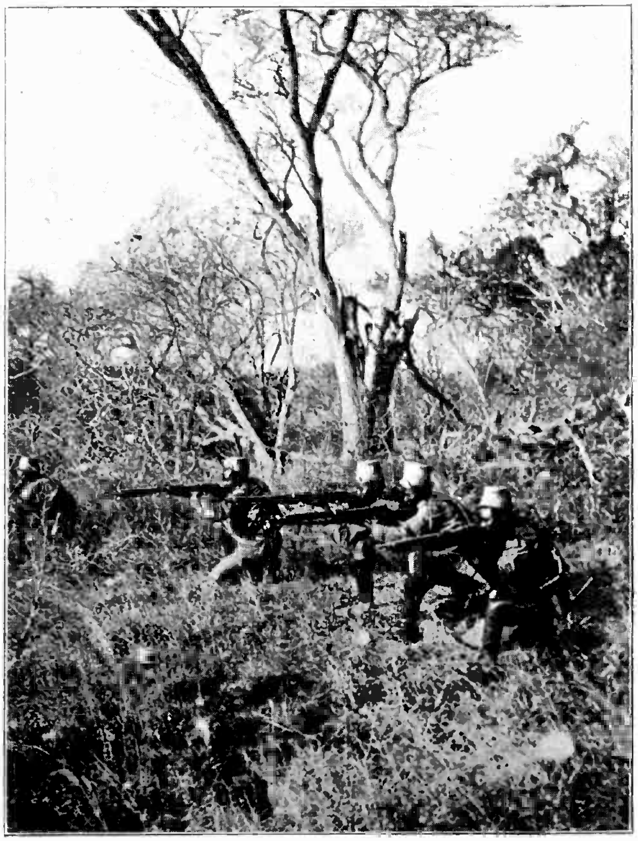
The moral effect on the native mind of the capture of Bagamoyo was most salutary, and its result, from a military point of view, became immediately apparent. A strong fortified position, which previously had blockaded the road for the British troops moving south from Saadani and Mandera, was evacuated, and the way opened for the forces advancing from the landward side.

Meantime preparations for the advance on Dar-es-Salaam were in full swing. Bagamoyo was chosen as the base of operations, the main body marching south and being strongly reinforced at Konduchi. Here, again, wireless telegraphy played the part of the directing agency, communication between the main column and the small craft inshore being maintained through the aerials of a naval wireless section. A fresh feint from the sea distracted the attention of their opponents and facilitated the advance of the real attack from the land side. Matters then appeared ripe for a demand upon the enemy to surrender, and accordingly H.M.S. *Challenger*, flying a white flag, proceeded to Makatumbe with a written summons jointly signed by the officers commanding the naval and military forces. The result may be summarised in the Commodore's own words:

" About 8.0 a.m. the deputy burgomaster, the bank manager, and an inter- " preter came off in the *Echo* and agreed to the conditions of the demand, giving all " the required guarantees. Our troops were at once told by wireless to advance into

" the town. All ships entered Dar-es-Salaam Bay, and during the afternoon the " monitors steamed into the harbour after destroying the hawsers of the boom across " the entrance. I landed with my staff at 2.30 p.m., and at 3 o'clock the Union " Jack was hoisted over the Magistracy with full honours."

The value of the moral effect produced by these skilful operations was apparent as soon as it was thought advisable to occupy the other seaboard towns further south. In every case the resistance offered was found to be much less strenuous than before, and indeed in many instances the enemy showed a desire to haul down his colours at the first reasonable opportunity. One town after another fell before us; and even where, as at Lindi, no answer could be obtained through the flag of truce sent in, no serious resistance was offered. Thus every post of any importance on the seaboard of German East Africa was occupied by means of joint naval and military expeditions, with the result that the whole coast line is at present occupied with the trifling exception of the Rufiji Delta.



[*Photopress.*

BRITISH ADVANCED GUARD ENGAGING ENEMY PATROLS IN THE BUSH COUNTRY OF EX-GERMAN EAST AFRICA.

Such is the story told by Admiral E. Charlton's despatch. Every gallant exploit detailed therein is strictly in accordance with British tradition, with the solitary innovation of the part played by radio-telegraphy. The fact that the list of officers and men " named " in despatches " includes a number belonging to this new branch of his Majesty's fighting forces is a matter of special gratification. As Englishmen we salute the gallantry of our fellow citizens, and as wireless enthusiasts we offer special tribute to the gallant fellows who utilised the new science in the good old British way!

Wrecked in the South Pacific

Some Curious Experiences of a Wireless Operator

THE sunshine in these Southern Seas would be oppressive were it not for the sea breeze. I had just come off my wireless watch and was leaning back in my deck chair, letting my eyes, wearied with the glare of the white decks, seek refuge in the deep blue of the sky. The clang of chains and derricks, and the shouting of officers and crew as they worked the cargo of the ship, mingled not altogether discordantly with the roar of the surf upon the reefs, which render the coasts of these islands so dangerous for navigation.

We were on board the good ship *Maitai*, a fine vessel of 3,393 tons, belonging to the Union Steamship Company of New Zealand, and, after an agreeable but uneventful voyage from New Zealand, found ourselves spending the Christmastide of 1916 at rest, just outside the Coral Reef of Raratonga, the principal island in the Hervey Archipelago, more commonly known as the Cook Islands.

The heavy ocean swell was causing the ship to roll heavily with an uneasy motion ; but I had long ago ceased to be troubled by eccentricities of maritime movement, and its effect was rather to intensify the semi-somnolent condition of my mind and to draw my attention away from my immediate surroundings. My mind was occupied with day-dreams about the brown Polynesian natives of days long since gone by ; and just as I was in the crisis of a scene wherein I played the part of a solitary white man in the midst of an assembly of swarthy savages, I was suddenly recalled to earth by a violent jerk which almost precipitated me from my chair. The cable, by which the *Maitai* was anchored, had parted. I rushed to the side of the ship and saw that we were drifting rapidly across the few hundred feet which separated us from the reef. Captain and crew were busy endeavouring to get steering way upon the vessel ; but—ere this could be effected—we found ourselves grinding into the coral where each succeeding swell, as it lifted our ocean home, lurched her further on to the bar. Sunset found us still in this uncomfortable predicament, and all night long the engines were kept working hard in the endeavour to force her back into deep water, but all in vain. I received orders to get into wireless communication with the French Radio Station at Papeete in Tahiti, about 600 miles away. I had many " worries " to contend with. In these South-Sea regions atmospherics are liable to be very severe, rendering the signals extremely hard to read ; whilst—to add to my troubles—the distracting noise caused by the engines and winches of the ship, combined with the harsh grinding of her keel upon the reef, made my task one of unusual difficulty. I got into wireless touch, however, and sufficient " traffic " passed between myself and the land station to enable me to place them *au courant* with our situation and to reassure them as to the safety of our passengers and mails; whilst they on their part communicated through our aerials the welcome intelligence that they were making prompt arrangements for the despatch of a relief steamer and for the institution of salvage operations.

THE "MAITAI" AGROUND ON THE REEF WITH RARATONGO NATIVES IN THE SURF.

Thus it was that I passed the Yuletide night. In the course of the morning of Boxing Day the water "made" by the ship mounted so high that it was found necessary to "draw" the fires, with the result that no more power was available for the running of my main transmitting apparatus, and I should have been completely shut down, had it not been for the Marconi system whereby I was provided with emergency gear. In the course of the afternoon all the officers and crew, myself included, were sent ashore. Not long, however, after these precautionary measures had been taken, the swell decreased and salvage work started in real earnest. The receiving side of my Marconi set was left on board and although it was unnecessary for day duty to be maintained, a watch was kept for a few hours every night, in order to receive the Press messages, which were being regularly sent out from one of the New Zealand coast stations. A boat's crew of natives was told off to take myself and my brother operator out to the stranded vessel every night for the purpose of this Press duty, and these "boys" would "stand by" all the time we were on board, waiting for the hour when we were due ashore again. In common with the other native islanders of these parts, the Raratonga boatmen manipulate these small surf craft extremely skilfully, and it is a point of honour amongst them not to leave a white man "in the soup" whenever through any accident the boat is capsized on its way through the troubled waters. Before New Year's Day an eleven thousand tonner belonging to the New Zealand Shipping Company, the s.s. *Rotorua*, warned of our predicament through the wireless messages exchanged between myself and the Papeete station, had arrived, and on January 1st, 1916, the passengers and a large part of our crew proceeded in her to Auckland, the most important city in the North Island of New Zealand.

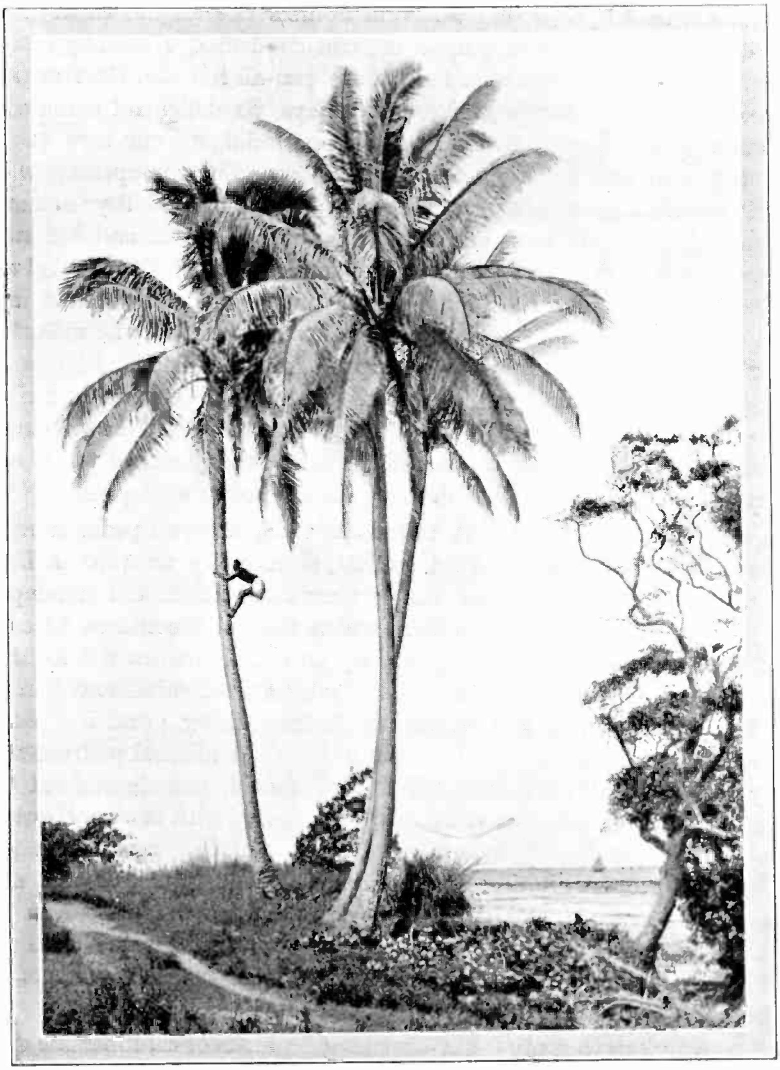


Photo: "Exclusive"

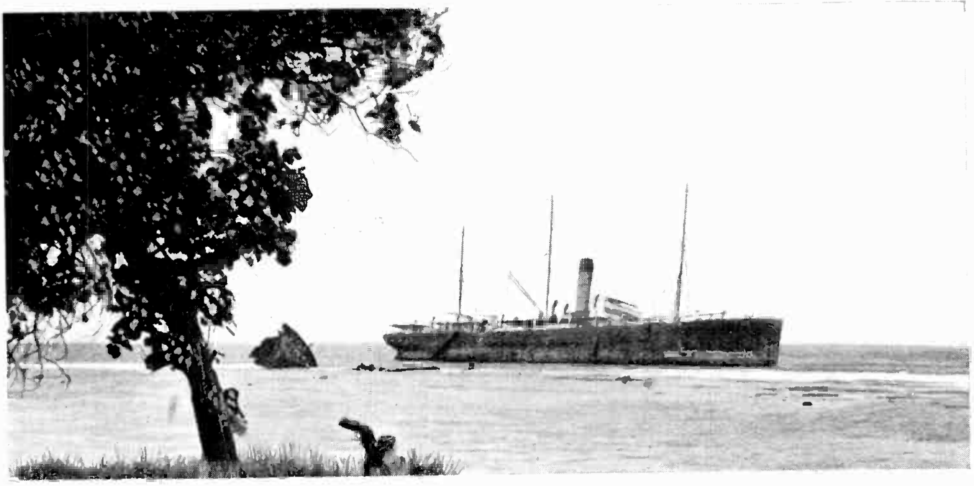
A NATIVE CLIMBING AFTER COCOANUTS.

Meanwhile the officers and sailors of the *Maitai* remained behind, in order to direct the salvage of the cargo, the greater part of which was being carried out by native labour. The work was not strenuous, and we enjoyed many opportunities, during the weeks that we were engaged upon it, for picnics and shore excursions. In fact I think it may be said that we availed ourselves with the utmost zest of the chances which fate had bestowed upon us, and conducted a thorough exploration of the little island. Most of us were fond of an open-air life, and Raratonga, with its mountainous heights, its fertile plains and valleys, its delightful climate and soft though bracing air, afforded us every chance of indulging our bent to the full. It is not often that one has the opportunity of spending the opening weeks of a New Year in swimming, canoeing, climbing hills and exploring valleys in a sun-kissed island within whose fertile areas cocoanut trees, orange groves and banana plantations are to be met with at every turn. The staple exports of the island are copra and fruit. The former consists of the kernel of the cocoanut broken into small pieces and dried in the sand. It is the staple raw material for the manufacture of cocoanut oil, and the quantity which is shipped from the Pacific Islands forms an important proportion of the world's supply. During our stay we had a practical illustration of the attractions of "lotus-eating" life; for the "unwritten law" of the islanders is much the same as that in force at Sunday-school treats at home: "Eat as much as you like here, but do not take any away with you."

Great Britain annexed the Cook Islands in 1888, and two years later included them in the Dominion of New Zealand, so that, in actuality we were on British soil all the time. Nevertheless, the natives enjoy a considerable amount of independence, and are organised under their own chiefs, whom they still continue to call kings. One of my "red letter" days was marked by an occasion when the royal dancers of Raratonga gave us an exhibition of their saltatory exercises and "hulshulas." These consist of the posturing so much in favour among primitive people, and mimetic representations of scenes of love and war; the musical instruments which accompany the performers consisting of drums, made from hollowed-out logs, and empty biscuit tins. The white residents and natives vied with one another in getting up picnics for our benefit. Those provided by our native entertainers possessed the peculiar interest of titillating our palates with food, prepared and served in native fashion. A special and distinctive feature thereof consisted in the fact that the dishes were cooked in holes made in the ground, and were served on leaves instead of plates. No forks and very few knives were supplied—fingers were the order of the day!

I need scarcely say that my "day-dreaming" visions of cannibalistic aborigines were "very much out of date." Although originally addicted to these practices, the natives are now universally as good Christians as the folk at home, and march to Church regularly on Sundays "in full rig." The women bedeck themselves in silks and satins, resplendent with all the colours of the rainbow; whilst the men set off their swarthy skins by clothing themselves in clean white drill suits.

A well-kept road runs right round the island, and at intervals of every four or five miles is fringed with native villages. The villagers construct their houses from coral rock, and these dwellings, white-washed and tidy, contrast yet harmonise most



THE WRECK OF THE "MAITAI" AS VIEWED FROM THE SHORE.

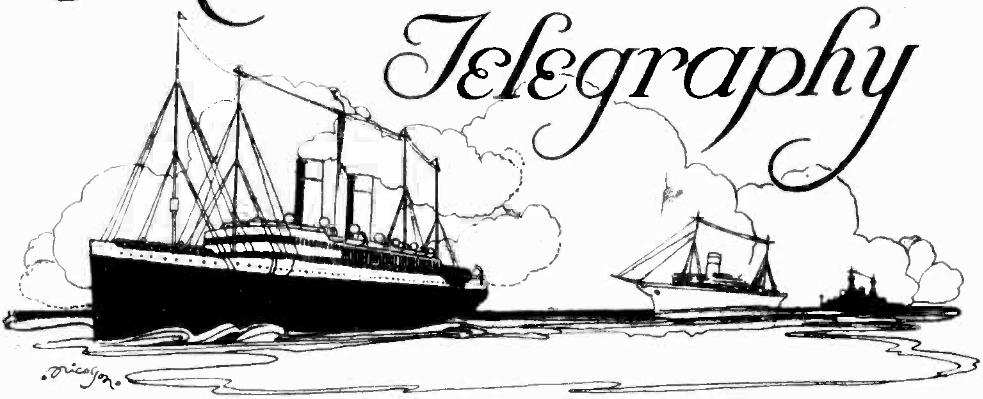
pleasingly with the palms and other tropical verdure. Some of them are surrounded by family tombs, and the relicts have a curious habit of placing mirrors upon them; apparently to serve much the same purpose as our tombstones at home. I was on many occasions the witness of a quaint and interesting form of sport in which the natives take great delight—the chase and capture of flying-fish in the hours of darkness. The fishermen go out, provided with huge torches to attract their quarry, and a man armed with a net, fastened to the end of a pole, stands at each end of the boat, deftly inmeshing the fish as they whiz out of the water towards the light.

Before leaving the island whereon we spent so many pleasant hours, each of us was presented with strings of beautiful native beads, manufactured from small shells and bright-coloured seeds. These necklaces form highly valued additions to my little collection of curios, as well as mementoes of one of the pleasantest and strangest New Year times I have ever spent. It is a curious experience to be able to say that one has thoroughly enjoyed being wrecked. Yet circumstances combined to make it so in my case; the disaster occurred on one of the most beautiful islands in the Southern Pacific, and there was not a single mischance to mar the feeling of beatitude; for no lives were lost and nearly all the cargo salvaged. A feeling of regret was uppermost in the thoughts of all of us as we looked back at our last glimpse of Raratonga—a tall blue peak capped with white clouds, which, as we steamed away, faded gradually away into the blue of the Pacific.

New Long-Distance Record Claim.

According to Royden Thomberg and Clio Bowers, operators of the American steamer *Sonoma*, wireless messages were picked up over the record distance of 11,500 miles by the *Sonoma* from the German station at Eilvese. The *Sonoma* was two days off Australia at the time.

Maritime Wireless Telegraphy



Navigation in the Ocean of Air.

We have many times during the last twelve months or so insisted upon the close connection between aircraft and wireless, and this interdependence of the two most modern developments of industrial activity again forced its way to the front in the recent important address delivered by Lord Montagu of Beaulieu before the Aeronautic Society of Great Britain. The rôle of wireless, of ever-increasing importance in the operations of ships at sea, when we come to the systematic navigation of air, assumes a character of essentiality. The sea, at all events, has its islands, its capes, its mountain heights, and similar *points d'appui*, for communication with vessels engaged in voyaging. The air has none of these. The only way in which (except at extremely low altitudes) aircraft navigators on a voyage through the atmosphere keep in touch with their fellows is through the medium of ether waves. We have long suspected, and recent information has tended to confirm our opinion, that the Zeppelin invaders when they visit our aerial territories would be ignorant of their course and location, if it were not for the directions conveyed to them by wireless from their home stations.

Lord Montagu addressed the Aeronautical Society as a practical man, versed in matters of aviation, dealing not with any flight of fancy, but treating of developments so near our experience that even the prosaic government of a prosaic people has appointed a commission to consider them. The lecturer does not consider that "continuous flying by night and day will be practical or popular for many years to "come," but bases his calculations on two periods of day-flights averaging 600 miles each, or ten hours in all. He looks forward to the establishment of fixed "lanes," or zones of flight, with specific altitudes allotted to certain types of traffic, varying from that of 2,000 to 4,000 ft. for commercial vehicles, with a speed under 80 miles an hour to one of 4,000-6,000 ft. allotted to "fast" traffic, running at a rate of 80-120 miles per hour; whilst, above these altitudes, the airways would be left free for official and "express" planes, running light. Lord Montagu suggests that the area between the earth surface and 2,000 ft. should be left free for the passage of private craft, and that over 10,000 ft. the air should be internationalised.

Such systematised flying involves many organic arrangements, such as the establishment of air police, a system of lighthouses for air pilots, traffic control centres, etc., and the whole plexus hangs upon radiotelegraphy. Police control will depend on wireless. The aid of wireless will be invoked for enabling pilots to discover the direction of other bodies in motion, and the same medium would have to be employed by airmen desirous of asking leave from officials in charge of control stations to quit or vary the altitudes and routes specially assigned.

The great " twin brethren " of Modern Industry will, in conjunction, solve the great problem which has been agitating British imperial statesmen for many a long year. The outlying parts of the empire will by their magic agency be brought into close touch with their centre, this " tight little island," and with each other. The great civilising power of the Romans centred round their matchless system of roads and posts ; that of the British Empire will centre round their air services and radiotelegraphic chain. There is but one necessary condition to be fulfilled :—

" If England to itself doth rest but true."

* * * * * *

MUTINY BY WIRELESS

When we read the story of the mutiny which recently took place on the Russian Black Sea Fleet we can hardly fail to be struck with the sentence which tells us that " Wireless messages were despatched by the mutineers to the crews of all the warships " to disarm their officers, whereupon to avoid bloodshed Admiral Koltchak wirelessed " to the officers not to resist."

The mental picture called up by such a statement is vivid but incomplete. Although wireless is impersonal enough, heaven knows ! it nevertheless requires human agency to set it at work, and we wonder whether the same radiotelegraphists sent the messages of the mutineers and the messages of the officers against whom the former were going " on strike." If the answer be affirmative, as would seem likely from the conditions on board so far as we can realise them, the incident would point to the tempering of official disagreement by personal good feeling. Yet, on the other hand, reading between the lines, we can see that the episode was marked by some feelings of personal irritation, because the admiral, when requested to surrender his sword, is said to have replied by throwing it into the sea. At this point we note the intrusion of the " personal equation," for the gallant commander had been returned by the Japanese the actual weapon which he was wearing at the time when the Russians were forced to capitulate at Port Arthur, and he treasured it as a tribute of gallantry from a gallant foe. To the men the weapon typified his authority over them, and it was as such that they demanded its surrender ; to the admiral it stood as a memento of past duty bravely executed.

A large number of people in this country have been very much " exercised " in these latter days by the various ebullitions of the intoxication of Russian freedom. But we wonder whether our worthy pessimists quite realise the conditions from which these men have just freed themselves. We hear much about the relaxation of " discipline," but discipline, as it is understood by a free people, has never existed in

A RECENT PORTRAIT OF HIS MAJESTY.

ON BOARD A BRITISH VESSEL OF WAR. HE IS ACCOMPANIED BY SIR DAVID BEATTY, WHO, AS ADMIRAL IN SUPREME COMMAND AT SEA, IS PERHAPS THE LARGEST USER OF WIRELESS IN THE WORLD.

Russia. There the officers, sprung from the aristocratic class, looked upon themselves as belonging to a different order of being, and discipline, as they understood it, meant, not the subordination necessary for organised action in pursuit of a settled purpose, but absolute slavery of the rank and file to their chiefs. Of course, circumstances here and there operated to mitigate this régime of slavery. When an ignoramus is in charge of technically skilled men he is unable to exercise the overbearing attitude which he would in other cases assume as a matter of course. The extent of the ignorance displayed by Russian officers of the *ancien régime* seems almost incredible. We have heard, for instance, of a man in charge of several military wireless stations so ignorant of his business that when his subordinates have, by way of protest against tyrannical conduct, taken the crystal out of their set of apparatus, he has been unable to detect it. At sea, under the conditions inseparable from modern warships, a large proportion of the petty officers and crew must be men of technical acquirements, and it is small wonder that, when such men find themselves in a position to resent tyranny or incompetence, they should avail themselves of their opportunity.

A very short while after the mutiny at the Nore in 1797 the British Fleet attained its highest degree of efficiency, and there is no reason to view these Russian incidents of revolution with a despairing eye, especially when we come to realise that lack of desire to reap vengeance for supposed, or even for real injuries, which has on the whole hitherto appeared to be a marked feature of the Russian revolution.

Mesopotamian Misrepresentations

Some Reflections on the Commissioners' Sensational Report

WE should have to go back to the Crimean letters of W. H. Russell, the famous *Times* correspondent, to find reports capable of stirring the public mind so deeply as that of the Mesopotamian Commissioners. The points specially connected with radio-telegraphy, though few, are intimately interwoven with the essentialities of the Report, and deserve some special mention.

Disregard for truth in public matters on the part of men honourable in their private dealing appears to have been rampant throughout. It is a curious and discreditable phase of Official psychology. The British public learns for the first time the severity of the losses incurred all through February and March, 1916, whilst instance after instance is given by the Commissioners wherein the responsible officials resorted to both the *suppressio veri* and the *suggestio falsi*. Nothing in an Official Report could be more scathing than paragraph 57 of Part X., which runs :—

> There are two methods of concealing a failure. The first is to suppress all mention of it. The second is to obscure its significance by the glare of a contemporaneous achievement. The first method was, as we have seen, used at the first battle of Kut. It was the second method which obtained after the battle of Ctesiphon when the military success of withdrawing all the wounded in the face of a pursuing enemy diverted attention from the grave medical defects which were disclosed in the course of that operation.

The policy of deceit almost attained the dignity of a conspiracy, carried through by the highest officials, and presided over by a Commander-in-Chief who threatened a conscientious subordinate with dismissal and ruin if he failed to " toe the line " ! The disgraceful episode of hospital barges, whose horrors put to shame those of the " Black Hole of Calcutta " was officially reported as " wounded satisfactorily " disposed of " !

Wireless equipment forms one of the most important items of *matériel* in the organisation of a mobile army. Aeroplanes are the eyes of the army, and radio-telegraphy its ears. Unprovided with a sufficiency of these two essentials, Samson is not only blind ; but deaf. " Early in the Mesopotamian Expedition the need for " aeroplanes was apparent " says the report. India, which was supposed to be managing the expedition, had none to send, and the army had to go without any at all until May 1915, and it was October before four of the B.E.2 C. type arrived.

> But there were many misfortunes . . . the upshot was that at the battle of Ctesiphon there were only reckoned to be five of the R.F.C. aeroplanes in Mesopotamia, and of these only three seem to have been actually available at the battle.

This would appear to be an extremely exiguous supply for a campaigning force of the magnitude then employed, and which was opposed by a thoroughly well-equipped Turkish Army, who had received from Germany a number of new " Fokkers " of the most recent type. Moreover, none of the British machines, so say the Commissioners, were fitted either for photography or wireless apparatus. Now, when General Botha captured German aeroplanes in South Africa he found them to be supplied with radio-telegraphic plant: and these machines must have been sent out by Germany before the war started, for the British Fleet left them no means of getting such machinery through later. The heart-breaking nature of an aeroplane observer's work, when he is operating without wireless, is obvious to the meanest intelligence. At the beginning of this year the Press was allowed to publish an account from a correspondent in Mesopotamia in which he detailed the sense of "lost opportunities" as described by a flying-man on an unfitted plane in an important engagement. This account will be found in the WIRELESS WORLD for February, page 842 of volume IV.

A very significant heading is placed by the Commissioners above Section D of Part XI. That heading runs:—"Atmosphere of economy up to date of war and "effect upon military preparations in India." To this deliberate and long-continued policy of false economy the Commisioners trace the origin of the evil. The Russian menace, of which so much was made twenty years before the close of the nineteenth century, had passed away, and the Financial Member of the Viceroy's Council argued that the Indian Army would only be required for frontier warfare against uncivilised tribes. Had he insisted on cutting down the number of the forces and supplied sufficient of the "sinews of war" to maintain the residue at the requisite standard of efficiency, his policy might have been defensible. To leave the force as it was, and economise by such cheese-paring as to render it inefficient, was not the action of a conscientious British official but of an opportunist. Matters were carried so far that a British officer officially reported to the Commissioners that it was commonly understood in the services that "keeping down expenditure "is more meritorious than efficiency" and that "Nothing new is likely to be "sanctioned unless a corresponding sanction in something else can be shown." The result was demonstrated by many witnesses, and by none more forcibly than by Sir O'Moore Creagh, Commander-in-Chief in India, for the four and a half years which ended in April, 1914! We read in the Report:

> He was constantly calling attention to the deficiencies of the Indian Army as regards modern equipment, especially in connection with machine guns, heavy howitzers, signalling apparatus, wireless and air equipment, transport and medical complements.

The supplementary statement issued from the pen of Commander Josiah C. Wedgwood, D.S.O., M.P., is naturally tinctured with his own peculiar views. But it is extremely interesting in so far as it emphasises several of the points made by the Majority Report. Commander Wedgwood asks whether "Mid-Victorian "manœuvres carried on without such modern accessories of warfare as mechanical "transport, air-park, wireless telegraphy, etc., are likely to be of much help as "training?"

Official prevarication and disloyal financial administration must conjointly share the blame, and no consideration or influence should avail to save their leading exponents from exemplary punishment.

Notes of the Month

Sensational Fiction Out-Thrilled.

We have heard a good deal during the last few weeks of "Flaming June," and the month was certainly characterised by the publication in our newspapers of stories which for thrill can give points to any fiction. One story which reaches us from Italy contains within its compass the whole range of sensation-apparatus figuring in the armoury of the expert specialist. We have: first a concealed safe stuffed with secret documents of the highest political importance and surrounded with all the trappings of melodrama. It was located in a dwelling-house, ostensibly private, but really surreptitiously connected with the Austrian Embassy; it was protected by a fiendishly ingenious device for overwhelming with poison-gas any bold burglar who might attempt to rifle it; whilst—simultaneously with the asphyxiation of all intruders—an alarum would resound and summon forces capable of dealing with any number of intruders. Then, still according to the most approved manner of detective fiction, the scene shifts to another country. Two notorious experts in crime are seen languishing in an Italian prison. They are sent for by the chief of the secret police, a bargain is struck, and they break out of gaol. Setting at nought all the Austrian precautions, they laugh at asphyxiating gas, and rifle the safe.

Now comes the turn of wireless telegraphy! The Austrian Government, not contented with permitting the announcement of a successful burglary to be given out to the Press through the usual channels, radiate from their aerials a statement that "a large sum of money had been purloined." Why was radio-telegraphy brought into the matter? The reader is kept in artistic suspense, until he learns that an important Vatican official, Monsignor Rudolph von Gerlach, Master of the Papal Wardrobe, has fled from Rome and managed to cross the Swiss border before the Italian authorities could arrest him. The ransacking of his house, and the investigation of the documents found there, reveal the startling fact that Monsignor was the head of a far-reaching Austrian spy system, outrivalling that of the notorious von Papen, and that the apparently innocent wireless message was really a warning to him in code that "all was lost." A treason trial is held *in camera*; and, at the end of June, the erstwhile proud and powerful Roman Prelate is condemned to penal servitude for life, whilst a number of his accomplices receive similar exemplary sentences.

A story so complete in every detail lays itself open to suspicion by its very completeness; but so far as we have been able, at present, to verify the particulars it would seem to be in accordance with actual fact. The only item of doubt appears to be the location of the original well-guarded receptacle to which was entrusted the custody of the " key to the situation.' 'According to the original story it was placed in a house in Vienna, adjoining the German Consulate ; but there is reason to believe that its true location was a city in a neutral country—to wit, Zurich, in Switzerland —and that the adjoining Embassy was Austrian, not German.

THE SEVENTH WONDER.

To the number " Seven " was assigned in ancient days the character of completeness. We find, for instance, that there were Seven Champions of Christendom, Seven Stages of Heaven, and we read in Shakespeare of the Seven Ages of Man. To this feeling with regard to the attributes possessed by the numeral is due the fact that we have seven days in the week. In the course of a lecture delivered at Burlington House, towards the middle of June, Dr. Wm. Martin reminded his audience of those outstanding examples of man's achievements, which were regarded by our forefathers as the Seven Wonders of the Ancient World. They comprise the Pyramids of Egypt, the Hanging (*i.e.*, terraced) Gardens of Babylon, the Temple of Diana at Ephesus, Phidias's Statue of Jupiter at Athens, the Mausoleum at Halicarnassus, the Colossus at Rhodes and the Pharos (lighthouse) at Alexandria. Dr. Martin asks what can the modern world show to compete therewith ? The answer given was seven new wonders : Wireless telegraphy, the telephone, the aeroplane, radium, the pharmacopœia of antiseptics and antitoxins, X-rays, and spectrum analysis. The lecturer is a man of distinction in the world of natural philosophy and his selection is plainly influenced by his own pursuits and point of view. But we suppose that there are few, either in the scientific or outside world, who would not *start* their list in much the same way. The order of precedence is always reversed as far as importance is concerned. The seventh is the highest heaven, and that is the reason for the heading we have placed at the top of this paragraph !

GERMAN FORECASTS OF PEACE CONDITIONS.

If we may judge by printed articles, even the most level-headed of German scientists and men of learning would appear to have lost their " balance " in the strain of war. The probability is that to judge them from such evidence is misleading ; at a time like this there is a marked tendency for nothing to be placed before the reading public except what bears on the " burning question." However this may be, in Maximilian Harden's *Zukunft*, a periodical marked by quite unusual sanity, we find an article written by Herr Melesser, an engineering professor, which professes to give a forecast of the New Peace. Such an article is, of course, peculiarly appropriate for a magazine whose title in German signifies " The Future."

Naturally, much space is taken up by consideration of the super-submarine. In a future development thereof the prophetic writer describes a journey from Hamburg to New York accomplished in 48 hours. The vessel is supposed to travel along a steel cable laid under the sea, whilst the motive power is supplied by an electrical current from the land. The item, however, which is most likely to attract the attention of our own readers occurs in the following paragraph :

" Meanwhile wireless telegraphy was perfected, until it was possible to send a "current round the entire earth. It was also possible to supply all airships at a "certain height from the earth with this current. In this year was founded the "company for a passenger and parcel air service without petrol, which served all "the important points of the world. The parcel traffic no longer needed human "pilots, because the airships which were built for the purpose were guided wirelessly "from the land, *an invention which was known before the war.*"

Post-War Trade Activities.

We note with interest the participation of Mr. Godfrey Isaacs in the important meeting of British industrial chiefs at Leicester on June 5th. Mr. Isaacs in the course of a fine address pointed out that "no subject at any time is treated by our "legislature which does not materially affect the interests of those engaged in "industrial life," and advocated that industry should take care to have a voice in the procedure adopted by public policy after the war. British industry is confidently looking forward to a world-wide expansion at the end of hostilities, and in that expansion wireless telegraphy is certain to play an important part.

Wireless in New Zealand

Photo by Beattie, Auckland.

THE ABOVE INTERESTING PHOTOGRAPH OF THE POST OFFICE AT AUCKLAND SHOWS VERY CLEARLY THE WIRELESS AERIALS WHICH CROWN THE EDIFICE. A COMBINATION OF MANY CIRCUMSTANCES RENDERS THE ROLE OF WIRELESS TELEGRAPHY OF PECULIAR IMPORTANCE IN THE SOUTHERN HEMISPHERE.

The Wheatstone Bridge

A Popular Explanation of an Useful Instrument

By F. P. P. CARTER

IN order thoroughly to understand the important principle of the Wheatstone Bridge it is necessary to grasp the simple fact that whenever two points, between which there exists a difference of potential or electric pressure, are joined together by a conductor there will be a flow of electricity from the point of high pressure to that of low pressure. Electricity traversing a wire may be compared to a stream of water flowing down a hill.

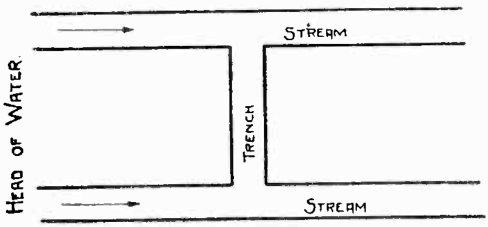


FIG. 1.

If there are two streams flowing along two paths, both having the same head flow and volume of liquid, and if we suppose a trench to be cut straight across from one to the other, no water would flow through the trench, because the facility for discharge would be the same in both cases. See Fig. 1.

But now if a trench were cut diagonally, as in Fig. 2, water would flow from A to B, because the *facility for discharge*—which can be compared to the resistance of a wire—would be different at these points. Exactly the same thing applies in electricity.

If two exactly similar wires are joined to a battery, as in Fig. 3, the potential at equal distances, a, a_1, b, b_1, c, c_1, from the + pole will be the same, and no current will flow from a to a_1, etc., there being no difference of potential. This can be proved by joining a galvanometer between any two points and noting the absence of deflection. But if a galvanometer be joined up between a and c_1 it will deflect, because a current will flow from a, the point of high pressure, to c_1, the point of low pressure. It can now be explained how this principle is applied in the Wheatstone Bridge to find the resistance of a wire.

In Fig. 4 we have a diagrammatic sketch of a Wheatstone Bridge. a and b are two known resistances, and d is an adjustable resistance, also known. The branch x is the unknown resistance.

A galvanometer G is connected between the points A and B and a battery E between the points C and D. Everything being ready the key K_2 is first pressed and then the key K_1. (In practice these keys can be clamped down.) If a deflection is observed on G the resistance d is altered until there is *no* deflection on keeping both keys down. This shows that the potentials at A and B are equal. Now, by Ohm's law if v is the current flowing through a and x, and v_1 the current flowing through b and d, then the fall of potential along $a+x$ equals $v\ (a+x)$ and similarly the fall of potential along $b+d$ equals $v_1\ (b+d)$.

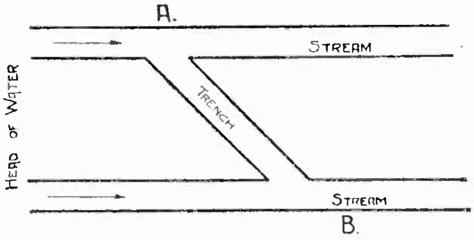


FIG. 2.

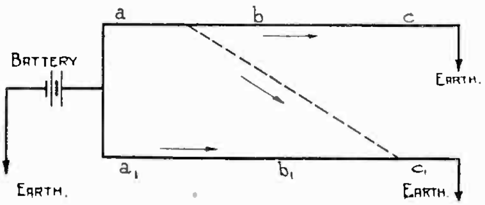


FIG. 3.

Also the fall of potential along a and b equal respectively $v\ (a)$ and $v_1\ (b)$. But since the potential at A equals the potential at B, and the total fall of potential from C to D along *either* path is the same, we have

$$\frac{v \times a}{v \times (a+x)} = \frac{v_1 \times b}{v_1\ (b+d)}$$

$$\text{or} \quad \frac{a}{a+x} = \frac{b}{b+d}$$

$$\text{or} \quad ab + ad = ab + bx$$

$$\text{hence} \quad ad = bx \ \text{ or } \ \frac{ad}{b} = x$$

Example 1.—Using figures, supposing that the resistance of the arms (Fig. 4), a and b equal respectively 1,000 and 1,000 ohms, and 2,500 ohms had to be unplugged in the arm d before balance could be obtained, then arm x naturally equals 2,500 ohms, because $\frac{ad}{b} = x$

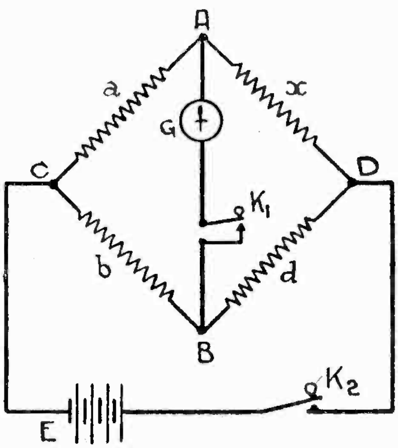


FIG. 4.

$$\therefore \frac{1{,}000 \times 2{,}500}{1{,}000} = x$$

Example 2. Suppose $a = 100^{\omega}$ $b = 1000^{\omega}$ and $d = 2500^{\omega}$ then according to formula

$$x = \frac{100 \times 2500}{1000} = 250 \text{ ohms.}$$

Example 3. Let $a=100^{\omega}$, $b=10,000$ and $d=2500$

$$\text{then}\quad x=\frac{100\times 2500}{10,000}=25 \text{ ohms.}$$

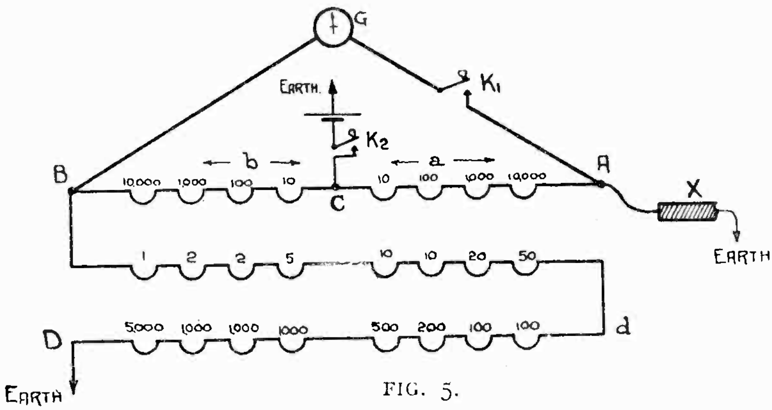


FIG. 5.

Example 4. Let $a=10^{\omega}$, $b=10,000^{\omega}$ and $d=2500^{\omega}$

$$\text{then}\quad x=\frac{10\times 2500}{10,000}=2\cdot 5 \text{ ohms.}$$

It follows from the above that, owing to the unequal ratios of the arms *a* and *b*, the resistance of *x* has become 10, 100, and 1,000 times less than the resistance unplugged in *d*; if the resistances of the arms *a* and *b* were reversed, the resistance of *x* would become 10, 100, 1,000 times greater than that unplugged in *d*.

Fig. 5 represents a working plan of a bridge. It will be seen that it corresponds with Fig. 4 except in form.

In Fig. 5 *a* and *b* are the ratio arms, where the ratios may be anything from 10^{ω} to $10,000^{\omega}$. *A* and *B* are terminals; to *A* is connected the unknown resistance *x*, and one wire of galvanometer, to *B* the other wire of the galvanometer. The + pole of the battery is applied at terminal C; the − pole of battery goes to earth, as also the terminal *D*. In practice the distant end of *x* is also to earth, thus forming a complete circuit. The circuit may be traced thus.

Current is applied at *C* (that is, + pole of battery), which splits here in proportion to the resistance of the arms *a* and *b*, from the arm *a* current goes through *x* to earth, the other portion of current goes through arm *b*, thence through adjustable or balancing arm *d* to earth and back to negative pole of battery.

Among the Operators

LUCKY ESCAPES.

On more than one occasion we have recorded some wonderful escapes from death on the part of wireless operators, but it is given to few men to experience disaster on three successive voyages. This has been the case with Mr. Ralph Frederick Taylor, who has just returned from a torpedoed ship, his previous vessel having been wrecked and the one prior to that torpedoed! Mr. Taylor is 22 years of age, and was born in Yorkshire. On leaving school he entered the telegraph service of the Great Northern Railway, and served some time at Leeds. At the end of 1912 he joined the Marconi Company's London School, and, on qualifying, served first on the s.s. *Pomeranian, Uranium, Start Point, Scotian, Alsatian, Corsican* and *Seal* prior to the outbreak of war. Since that time he has seen service on a number of other vessels, the last three of which have been lost in the manner described above. In all three cases Mr. Taylor has escaped without any injury, although he has had trying experiences before being picked up. We heartily congratulate him upon his extremely good fortune and trust that in future his vessels will go unmolested.

OPERATOR R. F. TAYLOR.

By curious coincidence the junior operator on the last vessel on which Mr. Taylor served also sailed with him on the previous ship, and thus has been wrecked on two successive occasions. The man in question, Mr. Reginald Albert Porter, was born in London eighteen years ago. After leaving school he served some little while in an engineering works, and in January of this year joined the Marconi Company's school. On appointment to the staff he proceeded to sea on the vessel which was shipwrecked, and on being saved from this joined his last ship, which was torpedoed and sunk. To him also we offer our hearty congratulations, and trust that in the future he will be more fortunate.

OPERATOR R. A. PORTER.

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S.S. "CAMERONIAN."

The sinking of this vessel has already been reported in the Press. The senior

OPERATOR WM. OSEMAN.

operator, Mr. William Oseman, unfortunately did not escape without injury, and is now in hospital at Alexandria. Mr. Oseman, who is 21 years of age, was born in Lancashire and educated at Whitefield. On leaving school he held two commercial appointments before he studied wireless at the City School of Wireless Telegraphy, Manchester. At this College he obtained his First Grade P.M.G. Certificate, and joined the Marconi Company in February, 1915. He has served on a number of ships, and in July of last year was operator on board a ship which was sunk by a mine. Fortunately he escaped injury in this wreck, and was afterwards appointed to the s.s. *Cameronian*, where he served for some time before this latter vessel was torpedoed. We sincerely trust that his recovery will be rapid.

The junior operator, Mr. William O'Halloran, is of Irish birth, his home being at Cork, where he was born 17 years ago. On leaving school he studied wireless at the Irish School of Telegraphy, Cork, where he obtained his Postmaster-General's Certificate. On appointment to the staff, Mr. O'Halloran served first on the s.s. *Denis* and was later transferred to the *Cameronian*, where he remained until this vessel was lost. We are glad to say that he escaped uninjured.

OPERATOR WM. O'HALLORAN.

OPERATOR H. H. W. GRAY.

MISSING.

We deeply regret to announce that two of the Marconi Company's operators, Messrs. H. H. W. Gray and P. J. Kilcoyne, are reported missing. Their respective ships have, unfortunately, not been heard of for some time and are presumed to be lost with all hands. Mr. Horace Harold William Gray was 18 years of age, and hailed from Birmingham, where he was educated. On leaving school he entered the service of the General Electric Company, Limited, at Witton, Birmingham, where he held a position as junior draughtsman. Later he took a course in wireless telegraphy at the North British

Wireless School, where he obtained his P.M.G. Certificate, and in February of this year joined the Marconi Company. The ship to which he was appointed was the first on which he had served. Deep sympathy is felt for this young man's parents in their terrible anxiety.

OPERATOR P. J. KILCOYNE.

Mr. Patrick James Kilcoyne, of Tubbercurry, County Sligo, was 24 years of age. After receiving his education at Tubbercurry he held a position with Messrs. Duff & Company at Ballaghaderrin, leaving to take up a course in wireless telegraphy at the Atlantic Wireless College, Cahirciveen, where he obtained his First Class Postmaster-General's Certificate. He joined the Marconi Company in February of this year, and was almost immediately appointed to a ship. The vessel has not been heard of for a long time, and all hope has been abandoned. Deep sympathy is felt with his relatives.

German "Amenities" in Spain

THE late Prime Minister of Spain, Count Romanones, recently gave an interview to a newspaper correspondent in which he emphasised his regret that the British, with all their world-wide connections "do not understand the Spanish "temperament." He spoke in bitter terms of the German intrigues in his country, to which he attributes his own downfall. The "German wireless," said he, "sends along stories daily, and over and above this, the Spanish papers are supplied "with free articles and photographs." The consequence of all this flood of propaganda, and of the monetary subsidies so liberally lavished on the Carlist and Clerical Parties, is most striking. Count Romanones states that he is constantly meeting "well educated Spaniards who honestly believe that the Allies want to force Spain "into the war." In the clutch of the German octopus, Spain is practically powerless to "root out the many hornets' nests along the coasts." In view of the fact that Count Romanones was the Prime Minister until quite recently it is significant that he dates the violent outbreak of U Boat activity from his completion of a commercial treaty with Great Britain. We have in THE WIRELESS WORLD on many occasions referred to German activities in Spain; so that we think it well worth while to call the attention of our readers to this deliberate and considered expression of opinion on the part of an eminent Iberian Publicist, who was hounded from office largely on account of his sympathies with the British and their Allies.

Notes on Wireless Transformers

By P. BAILLIE, L.Sc.

EDITORIAL NOTE.—The following contribution reaches us from France. We particularly welcome such papers from foreign subscribers, as one of our aims is to keep wireless men all over the world in touch with one another.

INCREASING the energy stored up in the oscillating circuit of a wireless transmitter necessitates using a condenser of large capacity. Induction coils are then unable to charge such condensers without any appreciable voltage decreasing. For this reason alternators and transformers are used to feed condensers.

Wirings are as shown in Fig. 1.

The transformer primary winding is connected to the alternator through a Morse key and an adjustable choking coil, *D*, provided with a moving iron core. When not depressed, the key closes the alternator circuit through a choking coil, *A*, in order to avoid "surgings." The transformer secondary is connected to the condenser through choking coils *BB'*, having a considerable self-induction coefficient, and presenting to high-frequency currents a very considerable impedance. Those coils act practically as an obstacle to H.F. currents, thus preventing these oscillations travelling back into the transformer, whilst they are easily traversed by the alternator low-frequency current.

Measuring instruments are connected as usual.

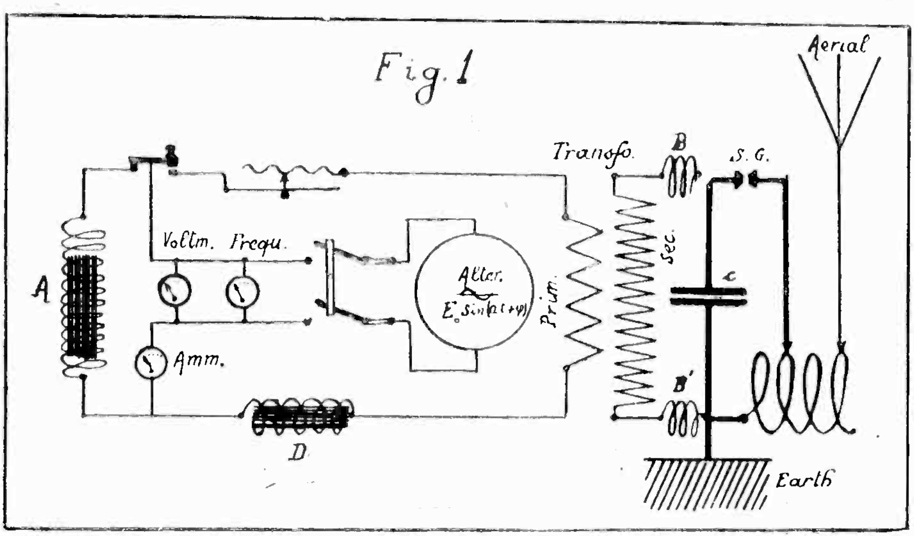
Power at the spark-gap is : $P=\frac{1}{2}ncV^2$

n =number of sparks per second.

c =capacity of condenser.

V =sparking potential.

A mean of increasing V is to increase the transformation ratio of the windings. Another mean is the making use of primary resonance phenomenon (quite apart



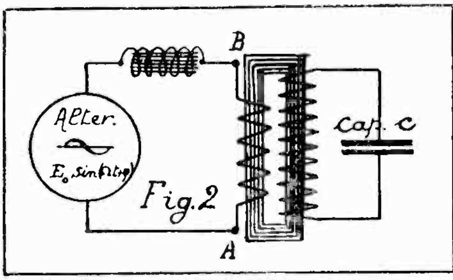


FIG. 2.

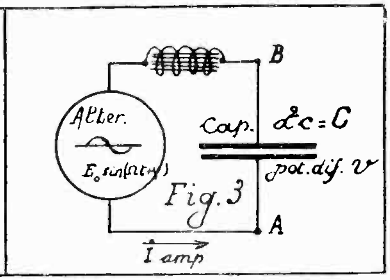


FIG. 3.

from the oscillating circuits resonance). If the alternator circuit inductance is altered, it is observed that (everything else remaining the same) potential difference across A and B (and therefore the sparking potential) reaches a maximum value for a definite value of that inductance.

Both means are used practically.

The problem it is purposed to deal with is what occurs when there are magnetising current and magnetic leakage, and to get constructional rules able to raise efficiency.

Consider an alternator (Fig. 2) generating a sine electromotive force $E = E_0 \sin (\Omega t + \varphi)$ and feeding a static transformer.

First consider the ideal case where the transformer is a closed core perfect one, without losses of any kind.

It is known (Blondel) that we may consider the alternator circuit just as if instead of primary transformer winding AB there was only a condenser, its capacity being $C = a^2 c$.

e = oscillating circuit condenser capacity.

a = transformation ratio of transformer.

Fig. 3 should be then substituted to Fig. 2. We then have :

$$E_0 \sin (\Omega t + \varphi) - L \frac{dI}{dt} - v = RI$$

$$I = C \cdot \frac{dv}{dt}$$

where :

I = current flowing through alternator circuit.

L = total self-induction coefficient of circuit BA (assumed to be a constant).

R = ohmic resistance of circuit BA.

v = potential difference across condenser terminals A and B.

This can be written :

$$\frac{d^2 v}{dt^2} + \frac{R}{L} \frac{dv}{dt} + \frac{1}{CL} v = E_0 \sin (\Omega t + \varphi).$$

Integrating we get :

$$v = e^{\alpha t}\left[\mu \cos\sqrt{\frac{1}{CL} - \alpha^2} \,.\, t + \nu \sin\sqrt{\frac{1}{CL} - \alpha^2} \,.\, t\right]$$
$$+ m \cos (\Omega t + \varphi) + n \sin (\Omega t + \varphi)$$

with

$$\alpha = \frac{R}{2L}.$$

Constants m and n are given by:

$$n(1-\Omega^2LC)=E_0+mRC\,\Omega$$
$$nRC\,\Omega=m(\Omega^2LC-1)$$

Constants μ and v are depending upon initial conditions. As pointed out by Mr. Bouchardon, it is good that current I be zero when condenser begins to discharge. Otherwise the spark acting as a conductor would allow current to flow through the spark-gap and cause "arcing." Therefore v should be a maximum when the discharge begins. Taking as time origin the instant when the discharge occurs, and assuming that discharge to be complete, we shall have $v=o$ $I=o$ when $t=o$; that will give μ and v.

With a perfect transformer it is found that maximum "overtension" S is reached when alternator circuit resonance is reached—*i.e.*, when $\Omega^2LC=1$. We then have $\varphi=o$, and neglecting α^2 before Ω^2, we get

$$\mu=\frac{-E_0}{RC\,\Omega} \qquad v=\frac{-E_0}{2}.$$

Neglecting $\frac{1}{4}$ before $\frac{1}{R^2C^2\Omega^2}$ and, moreover, assuming $\frac{\Omega}{\alpha}$ to be so large that $tg^{-1}\frac{\Omega}{\alpha}$ may be confounded with $\frac{\pi}{2}$, we get the approximate value

$$v=\frac{E_0}{RC\,\Omega}\left(1-e^{-\alpha t}\right)\cos\,\Omega t.$$

The overtension is then $S=\frac{\text{max. of } v}{E_0}=\frac{1}{RC\,\Omega}$.

With the same degree of accuracy $I=-\frac{E_0}{R}\left(1-e^{-\alpha t}\right)\sin\,\Omega t$.

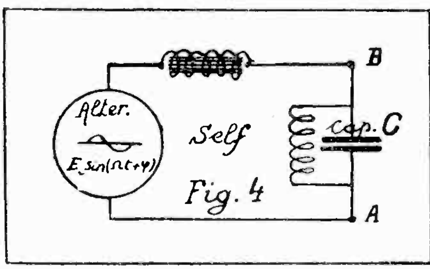
If there are n sparks per second, potential across condenser C will be $E_0S\left(1-e^{-\frac{\pi}{ns}}\right)$, and power at the spark-gap:

$$P=\tfrac{1}{2}nca^2E_0{}^2S^2\left(1-e^{-\frac{\pi}{ns}}\right)^2$$

Now, in practical transformers, current I is not zero when secondary is open. Let I_{os} be the value of I in such conditions. Then Fig. 3 should be changed into Fig. 4 where condenser C is shunted by inductance l. The impedance of the set "condenser C, inductance l" in parallel is Z, such as

$$\frac{1}{[Z]}=\frac{1}{o+\sqrt{-1}\,l\Omega}+\frac{1}{o-\sqrt{-1}\frac{1}{C\,\Omega}} \quad [Z]=\text{complex impedance}$$

$$[Z]=\sqrt{-1}\cdot\frac{l\Omega}{1-lC\,\Omega^2};\ \text{hence } Z=\frac{l\Omega}{1-lC\,\Omega^2}.$$



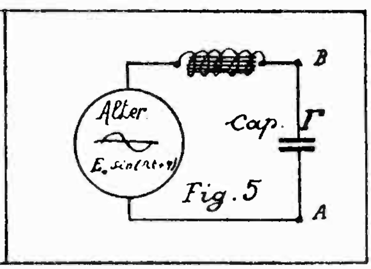


FIG. 4. FIG. 5.

The set "condenser C, inductance l" is equivalent to a sole condenser having a capacity Γ. This condenser being charged at the same potential as C, power at the spark-gap (which is proportional to capacity) will be multiplied by $\frac{\Gamma}{C}$; Fig. 4 should be changed into Fig. 5. Impedance of circuit AB is then $-\frac{1}{\Gamma\Omega}$. Both impedances are the same when $\frac{l\Omega}{1-lC\Omega^2}=-\,.\,\frac{1}{\Gamma\Omega}$ and the resonance condition is $\frac{1}{\Gamma\Omega}=L\Omega$.

Hence $\Gamma=\frac{lC\Omega^2-1}{l\Omega}$.

Let I_{cs} be the value of current, I, when secondary terminals are short circuited (closed secondary). We then have between maxima or R.M.S. values, and after neglecting resistances before inductances:

$E=I_{os}\,.\,(L+l)\,\Omega$. $E=I_{cs}\,.\,L\,\Omega$. Then:

$l\Omega=E\,.\left[\frac{1}{I_{os}}-\frac{1}{I_{cs}}\right]$. Since $\Gamma=\frac{lC\Omega^2-1}{l\Omega^2}$

and $\Gamma\Omega=\frac{1}{L\Omega}$ we have $C\Omega-\Gamma\Omega=\frac{1}{l\Omega}=\frac{1}{E\left[\frac{1}{I_{os}}-\frac{1}{I_{cs}}\right]}$

and $\frac{\Gamma\Omega}{C\Omega}=1-\frac{I_{os}}{I_{cs}}$.

Power at the spark-gap is then multiplied by the power factor less than unity: $1-\frac{I_{os}}{I_{cs}}$.

Practical transformers, no matter whether they are closed or open core, possess also magnetic leakage. When secondary terminals are short circuited, primary current, I, instead of being I_{cs} as when there is no magnetic leakage, is only $I'_{cs}<I_{cs}$.

Power is then multiplied by factor less than unity: $\frac{I'_{cs}}{I_{cs}}$.

In the most general case power is:

$$P'=P\,.\,\frac{I'_{cs}}{I_{cs}}\left(1-\frac{I_{os}}{I_{cs}}\right)=y\,.\,P.$$

The power factor y is a product of two terms:

First term, $\frac{I'_{cs}}{I_{cs}}$ is a decreasing function of leakage. It is greater for a closed core transformer than for an open core one. It should be increased by ordinary ways of reducing magnetic losses.

Second term, $1-\frac{I_{oc}}{I_{cs}}$ is a decreasing function of magnetising current. For a given transformer core (and a given feeding circuit) we dispose of windings so as to lessen $\frac{I_{cs}}{I_{cs}}$.

Let l' be the inductance equivalent to leakage, and let be $X=\frac{I_{cs}}{I_{os}}$ $\alpha^2=\frac{l'\Omega}{l\Omega}$

(α^2 depending only upon transformer core). Neglecting resistances we have between maxima or R.M.S. values :

$$I_{os} = E \cdot \frac{1}{L\Omega + l\Omega} \qquad I_{cs} = E \cdot \frac{1}{L\Omega}$$

$$I'_{cs} = E \cdot \frac{1}{L\Omega + l'\Omega}.$$

Hence

$$\frac{I_{cs}}{I'_{os}} = \frac{L\Omega + l\Omega}{L\Omega} \qquad \frac{I_{cs}}{I'_{cs}} = \frac{L\Omega + l'\Omega}{L\Omega}$$

$$\alpha^2 = \frac{l'\Omega}{l\Omega} = \left(\frac{I_{cs}}{I'_{cs}} - 1\right) \cdot \frac{1}{\left(\frac{I_{cs}}{I_{os}} = 1\right)}$$

and

$$y = \frac{I'_{cs}}{I_{cs}}\left(1 - \frac{I_{os}}{I_{cs}}\right) = \frac{X - 1}{\alpha^2 X^2 + (1 - \alpha^2)X}.$$

Differential coefficient of y is $+$ when $X < 1 + \frac{1}{\alpha}$ and $-$ when $X > 1 + \frac{1}{\alpha}$.

Hence power factor y is a maximum when $X = 1 + \frac{1}{\alpha}$. That maximum value is

$y_{max.} = \frac{1}{(1+\alpha)^2}$ and then $\frac{I_{cs}}{I'_{cs}} = 1 + \alpha.$

When power factor is a maximum, we have between the three inductances $L\Omega$, $l\Omega$, $l'\Omega$, the following relation $(L\Omega)^2 = (l\Omega) \cdot (l'\Omega)$. That is to say: alternator circuit inductance is the geometric mean value between leakage inductance and magnetising inductance.

Coefficient α^2 only depending upon core may be got by winding the transformer anywise, and afterwards measuring corresponding I'_{cs} and I_{os}.

α^2 may be calculated from

$$\alpha^2 = \frac{\frac{1}{I'_{cs}} - \frac{1}{I_{es}}}{\frac{1}{I_{os}} - \frac{1}{I_{cs}}}.$$

Windings should then be devised so that

$$X = \frac{I_{cs}}{I_{os}} = 1 + \frac{1}{\alpha}$$

Approximate curves of $y = f(X)$ show that the greater the magnetic leakage the sharper the maxima ; and therefore the greater the difficulty of devising proper windings. Since curves slope down more slowly on the right-hand side, windings should be made so that X be in excess rather than in deficit.

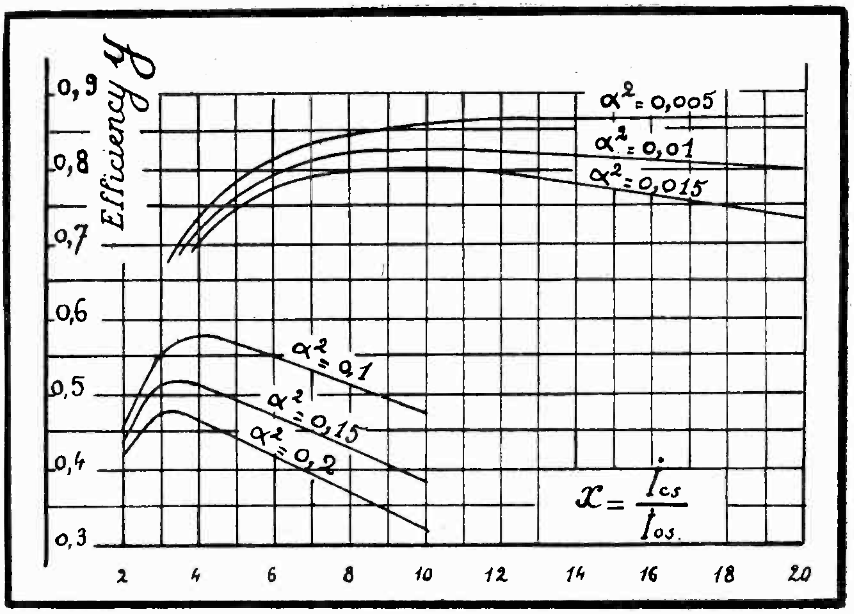
Measurements have been made :

1. On a closed core transformer A, under 110 volts and 60 periods ; that transformer was afterwards rewound according to above indications.

2. On another closed core * transformer B, under 115 volts and 600 periods.

3. On an open core transformer D, under 45 volts.

* A very elaborate transformer constructed by Société Française Radio-Electrique—Paris.



Results were as follows :

	I_{os}	I_{cs}	I'_{cs}	α^2	X	y	Max. of y	Corresp. X	Differ
A	1 amp.	14 amp.	11·1	0·02	14	0·737	0·768	8·07	3·1
A rewound	1·72	14	12·2	0·02	8·14	0·76	0·768	8·07	0·8
B	0·66	10	8·9	0·009	15·15	0·82	0·84	11·53	2
D	1·2	3·8	3·05	0·12	3·16	0·54	0·56	3·88	2

Maximum values of power factor y and corresponding X, in terms of α^2 are as follows :

α^2	Max. of y	X	α^2	Max. of y.	X
0·005	0·872	15·14	0·05	0·667	5·47
0·007	0·855	12·94	0·07	0·624	4·78
0·01	0·826	11·00	0·1	0·578	4·16
0·015	0·794	9·17	0·15	0·519	3·582
0·02	0·768	8·07	0·2	0·478	3·236
0·025	0·746	7·32	0·25	0·444	3·00
0·03	0·728	6·77	0·3	0·417	2·83

In 1914

A Yarn of the Early Days of the War

By "PERIKON"

OUR detachment had come back out of action and our horse lines and bivouacs were situated in a wood a few miles west of "Hindenburg's Ditch."

The wood was ideal camping ground and seldom had our caravan rested in more lovely surroundings.

The screens of greenery from the chestnuts, planes and elms obscured wagons, lines and bivouacs as effectively as walls of brickwork.

At noon when the sun filtered through the roof of branch and leaf, huge gaily striped dragonflies flitted down the aisles of the wood and with them butterflies, all seeking the fresh open meadows beyond.

The enemy had left his marks on the countryside, however. Many of the fruit trees had been hacked down, and only the long rows of ugly stumps on the roadsides remained to show where the graceful avenues of poplars had been. Large numbers of dwellings, too, had been destroyed.

To the west, where deserted lines of trenches and the sites of villages lay, the ground resembled a gigantic slag heap. To pass over the ugly blot in the grey of the dawn was to experience the dreariest depression.

From our wood we could see the fringe of the region—marked by black splintered tree trunks. From these trees eastward the country was fresh and green to the Hindenburg Line.

We had constructed shelters of branches and sacking in the wood, and one evening, wending my way toward my "lair" I encountered Cyclone stretched beneath a service wagon cover fashioned into a species of tent.

On one corner of the cover was a grotesque splash of "Service Green" freshly applied, and looming dimly and accusingly through the fog of paint were the black stencil markings of an R.F.A. battery whose lines were not far distant. However, I pretended not to notice.

"It's a splendid evening," observed Cyclone. I admitted it was, and we drifted into conversation.

From a wood out in front there came the regular detonations of 5·9 shells falling at intervals of three minutes.

"I notice they've got that battery of ours pretty well taped," said Cyclone. "They've been searching the wood for him most of the afternoon with 5·9's. Did you notice the enemy plane over this forenoon? I expect he must have spotted their flashes."

I looked across the hollow and saw the ugly black smoke drifting off from amongst the tree tops. The enemy appeared to have the range accurately. He also appeared to know it.

"Did it ever strike you that war minus aircraft would be much of a blindfold game—I mean, war on this scale?" queried Cyclone. "I remember we did some observing once, but we observed for the enemy with rather startling results. Like to hear the yarn ? It may appear 'tall,' but nevertheless it's actual fact." I nodded and sat down.

* * * * * *

"Well, it happened when Von Kluck's divisions were returning after their check outside Paris. At that time I was with a light field set (a pack) attached to the ——th Cavalry Brigade.

"When we turned round we were in a pretty rotten condition—as regards rations and clothing—and we looked rather an assorted detachment. One thing I remember was the lead driver bumping solemnly along on his rider, got up in regulation boots, puttees, and breeches, but with a French tunic, and—whisper it softly—a *Homburg hat.* Where he'd dug them up I never ascertained. I can remember after a bit when things were organised, we were hauled to the Q.M.'s stores of some unit and rigged out properly.

"Well, I'm going off at a tangent as usual. The news of the enemy returning was the finest tonic we'd had for weeks. We'd been sullen and bitter at the whole business till we got the order to turn about.

"I remember we trekked all night, sometimes along first-class roads, at other times along lanes, and at times across country. Day came and Brigade Headquarters pulled up outside a little village. We were ordered to 'erect.' We were kept busy for some time transmitting to G.H.Q. Then we dismantled and were told to cook ourselves a meal.

"Whilst we were coaxing our 'dixie' to boil we heard the drone of a plane somewhere overhead. We didn't pay much attention, however, till suddenly a gun somewhere on the right began ranging on him. Then we picked out the plane. It was rather cloudy and there was a thick ground mist, that's why he was so low, I expect. He must have got confused; at any rate, the gun kept firing slowly and deliberately. The first four rounds were hopelessly wide, and we were about to make comical remarks about that gun and its gunlayer when his fifth round burst directly on the plane's tail. The machine shot downward and landed a few fields off.

"When we got up we found both pilot and observer wounded, and curiously enough the plane was not so damaged as we'd expected she would be. She had been a graceful model. I remember I was forced to admire the cut of her wings, and the suggestion of hawk-like speed about her. In these days our few machines always reminded me of barnyard fowls somehow. Of course, its different now. We've got speedier and better machines than their Fokkers and Albatrosses, and they know it.

"Well, to get back to the yarn. We discovered with surprise that she had a small radio transmitter installed, and what's more, that the set had by some freak survived the impact of landing. However, the set's accumulators were badly smashed.

"Our officer bade us unclamp the little instrument and take it back to our wagon.

"We had bandaged up the prisoners. Their wounds were of no very serious nature. The senior of the two attempted to destroy a little wad of papers, which he took from an inner pocket. Fortunately we 'got there first,' and relieved him of the things.

" Our officer glanced through them and whistled.

" Shortly afterwards we handed plane and prisoners over to a cavalry escort.

" Before leaving we unscrewed the map case from the cockpit. It contained an excellent map, on a large scale, of the country we were passing over, and was divided and sub-divided into partitions and lettered squares.

" Brigade Headquarters moved, and off we went again. Things seemed quiet. There was a deserted air about the countryside ahead. The sky got threatening and it began to rain. A species of Scotch mist more than rain, it was.

" Towards midday we again halted and watered and fed our horses. It was then that our officer rode off, and we saw him have a lengthy confab with one of the staff. He cantered back and told us to saddle up, and said something about 'obliging the other side.' We didn't quite understand. Well, a few minutes later we were rattling along the roadway. Then we struck off across country. Occasionally we passed a few still figures in the grass. That was all. The fields and hedgerows somehow didn't have the appearance of being a battleground. It was all very hard to grasp, somehow.

" Well, we kept going for almost an hour, and at length pulled up on top of a ridge. We had a splendid view of the land ahead, but it was disappointing, there seemed nothing there. It still had the deserted look. There wasn't a wisp of smoke from a cottage chimney even, but here and there we noticed cattle moving, which put us on the *qui vive*. We discovered then that we were right in front of even our advanced patrols, and we were quite enthusiastic at being given 'the front pew' as you might say.

" It was then that our O.C. sketched the details of the scheme we were about to attempt.

" The plane which had been brought down earlier in the day was the observing plane for one of those batteries of especially hefty howitzers, which had been brought up to deal with the Paris forts. Well, having had to alter his plans, Von Kluck's C.R.A. must have decided to use his guns for other purposes, in all probability they were somewhere about eight or nine miles off, or again they might be moving.

" The battery consisted of three pieces and each gun had its call signal. One was ZA, the other two ZU and ZE respectively. The general call of ZZ would bring all three guns into action. The method was simplicity itself. When a target presented itself the airman's procedure was merely to get the coinciding point on his map, read off the map location by means of the lettered squares, and send the call signal and map reference.

" The map was on a big scale, you see, and the smallest numbered squares had a side of not more than one-tenth of an inch. It was an easy matter to fix any given point to the nearest ten yards. After that the observer corrected the fire by signalling them to drop or add 10 metres or bear so many right or left as the case might be. By this means the battery commander was able to plot out his range and open fire accordingly. It was what our siege-gunners term 'firing by the map.' However, every heavy gun 'shoot' is by map. The modern gunner gets a glimpse of his target once in a lifetime.

" Well, to return to our *moutons*. We set up the plane's transmitter on top of the ridge, crawling about in the nettles and invoking purple-hued maledictions on mankind and things in general.

"Our wagon and horses were halted below the skyline on the rear side of the ridge.

"After a few minutes we had quite a respectable aerial fixed, and the transmitter ready for work. Our 'juice' we got by tapping off on a couple of our accumulators.

"'Now,' said our officer, 'I'll look for a target—get ready to signal.

"In a field about a kilometre off we could see cattle moving about restlessly, and for some time our officer's glasses were focussed on the hedges bordering it.

"Suddenly he jumped. 'Ah! there they go. Quick—the map.' Whilst he was rapidly fixing the map location, I glanced across the hollow and coming from the hedgeways were dense groups of what appeared to be disorganised infantry. Apparently they had been resting. They formed up into a rough column and began to toil slowly across the fields.

"'This is going to be a dam'd difficult job,' cried our officer. 'I'll have to fix a point some distance ahead of them and chance getting them on it, when the coalboxes arrive. I'd much rather have a good machine gun.'

"'Here we are, send this—ZZ K17 R10 Z5—that's roughly the point where they'll reach the roadway on the right there. Send it now.' I spelt out the groups and repeated them three times. Then we waited.

"A lengthy pause followed. The head of the column was still a decent hundred yards from the roadway. Then from what seemed a great distance we heard a muffled 'thud-a-dud'—that's just what it sounded like. There was a fastly-rising roar which increased to a shrill shrieking and three huge jets of smoke leapt up about fifty yards ahead of the body, which, as the smoke cleared, we saw scattering in all directions.

"'H'm,' said our boss, 'not much good that—question if we've winged anybody. However, I daresay it hasn't exactly strengthened their *moral.*' It hadn't, for by this time the crowd had put almost a kilometre between them and these three shell holes. They were covering the ground at a speed which must have amazed even themselves, discarding packs, overcoats, and rifles, which was perhaps the wisest thing they could have done. Well, we left Target No. 1, and swept round for another.

"We were extremely surprised at our success. Their communications must have been in a very bad state and we eagerly strained our eyes for something further to 'krump.'

"Suddenly the boss handed me the glasses. 'Two fingers right of the farm out there, there's a roadway. See what you make of it.'

"I looked and saw a small string of transport—about six limbers I made it—halted on the roadside.

"I said so. 'Yes, that's just what I thought. Let me see. Yes, K17 R11 Z9 ought to find them all right, I fancy. Verify it, will you?'

"I ran over the map, fixed the point, and arrived at the same group of figures and letters as he had.

"'Right—now give the battery a call and that location.'

"I did so, and we listened. Again the long pause, and to our delight we again heard the treble boom in the distance.

"The scene which followed, as seen through the boss's glasses, was amusing, to say the least of it. He described it to me.

"The shells landed about a hundred yards behind the limbers on the left side of the road.

"When they burst the first two limbers bolted, or rather their teams did, minus drivers.

"The drivers of the remaining four managed to get mounted, and the people who had been left behind attempted to jump on their wagons.

"The whole cavalcade shot off at an amazing speed. After it disappeared there remained a few 'spare files'—people who had lost their wagons and others who had fallen off. They in turn decided not to loiter and disappeared in that type of formation beloved of the Keystone police. I'd have gladly dropped two rates of pay to have had a glimpse of it.

"Well, to cut a long story short, we drew blank the third time. The enemy had discovered his mistakes.

"Just then our leading patrols passed, and we put them on the track of our old friends, Target No. 1, who, like the gods of Homer, were now shrouded in the mists.

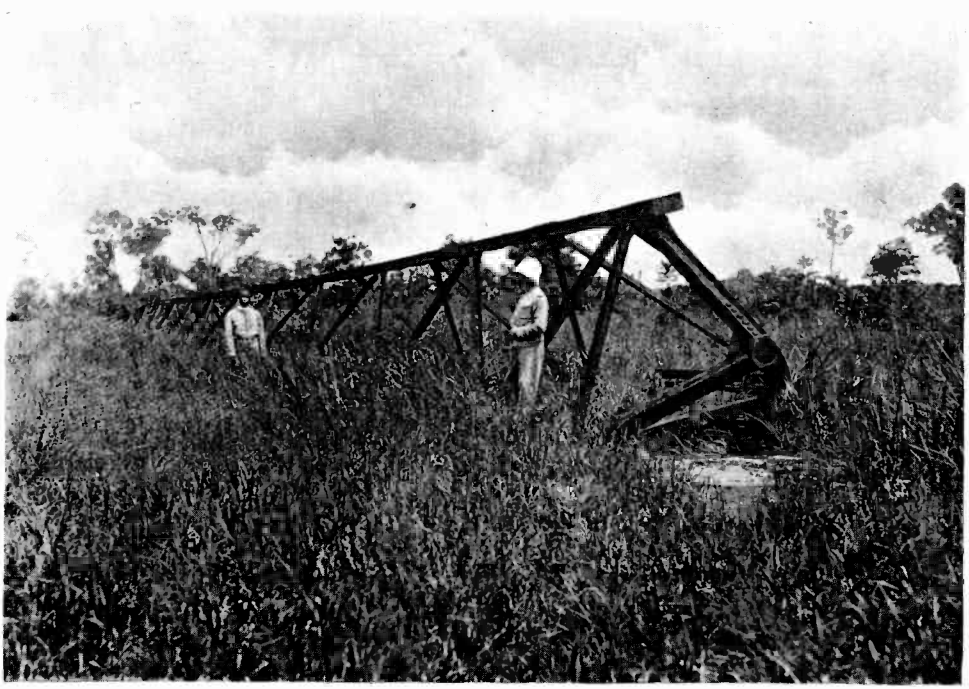
"We packed up then and waited for Brigade Headquarters to come up.

"An hour later we passed the spot where our second salvo had caused the stampede.

"There were dozens of full nosebags, a few forage caps and helmets, and some fragments of food. That was all. We didn't appear to have bagged anything—though we had had a splendid afternoon's sport.

"Yes, that was in '14 when one campaigned.'

PERIKON.



THE ABOVE IS A COMPANION PHOTO. TO THE HUN RELIC DEPICTED ON PAGE 313, AND SHOWS ONE OF THE WIRELESS MASTS OF THE EX-GERMAN STATION AT DUALA.

Instructional Article

NEW SERIES (No. 5).

EDITORIAL NOTE.—In the opening number of the new volume we commenced a new series of valuable instructional articles dealing with Alternating Current Working. These articles, of which the present is the fifth, are being specially prepared by a wireless expert for wireless students, and will be found to be of great value to all who are interested in wireless telegraphy, either from the theoretical or practical point of view. They will also show the practical application of the instruction in mathematics given in the previous volume.

CAPACITY.

26. Simple Condenser.—If two conducting plates are separated from each other by air or other insulator and the plates are connected to a steady source of electric pressure, then a current will flow in the circuit for a short time. When this occurs the plates are said to be **charged** with a definite quantity of electricity measured in coulombs. The quantity of electricity is dependent on the electromotive force and the **capacity** of the arrangement. Any arrangement of plates separated by an insulator is termed a **condenser.** The insulator between the plates of a condenser is known as the **dielectric.** It has been shown that when a condenser is charged there is a difference of potential between the two plates. This difference of potential causes the dielectric to be in a state of **mechanical strain,** and if this becomes too great the dielectric will be unable to stand the strain and **breaks down**; that is, a spark will pass between the plates.

27. Effects of Capacity.—The properties of a condenser can best be studied by the use of a mechanical analogy suggested by Dr. Fleming.*

Diagram 19 represents a system of tubes containing water with two meters, M_1 M_2, a pump, P, and an elastic diaphragm, D.

Let the diaphragm D be removed. Then on working the pump P in one direction the meters M_1 M_2 will record the flow of water that passes through them in a given time. This is equivalent to the electrical effect of so many coulombs of electricity.

If the pump is now replaced by a piston the water is caused to flow, first in **one** direction and then in the **other.** The meters will

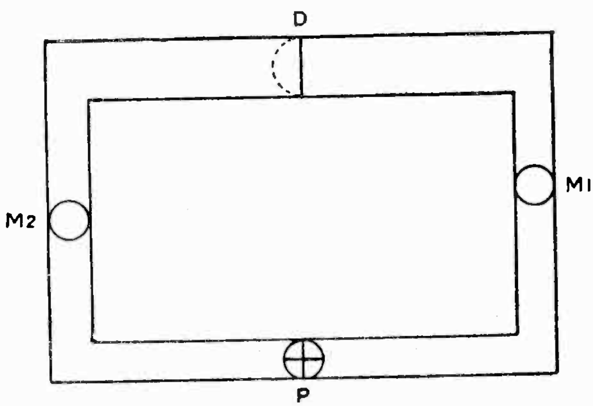


FIG. 19.

* See Joyce's Examples in Electrical Engineering.

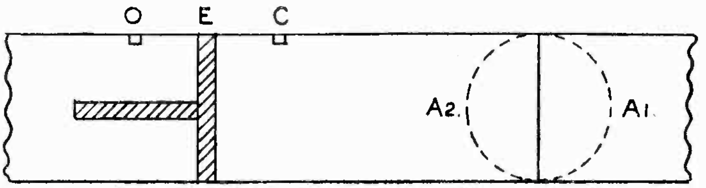


FIG. 20.

therefore not record this flow, but if suitable instruments are substituted for the meters they will record the amplitude of the motion of the water.

This arrangement then corresponds to an alternating E.M.F.

Now replace the diaphragm *D*, and let the piston first of all force the water **up** the right hand side of the system. Then the diaphragm will be stretched to the position *A*. The meter M_1 will record the amount of water flowing **into** the diaphragm and M_2 will record the same amount as flowing **out.**

When the piston first begins to move owing to the diaphragm not being stretched, the flow of water into the diaphragm will be **greatest** and will gradually **diminish** until the diaphragm is distended to its greatest extent.

If now the piston is drawn back, the water will flow **out** of the diaphragm on the right and **into** it on the left. This will be more clearly seen by referring to diagram 20.

When the piston is moved to *C* the water is forced into the diaphragm which distends to *A*. The flow of water is **greatest** at the start and diminishes to **zero** as the piston moves to *C*, being in the **same** direction as the piston. Now if the piston is drawn back to *E*, the water moves **towards** the piston, the rate of flow being a **minimum** at the **start** and increasing to a maximum, when the diaphragm is at *D*. As the piston continues to move towards *O* the water **follows** it, but the rate of flow **diminishes** to a minimum, as the diaphragm is distended to A_2. If now the piston is forced towards *E*, the water will flow **away** from the piston, the rate of flow being a **minimum** and increasing to a maximum as the diaphragm regains its original position at *D*.

28. Phase of E.M.F. and Current.—Since the piston in our mechanical analogy represented an alternating E.M.F. its motion can be plotted to a curve. Assume that the E.M.F. follows a sine law and that the current which flows in virtue of this E.M.F. also follows a sine law. Then when the E.M.F. is a **minimum** the current is a **maximum,** as the E.M.F. rises to a positive **maximum** the current decreases to **zero.** The E.M.F. now decreases to **zero** and the current rises to a negative **maximum.** When the E.M.F. rises to a negative **maximum** the current will diminish to **zero** again, and as the E.M.F. falls to **zero** the current rises to a positive **maximum.** (See Fig. 21.) Thus if the circuit has no resistance or inductance it is seen that the current **leads** the voltage by 90°, that is the maximum value of the current is 90° in front of the E.M.F.

29. Back E.M.F.—In section 26 it was shown that when a condenser is charged the dielectric is in a state of strain, and therefore it is constantly endeavouring to discharge itself. Hence an E.M.F. will **oppose** the charging voltage just in the same way as the back E.M.F. of self-induction opposes the impressed voltage. This E.M.F., provided there is no resistance in the circuit, will be **equal** and **opposite**

to the charging voltage. If the circuit possesses resistance, then the applied voltage can be found by adding the ordinates of the voltage necessary to overcome ohmic resistance and the back E.M.F. of the condenser (Fig. 22), similarly to that done to obtain the applied E.M.F. necessary to overcome self-induction and resistance (see section 16).

30. Calculation of Capacity.—The capacity of a conductor is defined by the quantity of electricity required to raise it from zero potential to unity.

Then if K be the **capacity** of a conductor and its **potential** is V the **quantity**

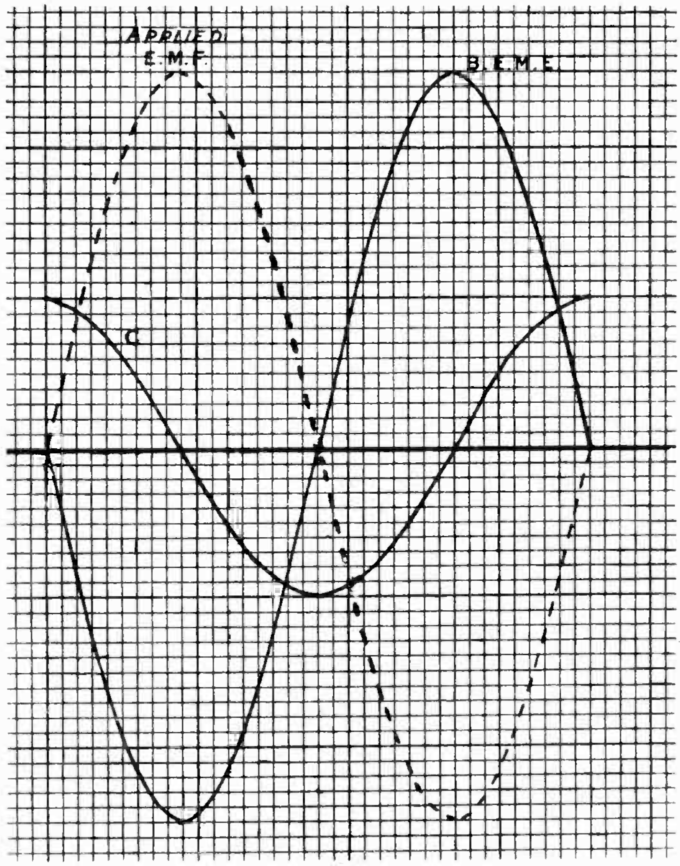


FIG. 21.

of electricity in coulombs in it, or the charge $Q=KV$. The **coulomb** is the **quantity** of electricity conveyed in **one** second past any point by a current of **one** ampère. The practical unit of capacity is the **farad** and a condenser has a capacity of 1 farad when a difference of potential of 1 volt between the plates charges it with 1 coulomb of electricity.

$$\text{Hence } K \text{ (farads)} = \frac{Q \text{ (coulombs)}}{V \text{ (volts)}}$$

The coulomb is equal to 10^{-1} c.g.s. units, the volt is equal to 10^{-8} c.g.s. units.

Therefore 1 (farad) $= \frac{10^{-1}}{10^{8}} = 10^{-9}$ e.g.s. units, or in electrostatic units

$$1 \text{ farad} = 9 \times 10^{11} \text{ units of capacity.}$$

The farad is too large a unit for practical work, so the **microfarad** or one-millionth farad is used.

Therefore 1 microfarad $= \frac{9 \times 10^{11}}{10^{6}} = 9 \times 10^{5}$ electrostatic units.

The capacity of a condenser depends on

(1) The area of the plates.

(2) Their distance apart.

(3) The medium or dielectric between them.

First consider the case of a single condenser with two parallel plates and air dielectric.

Then we have seen that $K = \frac{Q}{V}$, and it can be shown that

$$K = \frac{Q}{V} = \frac{A}{4\pi d} \text{ approximately.}$$

Where A = the areas of the plates,

d = the distance between them,

If the dielectric is other than air the formula becomes

$$K = \frac{Q}{V} = \frac{Ak}{4\pi d}$$

Where k = specific inductive capacity (S.I.C.) for air, $k=1$.

For condensers with more than two plates it is best to consider the number of spaces between the plates. We then have if number of spaces $= n$

$$K = \frac{Q}{V} = \frac{nAk}{4\pi d}$$

If A and d are measured in **centimetres**, then the **capacity** is given in **electrostatic** units.

Example :—What is the capacity of a condenser with 19 plates connected to one terminal and 20 plates connected to the other? The area of the plates is $13\frac{1}{2}'' \times 13''$. The dielectric is glass, the thickness is $0{\cdot}1''$, and $k = 4{\cdot}3$.

Since there are two

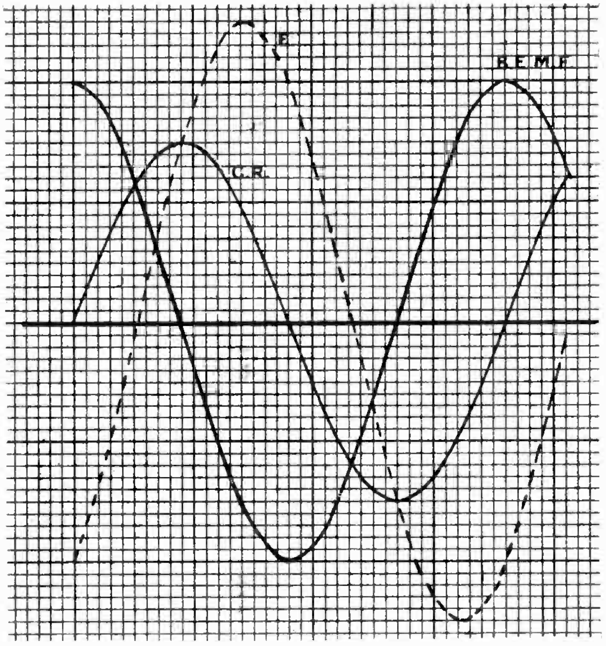


FIG. 22.

sets of plates, one of 20 plates and one of 19 plates, the number of dielectric spaces will be $20+19-1=38$.

By converting all the measurements from inches to centimetres the capacity will be given in electrostatic units, and dividing by 9×10^5 the capacity is obtained in microfarads. Then from formula

$$K=\frac{nAk}{4\pi d}$$

$$K=\frac{38\ (13\times 2\cdot 54)\times(13\cdot 5\times 2\cdot 54)\times 4\cdot 3}{4\times 3\cdot 14\times(0\cdot 1\times 2\cdot 54)\times 9\times 10^5}$$

$$=0\cdot 064 \text{ mfds.}$$

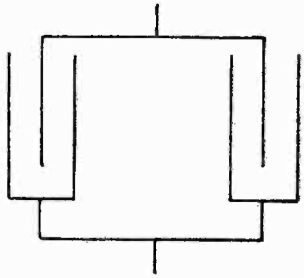


FIG. 23.

31. Capacities in Parallel.—If the **inner** plates of a condenser are connected to the **inner** plates of another condenser and the **outer** plates are connected to the **outer** plates of the second condenser, then the condensers are connected in **parallel.** (Fig. 23.)

Let the capacities of the condensers be k_1 k_2, and a charge of Q units be given to the condensers, thus raising the potential to V, then $Q=KV$ where K is equal to the total capacity. If q_1 q_2 are the charges in each condenser, then

$$q_1+q_2=k_1V+k_2V$$

But $$q_1+q_2=Q=KV.$$

Therefore $$K=k_1+k_2.$$

Therefore if condensers are connected in **parallel** the total capacity is the **sum** of their individual capacities.

32. Capacities in Series.—Instead of connecting the **inner** plates of the condenser to the inner plates of the other, they are connected to the **outer** plates, the condensers are then connected in series. (Fig. 24.)

If q_1 is the charge given to k_1, then each condenser will be charged to the same amount. If v_1 v_2 are the potentials of each condenser and k_1 k_2 the individual capacities, then

$$v_1+v_2=\frac{q_1}{k_1}+\frac{q_2}{k_2}=q_1\left(\frac{1}{k_1}+\frac{1}{k_2}\right)$$

Let the total capacity equal K and the difference of potential between the inner plates of the first condenser and the outer plates of the last condenser $=V$

Then $$K=\frac{q_1}{V}$$

But $$V=v_1+v_2=q_1\left(\frac{1}{k_1}+\frac{1}{k_2}\right)$$

Therefore $$\frac{1}{K}=\frac{1}{k_1}+\frac{1}{k_2}$$

That is, the reciprocal of the total capacity of condensers in **series** is equal to the **reciprocal** of their individual capacities.

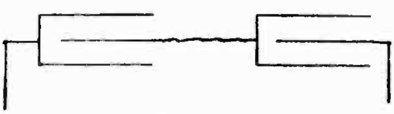


FIG. 24.

These two laws can be remembered by noting that they are the opposite of resistances in parallel and series.

In many large-sized wireless transmitting sets a number of condensers are connected in series and banks of these sets are connected in parallel. This is necessary where large discharge currents are required and the voltage across the condensers is too great for one condenser. Putting two or more condensers in series has the effect of a greater dielectric thickness. Hence the voltage across each condenser will be inversely proportional to the number of condensers in series. Connecting condensers in parallel causes the current to be directly proportional to the number of condensers.

Example :—The capacity of a condenser is ·036 mfds. Calculate the capacity when 36 condensers are arranged.

(1) 6 in series and 6 banks in parallel.

(2) 3 ,, ,, ,, 12 ,, ,, ,,

(1) Calculate the capacity of 6 condensers in series from the formula

$$\frac{1}{K}=\frac{1}{k_1}+\frac{1}{k_2}$$

Substituting ·036 for k_1 k_2, etc., we have

$$\frac{1}{k}=\frac{1}{\cdot036}+\frac{1}{\cdot036}+\frac{1}{\cdot036}+\frac{1}{\cdot036}+\frac{1}{\cdot036}+\frac{1}{\cdot036}$$

$$=\frac{6}{\cdot036}$$

Therefore $K=\frac{\cdot036}{6}=\cdot006$ mfd.

Since there are 6 of these capacities in parallel, the total capacity of the set

$$=K=k_1+k_2$$

$$=\cdot006\times6=\cdot036 \text{ mfd.}$$

Second arrangement—

$$\frac{1}{K}=\frac{1}{k_1}+\frac{1}{k_2}$$

$$=\frac{3}{\cdot036}$$

Therefore $K=\frac{\cdot036}{3}=\cdot012$ mfds.

Twelve banks of ·012 mfd. in parallel.

$$K=k_1+k_2$$

$$=\cdot012\times12=\cdot144 \text{ mfds.}$$

A Recent Honour for Senatore Marconi

SENATORE MARCONI, who is now in the United States in connection with the Italian War Commission, has been presented with the Honorary Degree of Doctor of Science by Colombia University. The ceremony took place on June 6th. This forms the latest addition to the list of distinctions bestowed upon the eminent Italian scientist by Governments and Universities and Societies all over the world.

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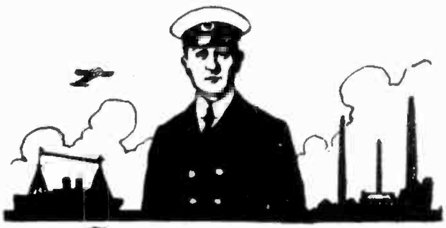

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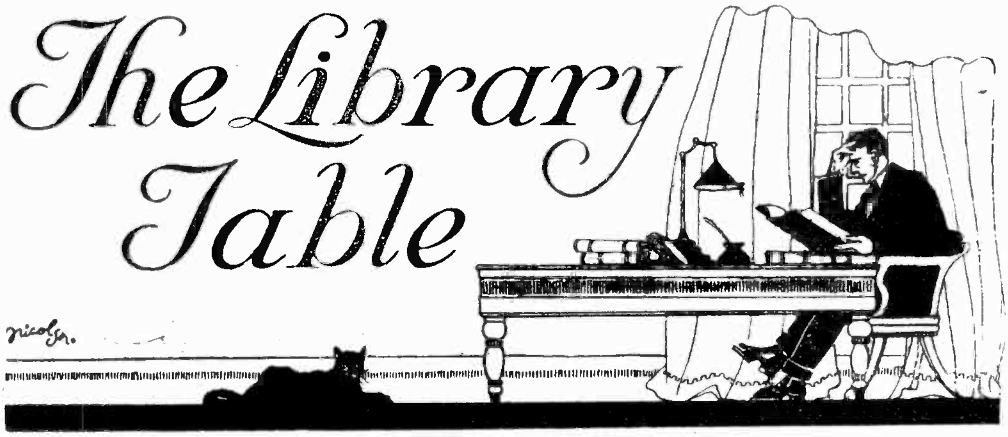


AIR NAVIGATION FOR FLIGHT OFFICERS. By Lieut.-Commander A. E. Dixie, R.N. Gieves Publishing Co., Ltd., The Hard, Portsmouth. Price, 10s. 6d. net; postage, 5d.

On page 322 of this issue we emphasise the fact that the ocean of air possesses the special characteristics of " the salt sea wave "—only, from some points of view, intensified. By a curious coincidence, the first volume to which we turned after penning that article illustrates our point in a striking degree. The perfect navigator of the seas should, in these latter days, be master of such a compendium of knowledge that an ordinary lifetime is too short for the acquisition of it. Captain Dixie's manual goes to show that the Admirable Crichton of the air requires for the attainment of his " admirability " a wider range of knowledge still.

The volume opens with a preliminary discourse on magnetism in which the fundamental theories are set clearly forth in such a way as to lead up to the natural phenomena of the magnetic poles, and to the various forms of compass in general use. The respective qualities of those varieties are briefly touched upon, together with some practical hints with regard to their use, their location on aircraft and their repair. The reason for the unsteadiness of the compass after a heavy aeroplane " Bank " is made the occasion of some useful and practical hints on how to remedy the trouble ; the student being referred for more detailed information to Capt. F. Creagh Osborne's useful pamphlet on the subject of " Compasses in Aircraft." The great height, at which flights are now carried out, renders the subject of supreme importance to a pilot, who has frequently, when objects below are hidden by cloud or fog, to rely absolutely upon the compass for his direction.

In Chapter VI. our author initiates a study of meteorology, a subject daily becoming of increasing importance to the flier, now that the distances covered are so much greater than they used to be, and now that machines are being built with an ever increasing capacity for remaining a long time in the air without a return to earth.

Captain Dixie justly points out that " even the best observatories equipped " as they are with every improved type of instruments, and with all their telegraphic " facilities, are continually out in their forecasts," so that an airman must not allow himself to be discouraged by his own failures. He then proceeds to give practical hints on the various methods of anticipating what weather may be expected under certain conditions, and we note with interest that he adds to his list of assistants towards such calculation, the wireless reports received from the stations, or ships, lying to westward of him, " bearing in mind that nearly all depressions with their " attendant bad weather are travelling to the eastward."

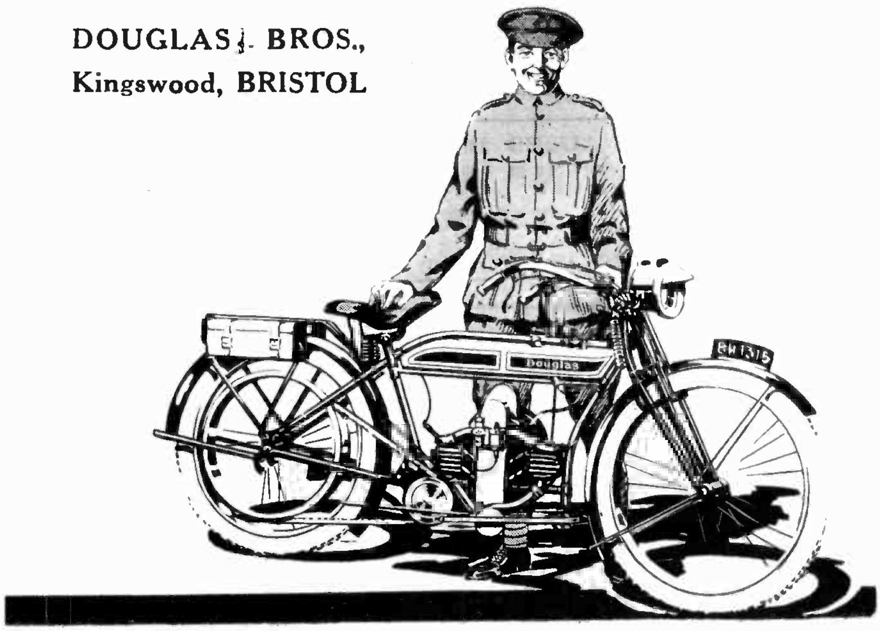
Having first directed the attention of the airman to magnetism and meteorology, his preceptor next demands from him a study of astronomy. The constellations which are here recommended as the best guides are those of Orion and Ursa Major (why the adjective is printed in the genitive—Majoris—we fail to understand). Of course, at this point the student comes into contact with the needless discrepancy between astronomical and conventional time, and is made to realise the absurdity of the arbitrary division of the latter into *a.m.* and *p.m.* The explanatory notes on the nautical almanac and its tables seem calculated to prove of real assistance, and some interesting examples of working the G.M.T. from latitude and date, and *vice versa*, elucidate the author's meaning better than any amount of explanation. Following the Admiralty practice, the volume under review only concerns itself with the " Gnomonic " and " Mercator " projections for charting work, the student being left to continue his mathematical studies into conic sections for other devices whereby the spherical surface of the earth may be represented on a flat surface. We do not observe, by the way, any reference to the fact that Isobaric and Isothermal charts are usually drawn on a Polar projection, although both of them are dealt with by our author. Map- and chart-reading is in itself by no means to be picked up in a few days, even by men with a natural gift that way, but much of the instruction given in the volume will be found of real practical service.

* * * * * *

AIR POWER. By Claude Grahame-White and Harry Harper. Chapman & Hall, London. Price 7s. 6d. net.

We turn to the list of illustrations, and we find that the frontispiece consists of a portrait of Claude Grahame-White, whilst the illustrations have been secured specially for this book from photographs taken in the factory of the Grahame-White Aviation Company, Ltd. The types of machine illustrated consist also for the most part of selections from those produced by the same commercial company. The volume, therefore, consists of the subject of aircraft viewed from this particular point of view. The earlier pages comprise a review of past events and the present position, subject doubtless to such restrictions as it may have been thought necessary to impose in the public interest, and contain nothing of very special novelty. although the points with regard to the various matters dealt with—" Speed and Striking Power," " One Machine One Task," " Long Distance Raids," " Silence and Invisibility," etc.—are well and clearly put.

When we turn to Part II., " Problems in Construction," we find—naturally from the writers' point of view—that the problems are simply stated, without any strenuous effort to indicate the lines on which they may be solved. Part III. deals with " Our Policy after the War," and we are certainly of opinion that the authors have made out a good case for the allocation of public money in aid of aeroplane development. Particularly *apropos* is Mr. White's assertion that the training of an aeroplane pilot is a matter of time and money and that " the period of training cannot be hurried or curtailed."



Personal Notes

THE war has been responsible for many sad tragedies, but few can exceed the unhappy lot of a mother bereaved of both her sons. This is the sad fate which has overtaken Mrs. Fenton, of Paramatta Street, Rawtenstall. One of her lads, Mr. J. A. Fenton, was the first to enlist in the Royal Engineers at Rawtenstall Recruiting Station after the outbreak of war. After serving from August, 1914, until September 1st, 1915, he was drafted out to France, attached to the Artillery. Subsequently he was transferred to the South African Contingent as wireless operator, and at the time he received his fatal wound he was acting in this capacity with the Canadian Division. For six weeks he lay at the first Canadian Hospital in France, and was thence removed to London, where he died a week later.

Sapper J. A. Fenton's brother Harry was also a wireless operator, but in the Mercantile Marine. He had been following the sea for some years, and at the time of his death, which took place off Sierra Leone, West Africa, on the 10th May last, he was wireless telegraphist on board the s.s. *Elmina*, belonging to the Elder Dempster Company.

We tender our very sincere sympathy to Mrs. Fenton in being so tragically bereft of both her sons within a comparatively short space of time.

* * * * * *

Life and Death! How closely the two are mingled! Just after penning the above message of true sympathy to a sorrowing mother at Rawtenstall, we find ourselves joining with others in sending congratulations to a bride and bridegroom who were, during June last, joined in holy matrimony at St. Mary's Church in the *same Lancashire town*. Second Lieutenant W. Birtwistle, R.F.C., who was, when the war began, in the service of the Marconi Company as wireless operator, led to the altar Miss Helena Craven, of Hurst Bank, Rawtenstall. Mr. Birtwistle, born at Blackpool in 1890, received his technical training at Manchester W. T. College. Appointed to the Marconi staff in April, 1913, he served first on board the Royal Mail S.P. Co.'s *Tagus*, and afterwards on the P. and O. Co's *Himalaya*. He transferred his energies to the service of his country, originally doing

MR. WM. BIRTWISTLE.

duty in his peace capacity as wireless telegraphist, and later on as a member of the R.F.C. He was gazetted Second Lieutenant in August last year, and is now stationed at home. Our congratulations to the happy pair!

MR. C. G. ALDERTON.

* * * *

In the supplement to the *London Gazette* dated Wednesday, June 27th, we find a number of awards of the D.S.O. granted to officers "in recognition of services in "vessels of the auxiliary patrol between "the 1st February and the 31st December, "1916."

The following wireless operators are included in the list of recipients of the Distinguished Service Medal:—

Operator Philip Martin Read, R.N.R., and Operator Wm. John Scott Watson, R.N.R., whilst amongst the list of those who have distinguished themselves and are therefore "mentioned in despatches," we find:—Warrant Telegraphist Cecil Guy Alderton, R.N.R.; Operator John Bradley Gambling, R.N.R.; Telegraphist Robert F. H. Gardner, R.N.V.R.; and Operator Athelstone Hill Millard, R.N.R.

We are glad to have this opportunity of recording the official recognition, which has been made in the cases of these gentlemen, of the gallantry which wireless men are displaying on all seas, and we offer our congratulations both to the telegraphists themselves and to those dear to them.

We should have liked to have included photographs of each in these pages, but up to the present we have only been able to secure those of Mr. A. H. Millard and Mr. C. G. Alderton. The former, born 25 years ago at "Merry Islington," received his wireless training at the London Telegraph Training College, from which establishment he obtained his first-class P.M.G. Certificate. He entered the Marconi Service in March, 1912; and—after serving on board several vessels—left to take up another position in June, 1913.

MR. A. H. MILLARD.

Mr. Alderton is two years younger, and has received the distinction of "official mention" in the *Gazette* at the early age of 23. He was born at Lowestoft, and received his education at Lowestoft College and Framlingham College. His preliminary wireless training was carried out at the London Training Telegraph College, and he joined the Marconi Company's

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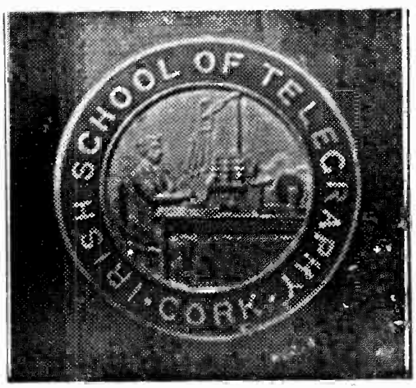

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London School in May, 1913. After receiving his appointment to the staff of that company, he served on board the s.s. *Beacon Grange* and s.s. *Dongola* for a number of voyages in the peace days, which now seem so far away. On the outbreak of war Mr. Alderton volunteered for special Admiralty service.

* * * * * *

One of our Sussex contemporaries recently published a letter from "a former "clerk and telegraphist in the Midhurst Post Office, now serving in the R.F.C. as "a wireless operator." This young Flying Corps man draws a graphic pen-picture of what a wireless man's life attached to a battery in the British advance really means. "Duty from dawn to dusk, with often a lot of repairs and alterations to make to the "station after dark!" He details his experiences in a town "in German occupation "less than a fortnight before we marched in"—and in the course of narrating how he had recently met a number of comrades from the same Sussex district as himself—he winds up: "I am convinced that my own life is charmed, and that I shall get out "of this all in one piece after all. . . . Cheer-ee-oh!"

Alas that the same page of the journal which prints his cheerful experiences and reflections should also announce his death! Yet so it turned out. The *Sussex Daily News* editor adds a footnote to state that within four days of writing home the gallant lad passed away. "Died of his wounds" was the official report sent to his sorrowing parents. Our contemporary does not reveal their name.

* * * * * *

Amongst those who lost their lives when the ill-fated hospital ship *Salta* struck a mine in the Channel on the 10th April last was Senior Operator John E. Glaves. A native of Harrogate, he received his education at the local school, distinguishing himself all through his early career as an all-round athlete. He attained to the front rank in cricket, football, swimming and motor-cycling, and was as fine a specimen of an athletic young Englishman as you could wish to see. After turning his attention to radio-telegraphy, he went through a course of training at the North-East School of Wireless Telegraphy at Leeds, and gained his first-class certificate whilst at that college. He started his career at sea as wireless telegraphist on the s.s. *Sachem*, from which vessel he was later on transferred to the s.s. *Rossano*. It was only a fortnight before his death that he was drafted to the hospital ship *Salta*. We offer our very sincere condolences to his family at Harrogate in their bereavement.


THE LATE MR. J. E. GLAVES.

* * * *

In our November issue (page 610) we printed a description, written by a wireless man "on duty in the North Sea," describing under the title of "Notes in the Air," various distinctive features of the ether waves received from various stations ashore and ships at sea. That account was based on particluars sent by Mr. A. J. Collins, R.N.R., a naval wireless telegraphist, and we are pleased to congratulate him on having been recently awarded the D.S.M. He was a pupil at the Liverpool School of Wireless Telegraphy and has for the last eighteen months been stationed on the East Coast patrol. He is an old subscriber to the WIRELESS WORLD, and we learn with very much pleasure of the distinction thus conferred upon him.

* * * * * *

We notice that three gentlemen formerly attached to the Marconi Service have recently been granted commissions in His Majesty's Forces. These are :— Mr. J. Cowan, who has been gazetted Second Lieutenant to the City of London Regiment, Mr. P. D. Parker, who has been attached as Second Lieutenant to the Dragoon Guards, and Mr. C. J. McCarthy, who has received the appointment of Sub-Lieutenant R.N.V.R. Mr. Cowan, who is at present 27 years of age, joined the Marconi Company on June 21st, 1912, and left for service in the Army on November 19th, 1915. Mr. Parker, who recently came of age, received his first appointment in the Company's service on September 15th, 1911 ; and—being already a member of the Yeomanry—was called up at the mobilisation of his regiment in August, 1914. Mr. McCarthy was born at Birmingham in 1894 and educated at the Oratory Preparatory School and St. Phillip's Grammar School. Prior to " joining up " he had served as wireless operator on a number of vessels.

The list of Marconi men who have distinguished themselves in the present war is already large and is continually being added to. We offer our hearty felicitations to these latest additions to the wireless " Roll of Honour."

* * * * * *

In our January issue (page 773) we chronicled some gallant but abortive attempts on the part of the Dutch steamer *Rijndam* and the American steamer *Rockingham* to go to the rescue of the American four-masted ship *Manga Reva* in answer to a wireless call for aid. Despite every endeavour on the part of the gallant Dutchmen and Americans no trace of the unhappy vessel could be found. The crew therefore were all given up as lost, and we have the sad duty of recording the death of Operator Geare, a young American attached to the *Manga Reva*, who sent the last message radiated from the aerials of the unfortunate vessel. He was born at Washington, D.C., and had only attained the age of 21 at the date of the fatal catastrophe.

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Company Notices

Marconi International Marine Communication Co. Ltd.

Report of General Meeting

The Seventeenth Ordinary General Meeting of the Marconi International Marine Communication Co., Ltd., was held on July 4th at the Cannon Street Hotel, Mr. Godfrey Charles Isaacs, the managing director, presiding.

The Chairman said: Gentlemen, I regret that Mr. Marconi is again unable to preside to-day as you are no doubt aware from the public Press that he is representing his Government on a Special Commission to the United States.

The Balance-Sheet: Debentures Reduced and Reserves Increased.

I propose to adopt the usual course of taking the report as read, and will proceed to deal with the figures of the balance-sheet. The whole of the 350,000 shares were issued prior to the end of the year, and of these at that time some 34,587 were only partly paid, which accounts for the increase of some £26,000 under this head. The First Mortgage Debentures have been reduced during the year from £121,000 to £114,000 by means of purchases made from the reserve for this special purpose, which will also account for the reduction of that reserve to £5,110. It is our policy to purchase Debentures as opportunity offers from the amount which we place to reserve for this purpose yearly. The general reserve account has been increased from £17,639, at which it stood last year, to £47,653 10s., and to this figure we are adding £17,346 10s., bringing the reserve account up to the round sum of £65,000. The credit balances have increased in proportion to the increase of the business, and call for no special comment.

Turning to the credit side, the item of plant, apparatus, furniture, and stores has been increased by some £95,000 during the year, after writing off a substantial sum for depreciation. This increase, of course, is accounted for by the additional stations which have been installed. The debtor balances show an increase proportional to the increase of business. The item which stood last year as Debenture discount disappears entirely this year, it having been written off against the share premium account. The cash at bankers is substantially less, but investments and loans show a large increase, accounted for mainly by the investment of £50,000 in War Loan, which I am confident will meet with the approval of all shareholders. (Hear, hear.).

The Profit and Loss and Appropriation Accounts.

Turning to the profit and loss account, "Salaries, General Charges, and Expenses of Ships' Telegraph Stations," including depreciation and loss of plant and apparatus, show necessarily a marked increase by reason of the greater volume of business done, and in part in consequence of substantial losses which have been made of ships' installations resulting from the submarine warfare. All of these losses we have debited to profit and loss account. (Hear, hear.). The Debenture interest, of course, is somewhat reduced in consequence of the Debentures which were purchased and cancelled. The last figure, the balance carried to balance-sheet, is £96.748, as compared with £63,630 of the preceding year, and represents an increase of something over 50 per cent. On the other side you have the revenue from ships' telegrams, subsidies, etc., which shows an increase for the year of over £60,000, and in this the item pertaining to ships' telegrams is a negligible one. I shall have more to say upon this subject a little later.

Turning to the appropriation account, you will find to the credit of profit and loss account, as per balance-sheet, the sum of £123,744, being the profit for the year plus the amount carried forward from last account after deduction of excess profits duty. We have paid already an interim dividend of 5 per cent., which amounted to £16,622, and we are now proposing to pay a final dividend of 10 per cent., which will absorb a sum of £34,996, and after placing £3,500 to reserve for repayment of Debentures, which is our custom every year, and crediting the general reserve with £17,346, we carry forward a sum of £51,279, which, of course, is subject to excess profits duty.

THE REVENUE FROM SHIPS' SUBSIDIES.

In view of the fact that our business is still being conducted under exceptionally unfavourable conditions, I think you will agree with me that we have every reason to be satisfied with these figures. (Hear, hear.) I said "exceptionally unfavourable conditions"; by that I mean that practically the whole of our profits are derived from ships' subsidies, for there is practically nothing doing at the present moment in commercial or private telegrams at sea. Normally we derive a very substantial revenue from these telegrams, and when we return to peace conditions we shall, no doubt, see a very substantial increase in our receipts derived from this source. Not only has the number of ship telegraph stations been immensely augmented during the war, but there has been also a large addition to the coast stations, which will give far greater facilities for communication with the land than obtained prior to the outbreak of hostilities. Further, we are making very considerable losses in consequence of the submarine warfare, all of which, as I have said before, we are debiting to profit and loss account. It is to be hoped that these losses will cease and that we shall see additional revenue in consequence.

Here I should tell you that in past years it has always been our custom to insure against the risk of losses at sea, but the premiums having become so very high owing to the submarine warfare, we determined, after careful consideration, to take the risk ourselves, and it will interest you, no doubt, to know that during the year under review, notwithstanding the severity of the submarine warfare, we saved under the war risk insurance the sum of £1,174 and in marine risk £451, or a total of £1,600, as a result of taking ourselves the risk instead of paying the high rate of insurance premiums asked. We feel that we are justified, having regard to the sound development of our business, in recommending to you the payment of an increased dividend, which we feel confident of being able at least to maintain, notwithstanding the necessity for increasing the capital.

INCREASED NUMBER OF PUBLIC TELEGRAPH STATIONS ON THE HIGH SEAS.

We informed you in our report that the number of public telegraph stations owned and worked by the Company on the high seas increased from 1,008 at the end of December, 1915, to 1,472 at the end of December, 1916. You will be able to appreciate the considerable capital expenditure which we are called upon to make when I tell you that, up to June 30th this year, we have already fitted 595 additional ships. This brings the total number of ships installed, after deducting losses, to 1,055, which is by far the biggest rate of increase in the history of the Company. Our orders in hand, too, are very considerable indeed, and we contemplate their being very largely augmented in the near future; for this provision must be made.

There is one further figure which it will interest you to know, and that is that our subsidies alone, at June 30th, had increased to the sum of £451,713 per annum. When you compare this figure with the sum of £24,445 6s. 6d., which were the total receipts for the year 1909—the year before I joined the Company—you will appreciate the rapid growth of our business and the necessity of our summoning an extraordinary general meeting to ask you to approve of the Company's capital being increased by the creation of 250,000 new shares. Subject to that resolution being passed and in due course confirmed, Treasury authority will be asked for an issue. Shareholders may rely that, when that time comes, their interests will be carefully considered.

ADDITIONAL DIRECTORS APPOINTED.

This leads me to refer to the very valuable assistance and the loyal support which I have always received from Mr. Allen and Mr. Bradfield from the moment I assumed the managing direction of the Company in January, 1910. Many of you who have been shareholders from the outset will know that both Mr. Allen and Mr. Bradfield have been connected with the Company since its formation, and there is nobody better acquainted with its affairs than they are. In my view, no man should be indispensable, particularly in a business of this magnitude. It has, therefore, always been my custom to confer with Mr. Allen and Mr. Bradfield upon all matters of importance affecting your interests, but it was nevertheless to my mind impossible that these gentlemen should be able at any moment, in case of need, efficiently to carry on the business without me unless they were conversant with all that transpired at the meetings of the Board. I also deemed it necessary for them not only to be present at the meetings of the Board, but to be thoroughly conversant with the policy of the directors in all respects, and to be able to discuss that policy, and give the benefit of their advice, irrespective of the positions which they

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otherwise hold in the Company, in the same position and with the same authority as the rest of the directors. I am fully convinced that the shareholders will applaud the election of these two gentlemen to the Board. (Cheers.) I need not, perhaps, add that I am confident that the position of the Company is materially improved thereby. The work generally has developed to such a degree that it has been necessary to obtain additional assistance, and Mr. Maurice Bramston, who has been for some years associated with another of our companies, has been offered, and has accepted, a seat on the Board of this Company. I am confident that we shall derive considerable assistance from the sound judgment and experience of our new colleague. (Hear, hear.)

Heavy Work of the Staff.

Before formally moving the resolution, I must refer to the immense amount of heavy and responsible work which has fallen upon our staff. They have been untiring in their efforts, working continuously, day after day, very long hours with hardly a day's holiday. Every member of the staff has given of his best most willingly, and although it has not been their privilege to take part in the defence of the country in the field, the services which they have rendered to the country have not been surpassed by those who could be spared to join the Army.

Gallantry of the Operators at Sea.

We must also not forget to express our great appreciation and profound admiration for our operators at sea. (Hear, hear.) It will interest you, gentlemen, to know that to June 16th we had some 3,347 operators and students. Of those to that date some 333 had been saved from vessels sunk, 45 were drowned, 29 had been injured, 1 killed, and 19 have been taken prisoners of war. Notwithstanding the great increase of risk and danger in the services which they perform, in no single instance has any one of them murmured, and in no case has any one failed in the critical moment to do a full and heroic duty. (Cheers.) The experiences of many of them would make thrilling stories, but all we hear from the men themselves is, "Ship torpedoed, all effects lost, awaiting instructions," and the information we obtain of the magnificent manner in which they have behaved comes from the shipping companies, the officers of the ship, or from other sources, but never from the men. (Cheers.)

It will interest you, perhaps, to hear some few of the reports which from time to time have reached us. In one case an officer of the ship informed us that after the torpedo struck the ship the operator went along to the captain to obtain instructions and the position of the ship. He was given the position, and told by the captain that he had better not go to the wireless cabin, as it was too dangerous, and that the crew were leaving in the boats. Notwithstanding this, the operator returned to his cabin, called for assistance, gave the position of the ship, and received a reply. This resulted in the survivors being picked up at 8 o'clock the following morning, the disaster having occurred at 11 o'clock the night before. (Cheers.) Another instance was that of an operator who, after a torpedo had struck the ship, and while the crew were leaving, remained at his post and sent out the signals of distress. The ship foundered in four minutes, and the operator went down with her. The following is a report we received in another instance. The operator himself wrote: "I met with no injury except a few bruises, and am feeling pretty fair, considering it is the second time within two months that I have been torpedoed. Should like to draw attention to the kindness of the captain, who on getting into the boat was told that I was still in the cabin, and, although the ship was half under water and sinking fast, he came back and took me off." ("Bravo!" and cheers.)

I am afraid that I must not go on or I should keep you here for hours giving similar accounts of the fine indomitable pluck of these young men. There is, however, one more case which I must mention, and that is the case of an operator who has been torpedoed three times within three months On each occasion he stood to his post unflinchingly, and I am glad to say was eventually saved without suffering any apparent ill-effect. He was quite prepared to be ordered to his next ship. We have, however, come to the conclusion that if his nerves have not suffered perhaps they ought to have done so—(laughter)—and we have decided therefore to give him a post on shore. (Hear, hear.) When this war is over, no doubt a book will be written upon the experiences of wireless operators. It will certainly be a most interesting book, and will add to the very high respect and admiration which we all have for those who follow that occupation. (Cheers.) I will not keep you longer, gentlemen, but will formally move "That the report of the directors submitted, together with the annexed statement of the Company's accounts to December 31st, 1916, duly audited, be received, approved, and adopted." (Cheers.)

Questions & Answers

NOTE.—*This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless telegraphy. There are no coupons to fill in and no fees of any kind. At the same time readers would greatly facilitate the work of our experts if they would comply with the following rules:* (1) *Questions should be numbered and written on one side of the paper only, and should not exceed four in number.* (2) *Replies should not be expected in the issue immediately following the receipt of queries, as in the present times of difficulty magazines have to go to press much earlier than formerly.* (3) *Queries should be as clear and concise as possible.* (4) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. This will save us needless duplication of answers.* (5) *The Editor cannot undertake to reply to queries by post, even when these are accompanied by a stamped addressed envelope.*

H. L. (Bradford).—(1) Yes, the holder of a third-class or temporary certificate can sit for an examination for a first-class certificate when in port. (2) Yes, if he is appointed to the staff he is paid the usual rate.

H. M. H. (Hartford) tells us that he has recently made a few experiments with gas carbons, chiefly with bichromate batteries, and finds that the internal resistance is reduced and polarisation retarded by immersing the carbon plates in melted paraffin wax for three minutes. He has also undertaken six tests, and submits to us several curves showing the results obtained. From these it would appear that the wax carbons give the effect he claims, although in the absence of details it is impossible to say whether this is a genuine effect or due to faulty observation. It is certainly very difficult to understand why the internal resistance of the cell should be reduced by the wax, which is one of the best insulating materials known. Perhaps some of our readers can give us a little information on the subject. We shall be only too pleased to forward a copy of our correspondent's letter, together with the curves, to anyone who would like to go into the matter.

J. P. D. (Ardrossan).—Thank you for your correcting note.

H. S. (Durham) and one or two other correspondents send us queries which will be answered as soon as they forward their names and addresses. We take this opportunity of reminding readers that we cannot answer questions from anonymous correspondents. All letters must bear the full name and address of the sender, which are required for reference purposes. All queries are answered either under the initials of the correspondents, or under a nom-de-plume if one is sent.

S. L. P. (London) asks: (1) What are the principal qualifications required to become a wireless engineer? (2) If it is necessary to have previous workshop experience, and to have served an apprenticeship with a firm of electrical engineers, and (3) what text-books on engineering mathematics and electricity we would recommend?

Answers.—(1) and (2) Applicants for positions on the wireless engineering staff of the Marconi Company must have been trained as engineers, by serving an apprenticeship in engineering, and by having passed with credit through the engineering courses of a recognised technical college. They must also be physically fit and able to pass the company's doctor, willing to serve in any part of the world, and their general education must be such as to make them suitable for the work which they have to undertake. (3) We cannot undertake to recommend any particular books on engineering mathematics and electrical engineering generally. We would recommend our correspondent to make his choice from the numerous books on these subjects which have been reviewed in the Library Table section of our magazine.

F. A. (Manchester).—(1) Applications for employment on the marine operating staff of the Marconi Co. should be addressed to the Traffic Manager, Marconi International Marine Communication Co., Ltd., Marconi House, Strand, W.C.2 (2) The age limit is 25. (3) Lameness will debar a man from this employment.

H. W. J. (Accrington).—The following is the standard uniform for the Marconi operator: Double-breasted coat with no flaps to

pockets (pocket on left breast, two pockets at side and ticket pocket inside), four button front, slits at side (not back), gold lace on sleeves (single wave for junior and double wave for senior); vest with no collar and six-button front; trousers as usual, but not turned up at bottom; cap of naval regulation pattern with mohair band and Marconi badge; great coats as worn by Royal Navy with Marconi buttons; mess coat as worn by Royal Navy with Marconi buttons; patrol coat with two pleated pockets on breast, two plain pockets at side, no slit at side, and stand-up collar; the mess coat is not always necessary, and is only worn on certain passenger liners. It is advisable to carry as large a supply as possible of clean linen, underclothing, etc., as frequently an operator is required to sail on a long voyage where very few facilities exist for washing. Hints on uniform and clothing are given in the Wireless Diary and Note-book.

E. M. (Burgess Hill).—A weak heart would debar you from entering the service of the Marconi Company as a wireless operator, as you would not be able to pass the company's doctor. The code used in wireless is the ordinary Morse or Continental code.

"Sincere Reader," who lives at Plumstead Common, is anxious to hear and know whether any reader or readers in this district would care to meet him for the purpose of studying wireless together. We shall be only too pleased to place our readers in communication with "Sincere Reader" if they will communicate with us.

"Disabled" (Liverpool).—(1) The length of time for a full course in wireless telegraphy—*i.e.*, a course which will enable the student to study for the Postmaster-General's Examination—should not take longer than six months if evening classes are attended as well as day classes. This is, of course, on the assumption that the student starts with no previous knowledge either of telegraphy or wireless. The fees depend upon the particular college at which one attends. At the present time the Marconi Company is prepared to provide free training to approved candidates (see our advertising pages). (2) A wireless operator in the Marconi Company commences at £1 per week, with an additional 5s. as soon as he takes charge of a ship's installation. Increases are given at the rate of 2s. 6d. per annum up to 30s., after which the salary advances at the rate of 5s. per annum to a maximum of £2 15s. The additional 5s. "charge money" is only paid to those operators whose salary does not exceed 30s. per week. (3) Vacancies in the ranks of inspectors, instructors, etc., are filled from the operating staff, and an intelligent man who attends to his duties and extends his knowledge by study and observation stands a good chance of receiving one of these appointments after he has served some while at sea.

"Constant Reader" (Nottingham), asks the manner in which a message is received in an airship or aeroplane—*i.e.*, how the aerial and earth connection are arranged, and the manner in which this latter is made. (2) The method used to get various wave-lenths. (3) Whether it is possible to actuate various solenoid coils by various wave-lengths.

Answers.—(1) There is no "earth connection" in aeroplane and airship wireless. The aerial consists usually of a trailing wire, the usual earth connection being replaced by what is known as the "balancing capacity." In this way the radiating and receiving system somewhat resembles the original Hertzian oscillator, which was not in any way connected with the earth. The apparatus used on an aeroplane or an airship does not differ in principle from that used on land or ship sets, although naturally it is made as light and compact as possible. In view of the fact that modern aeroplane and airship wireless has been developed since the outbreak of war, we are unable to give any details of apparatus. (2) Adjustments for various wave-lengths both for transmission and reception on an aeroplane or airship is carried out by the same method as on an ordinary wireless installation. (3) We do not quite understand what our correspondent wishes to know. With modern amplifying apparatus, it is possible to magnify the receive signals to such an extent that they will actuate relays carrying comparatively heavy current, and these relays may be made to bring into circuit various other pieces of apparatus such as solenoid coils.

"Obelisk" (Manchester).—(1) Whether or not a wireless operator can take a camera on board ship with him depends on circumstances. At present, while the war is on, one would not be allowed to be in possession of a camera in the neighbourhood of any docks in this country, and, of course, under the Defence of the Realm Act it is an offence to take photographs in a large number of localities. (2) You cannot carry a revolver and ammunition without a licence. Personally, if we found a new wireless operator coming on board armed to the teeth in this way, we should, to say the least, be filled with mild wonder. (3) This question is dealt with in the answer to H. W. J. (Accrington). (4) Conditions of employment for wireless operators are obtainable on application to the Traffic Manager, Marconi International Marine Communication Company, Limited, Marconi House, Strand, London, W.C. 2.

J. K. (H.M.T. ——).—It is, of course, difficult without knowing all the circumstances to advise you what steps to take. Why not enquire of your Senior Officer if there are any prospects of a commission in the R.N.A.S. if this appeals to you? With your qualifications you should be able to do very well in the wireless branch of this service.

L. M. 2 (Belgian Army in the Field).—The first of the two circuits is obviously the simpler, and we do not think that the second would give any better results in practice.

J. R. (Sheffield).—The effect which you describe is most probably due to the proximity of a high-power continuous wave transmitter. At the present time, for reasons which will be obvious to you, we cannot discuss any matters relating to the position of such stations, neither do we think it advisable to publish your letter. Nevertheless we are very interested in it, and we hope that you will realise that nothing but the war prevents its publication.

G. E. S. (Nottingham).—You cannot do better than to carry on as you are going at present, and, if you carefully study parts one and two of the book in question, you should be splendidly equipped with theoretical knowledge when you join up. Promotion in the Service depends entirely upon yourself, and you may be sure that merit will be recognised. Carry out the work which is allotted to you to the best of your ability and you will be sure to do well.

H. H. (Gloucester) does not give his full name and address, and therefore his queries cannot be answered.

W. I. H. (Birmingham).—Apply to the Chief Engineer, Marconi's Wireless Telegraph Company, Ltd., Marconi House, Strand, London, W.C.2, for conditions of employment of wireless engineers and a list of approved technical institutions.

A. N. C. (Bowdon).—Unless the holder obtains employment in the Mercantile Marine within two months of its issue, the Postmaster-General's certificate (whether first, second or third class) ceases to entitle the holder to exemption from military service. Third class certificates will undoubtedly be withdrawn as soon as circumstances permit, as they are only of a temporary nature. In reply to your last question, if a man enters the Army or Navy he does not lose his certificate.

A. Y. E. (New Cleethorpes).—In our October 1916 issue we published an article on Wireless in the Navy, which we think will give you all the information you require.

Queries from "SPARKS" and F.T.H. (H.M.S. ——) are held over until next month, in order that they may be fully dealt with.

Share Market Report.

LONDON, *July 10th*, 1917.

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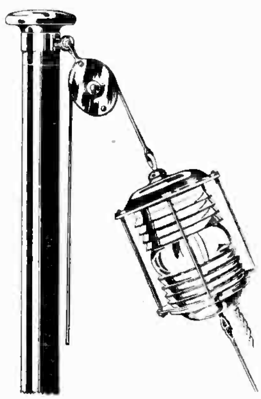

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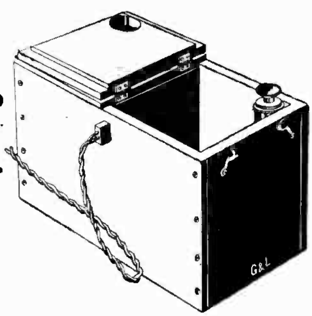

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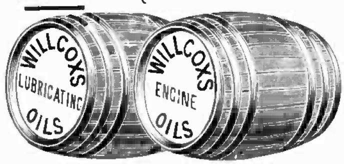

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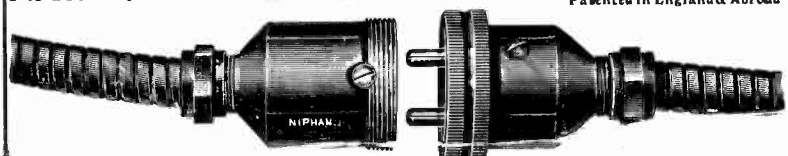

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