VOL. VI. No. 64. JULY

The Wireless World

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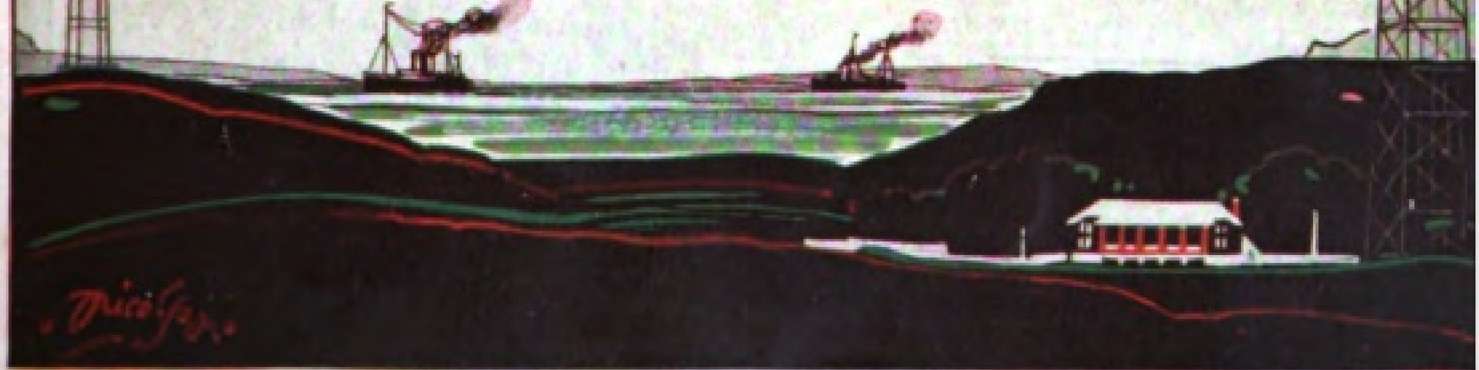


The
WIRELESS WORLD

Volume VI. No. 64. JULY, 1918.

Winter in the Mediterranean

An Operator's Account of His First Cruise

By HAROLD WARD

Our first appointment means much to all of us, and, in my own case, I was doubly justified in self-congratulation, for I received orders to join the R.M.S. *Celtic*, a famous White Star liner, on an occasion when she was chartered for a winter cruise in the Mediterranean by a prominent firm of American tourist agents. What more could a junior wish for ? A short trip to " little old New York " just long enough to give me my sea legs, a fortnight there, and then away for a couple of months " rubber-necking," as our transatlantic cousins call it, in and about the most historic sea in the world. Assuredly nowhere else do we find such varieties of scenery, peoples and climates, packed within so small an area.

It all happened in the " piping days of peace," and the *Celtic* was not fitted with her present up-to-date gear. Despite a fair amount of " traffic," my senior had no complaints to deal with on our return, so that we must have " made good." The apparatus consisted of but a single ten-inch coil, with the result that we generally

A VOLUMINOUS HEADGEAR FOR A WARM CLIMATE.

worked P.A. during transmission. We had no multiple tuner, but relied for reception upon an old "Maggy," a variable plug inductance-coil and a disc condenser. I need hardly say that in those days there was not half so much jambing as occurred later on, after the multiplication of stations, or I fear that our record would not have proved so blameless.

It is hardly worth while to dwell upon our journey to New York; over the first part thereof I am only too happy to be able to draw a veil—perhaps it is needless to say why! In due course, sailing day for the cruise proper arrived. Passengers and baggage came on board, first-class all of them, save for a few Italians seeking repatriation, and they arrived in such numbers that I wondered where they would all find room. The very ship seemed to palpitate with excitement; the "white feather" at the funnel top grew larger and larger until it finally burst forth in a thunderous roar, as though irritated at the delay. A bell rang out; visitors streamed ashore; the band struck up "The Star-spangled Banner"; and amidst a chorus of farewells and a cloud of waving handkerchiefs, we slowly slipped away from the dock, yielding with a dignified air to the fussy little tugs straining at their lines and sidling us out into mid-stream. Slowly we "came about," the engine-room gongs clanged, and away we went down the Hudson, till all the waving hands and little flags first blurred into an indistinct mass, and finally vanished altogether. Even to-day I always feel on leaving a port the same peculiar thrill as then went through me. As matters stood then, I had to go on watch immediately, and missed the wonderful sight of the crowded shipping huddled in the lower reaches.

A few pleasant days at sea brought us within sight of the lovely green hills of São Miguel, the most important member of the Azores Archipelago. Never did hills look greener or houses whiter than on the day when we dropped anchor off Ponta Delgada, the capital city of the group. The island of St. Michael, as it is more commonly called by English-speaking people, though situated some thousand miles from the Iberian Peninsula, is officially reckoned a constituent part of Portugal, and not merely a colonial town as would be the case under the British *régime*.

SHEEP-DRAWN CART IN THE STREETS OF ST. MICHAEL'S.

It possesses a perfect climate, and fruit in endless variety flourish in the open, whilst we see on every hand such strangers to our temperate zone as plantations of tea, coffee and sugar. Many curious sights greet the eye as one strolls around the quaint little streets; that which most impressed me being the tiny carts drawn by sheep. So far as my own experience goes, this is the only place in the world where such animals are used in this way, and the illustration reproduced on the opposite page will give some idea of what it looks like. Heavy carts, with solid wooden wheels and wicker sides, lumber along and creak over the cobbles as the driver noisily urges his oxen onward. Strange, too, appear the peculiar head-dresses worn by the women; their vastness of spread and sombre black tint would seem as though they must prove oppressive to their wearers in such a warm climate. Once again we have —as indicated in our picture—an illustration of the popular proverb "Pride feels no pain." The general effect produced upon my mentality by life in this favoured land was a sense of peace and perfect content; and indeed the feeling which I experienced

THE BUSY WHARVES AND DOCKS OF THE OLD "PIRATE CITY."

appears shared by both island and people. Small wonder that the ancients should have included this amongst their "Islands of the Blest."

Here, as in all Roman Catholic countries, churches abound, and the pleasant-toned bells are ever calling the faithful to prayer.

I quitted the Azores with regret, and, although up to the present I have not been afforded a chance of returning, I registered a vow that I would take the earliest opportunity of so doing, "when my ship comes home."

Gibraltar was our next port of call, and I felt to the full all the fascination of the "Rock" (as it is familiarly called). The scenes here have, however, been so frequently described that it is needless for me to dwell upon them, save for a passing remark on the cosmopolitan nature of the crowd which throngs the lower streets.

After this, our way lay through glistening seas to Algiers, the ancient home of piracy and slave trading, familiar to us all from the adventurous yarns we enjoyed as boys. Although piracy of the forcible variety has passed away, a modernised form still exists, and corsair-touts carry on piratical attempts upon the purses of tourists all through the frequented ports of the Mediterranean. Their outward

A CONFAB OF CRONIES ON THE GRANDE PLACE, ALGIERS.

appearance is varied; but guides, itinerant musicians, and pedlars of worthless faked curios, continue to maintain the ancient tradition of preying upon "the Stranger within their Gates."

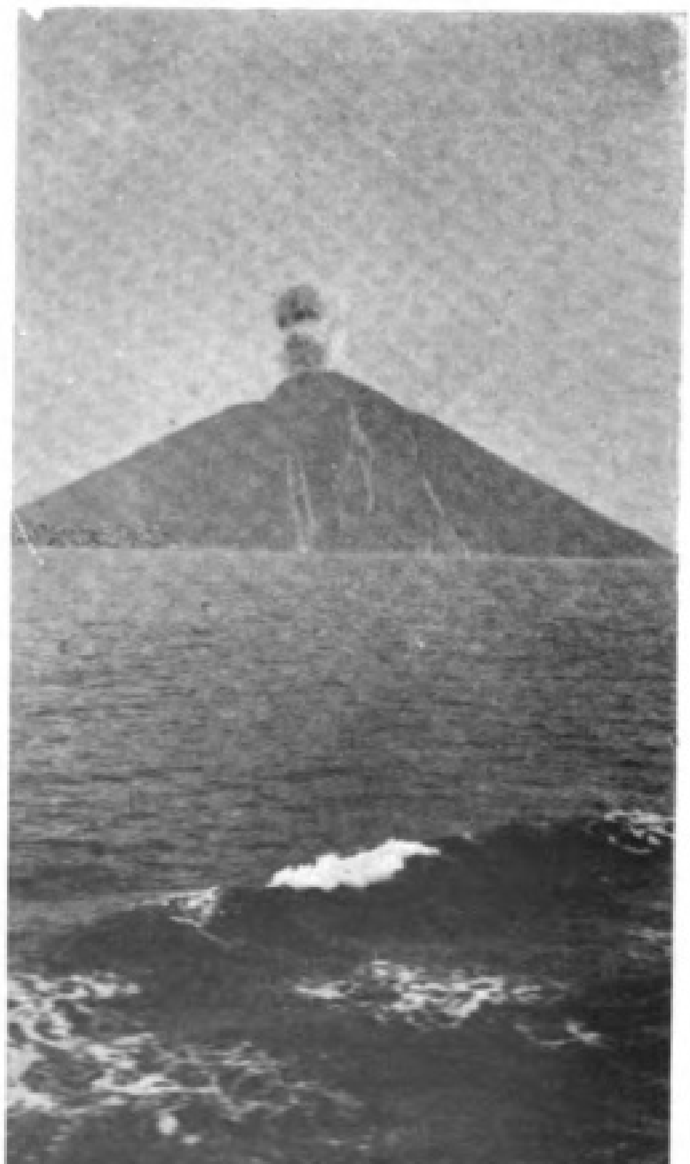
The ship's mate has a favourite yarn about the tout's idea of fun, and it is in Algiers that the scene was set. I will retail it here for the benefit of those who do not happen to have heard it before; 'tis a standard tale which varies but little, except that it is usually narrated as having happened to the teller:

I could not get rid of him. He offered me postcards, cigarettes, curios, etc.—especially etc. —to all of which offers I returned a firm "NO!" As a last resource, to lose no opportunity of doing business, he whined "Ah, sare, you come along o' me to-night, I show you *plentee* fun. Last night two men killed; to-night plentee more fun."

Climatic conditions are so favourable that many Europeans winter here, and a number of fine modern hotels have sprung up which, although somewhat incongruous amidst the surrounding streets of dirty native haunts, add immensely to the comfort of those who desire to make a prolonged stay. It was here that I first realised the full meaning of the Biblical phrase "the Street that was called Strait."

Many of the purer Arabs are rather handsome; that is to say, so far as the menfolk are concerned. With regard to the women, it is impossible to express an opinion, their faces being so enveloped in drapery that two gleaming dark eyes are usually all that one can see as they shuffle past you. The central *Grande Place* of Algiers—a handsome, spacious, open space paved with stone—presents a kaleidoscopic scene of ever-varying humanity in Eastern and Western garb alike. Our illustration depicts an Eastern group holding a confab at one corner thereof.

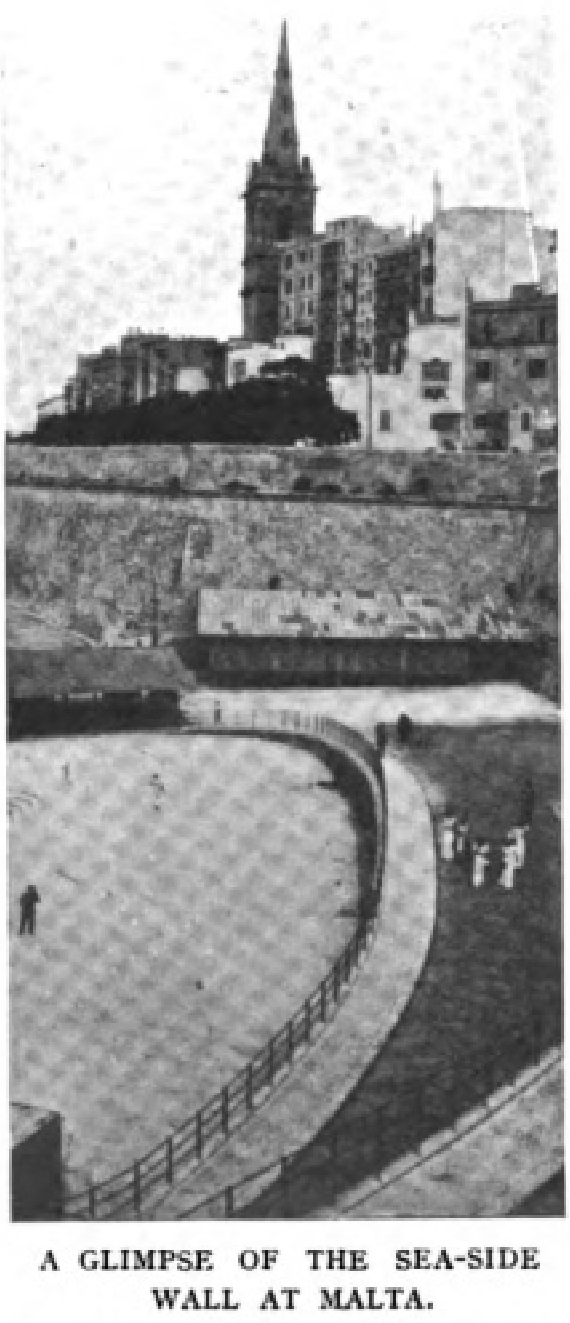
Hence we pass on to Alexandria, stopping only for a short interval at



STROMBOLI, BELCHING SMOKE AND STREAMS OF LAVA, WITH HUMAN DWELLINGS NESTLING ALONGSIDE.

Malta. I was amused at the way in which the people on this island evade the danger of watered or adulterated milk. *The milkman brings his dairy with him!* What I mean is that he drives a flock of goats from street to street and taps them on the doorstep of his customer.

As soon as we arrived at Alexandria our decks quickly became converted into an Oriental bazaar. Streams of Arab traders clambered over the rails and displayed their wares to the fullest advantage. What an assortment of goods and rubbish they offered for sale! Scarabs, carpets and cheap jewellery were commingled with heaps of tins of cigarettes, until one had scarcely room to move. The vendors price their articles according to what they think the intending customer will give, but are easily beaten down to half (or even less) of their original demand by an astute old-timer. Practically all the jewellery and metal curios are of Brummagen origin in reality, although highly coloured stories of their value and rarity fall glibly from the lips of the traders. The native quarters ashore are well worth a visit. Here the trading is mostly done on stalls such as those shown in the picture on page 200; whilst bargaining, even for trifles, is carried out on the same chaffering lines. My shipmates and I made the usual excursion to Pompey's Pillar (which has nothing to do with the Great Pompey at all), and near by we saw some interesting catacombs, believed to be the tombs of Early Christians. Should it fall to your lot, reader, ever to visit them, the guide will probably show you, as he showed us, a chamber which has only been opened that day. It is likely indeed that your party (like ours) will be the first to enter it! Be discreet, as we were, and refrain from asking your informant how so many European names came to be scratched upon the walls!



A GLIMPSE OF THE SEA-SIDE WALL AT MALTA.

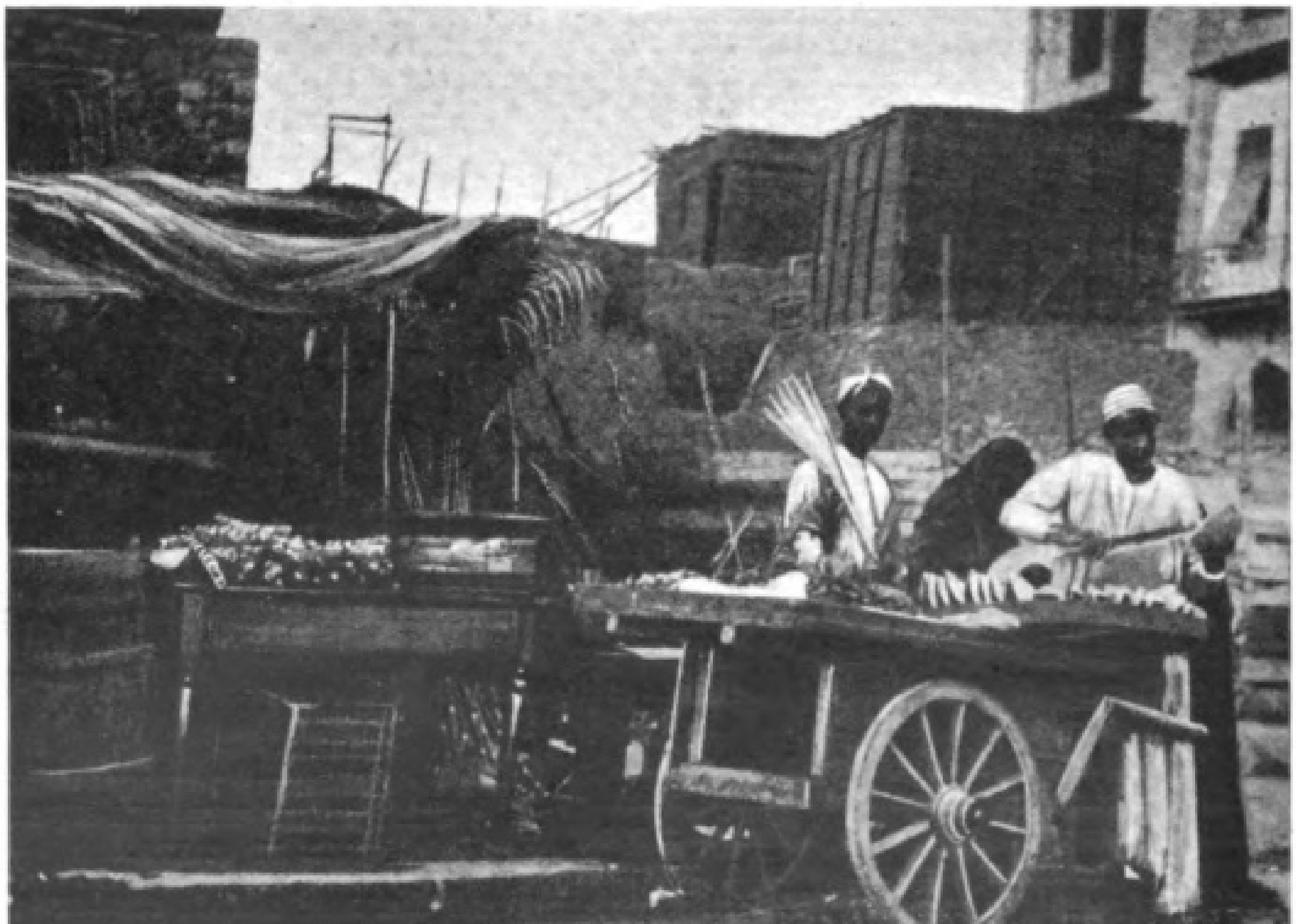
After the heat of Alexandria I was not sorry to meet the fresh breeze once more, and welcomed the sea voyage which lasted till we passed through the Straits of Messina and arrived at Naples.

The Straits of Messina present some magnificent pictures: the comparatively narrow waterway runs between high snow-capped mountains towering on either side, and the verdant slopes of these giant hills are dotted here and there with little clusters of white-painted houses.

Stromboli lies to the north of the Straits and presents a sight worth seeing by day or night. The volcano is constantly active and, during the day, high clouds of smoke come volleying out of the top, followed by the dull rumbles of some internal explosion, whilst molten lava can be seen running red hot down the mountain side until it pours hissing into the sea, wherefrom rise huge clouds of steam. It is said that, when Stromboli stops, Vesuvius starts. However this may be, smoke may nearly always be seen hovering over the crests of both. At night the dull glare of Stromboli is almost constant enough to serve as a lighthouse, and several of our passengers lost their beauty sleep staying up to enjoy the spectacle.

An old English proverb says " A burnt child dreads the fire," but apparently the proverb does not hold good in Italian, for, in spite of many catastrophes, the dwellers by the sides of active volcanoes still persist in building their houses along their sides. Possibly the soil is more fertile on the slopes, but most of us would imagine that a smaller crop reaped in safety would be preferable to a slightly larger one matured in such dangerous proximity. Our illustration shows Stromboli under these conditions and indicates the temerity with which the buildings cluster close to the current of the molten stream.

" 'Twere long to tell " the tale of all the ports we visited and all the sights we saw. What I have already narrated must suffice as a sample. Our voyage was divided into a number of cruises, each of a little over a month, and one and all afforded a round of pleasure and enjoyment from start to finish. Even the time at sea was spent in sport, cricket and deck games being the order of the day ; concerts, dancing and cards rounding off the enjoyment by night. We wireless men found ourselves not overworked, as all the passengers were " on pleasure bent," so that, except for a few service messages and the listening-in during our watch time, our radiotelegraphic duties were light. Altogether I have extremely pleasant memories of my first wireless voyage at sea.



EGYPTIAN FRUITSELLER'S STALL, " SNAPPED " IN THE NATIVE QUARTER OF THE CITY.

The "Wireless Press" Armature Model

A New and Ingenious Aid to the Study of the $1\frac{1}{2}$ kw. Converter

FEW pieces of apparatus in the standard $1\frac{1}{2}$ kilowatt Marconi ship installation invite such careful study as the rotary converter. Superficially, its action would appear to be simple, seeing that it may be considered as an ordinary D.C. motor, from the armature of which alternating current is tapped off and led to slip rings. But directly we come to study its function in detail a number of problems arise, none too easy of solution.

Until now the student who has not had access to a dismounted armature has been severely handicapped by reason of his ignorance of the exact method in which the windings are arranged. Seeing that the armature is cylindrical, diagrams can give very little help, for they must necessarily be flat. The ideal way to pursue the study would, of course, be to place oneself before a complete armature and trace the circuits on the actual machine. This, however, is obviously impossible.

In the circumstances it is a great pleasure for us to announce that the "Wireless Press" have now placed on the market a remarkable ingenious model of a $1\frac{1}{2}$ kw. converter armature on which every slot and every winding is clearly shown. The model, which is issued in the flat, consists of three parts, one requiring to be bent into a cylinder, and the remaining two fastened to its ends. Built up, the model —some six inches in diameter by eight in length—carries on one end the commutator figures, and on the other the slip rings. Starting from any particular segment of the commutator the windings can readily be traced from start to finish, thus making clear to the student not only the principle of lap winding, but also many other important matters in dynamo construction.

As the number of slots, the number of conductors and the general arrangement of windings have been faithfully copied from the standard converter, the student enjoys the same facilities for study as he would if he were the possessor of the armature itself; and further, as adjacent conductors are shown in different coloured inks, there is no risk of confusing two windings in the same slot, which may happen on the actual machine. The uses to which such a model may be put are too numerous to mention here, but will occur at once to every student.

Full instructions as to making up are issued with every model, together with a brief description of the converter windings, and nothing more than reasonable care is required for its construction. For rough handling and class use the model can be reinforced with wood or cardboard in one of many ways which will occur to any ingenious student or instructor. Best of all methods would be to turn a wood cylinder to the exact size of the model. On such matters the Editor will always be pleased to hear from readers so that their individual experiences may be published for the benefit of all.

Operators, students, instructors and all interested in practical wireless work, as well as students of motors and dynamos generally, will be well advised to secure this model at an early date. The price, it may be mentioned, is 1s. (or 1s. 3d. post free), a sum which brings their admirable aid within the reach of all. The first edition is already on sale, and—as a large demand is anticipated—orders should be placed at once to avoid delay or disappointment.

PERSONALITIES IN THE WIRELESS WORLD

SIR RICHARD GLAZEBROOK

THE National Physical Laboratory, founded in 1899 for standardising, testing, and research work, fully justified its existence from the start; and its importance was, even during peace time, recognised in a dozen directions. Since the initiation of the present struggle, its peacetime achievements have been vastly exceeded by its wartime activities. The full extent of the services rendered by this admirable institution can only be revealed in the happier days to come, when the present censorship is withdrawn; but we may state that in radiotelegraphy alone—to mention but one of its many paths of research—the work conducted under the able supervision of Sir Richard Glazebrook has proved of the greatest assistance to the Allied cause.

Sir Richard Tetley Glazebrook, Kt., the distinguished Director of the Laboratory, whose portrait figures on the opposite page, was born in 1854, and educated first at Liverpool College and afterwards at Trinity College, Cambridge. His exceptional gifts soon manifested themselves; for we find that in 1876 he won the high position in the mathematical tripos of Fifth Wrangler, being elected Fellow of his College in the course of the following year. Five years later he became one of the University Lecturers. In 1866 he was Hopkins Prizeman at the Cambridge Philosophical Society, whilst in 1909 he received the Hughes Medal of the Royal Society. Amongst the positions he has held, we may enumerate those of University Lecturer in Mathematics, Assistant Director of the Cavendish Laboratory, and Principal of University College, Liverpool. The last-named post he vacated to take over the Directorship of the National Physical Laboratory on its first initiation in 1899, entering upon the duties of his post on January 1st, 1900. In 1906 he was elected President of the Institution of Electrical Engineers.

Knighted by the King in the course of last year, Sir Richard is a Companion of the Bath, a Master of Arts and a Doctor of Science. His publications include a number of treatises on Physics, Mechanics and Electricity, whilst he has fulfilled, in a manner that has won the general approbation of all concerned, the onerous task of editing the valuable series of the Cambridge Natural Science Manuals.

Mechanical Analogies to Inductively Coupled Electric Circuits

By H. M. BROWNING

I.

Introduction.

If a condenser is charged up and then discharged through an inductance, damped simple harmonic electric vibrations are set up, with frequency of the order a million per second. It is easy enough to imagine the nature of so simple a discharge, and the motion of a simple highly damped pendulum is analogous to it. But if two circuits containing inductance and capacity are placed so that they act and react on one another, two superposed simple harmonic vibrations are set up in each circuit, with frequencies which differ from each other and from the free vibrations of the separate systems. But obvious as theory may make this to the trained mathematician, it is difficult to bring it home to the average electrical student. Hence any mechanical analogies that can be visibly coupled, adjusted and worked, are helpful to students trying to grasp the subtle electrical phenomena which make no appeal to the senses of sight and touch.

Two types of pendulum have been used to illustrate the electrical phenomena. These can be set up from materials at hand in any laboratory and very fair results obtained. With more costly apparatus any student can make experiments with speed and accuracy.

As it is difficult to follow the intricacies of the motions while they are being executed, the pendulum bobs should carry funnels to give sand traces on moving boards.

Two electric circuits are said to be coupled when they are placed so that they act and react on one another. The closer the coupling the greater is the mutual induction between the circuits. The looser the coupling, the smaller the mutual induction. If two pendulums are made to act and react on one another they may be described as coupled, and their coupling may be increased or diminished.

Loose coupling in an electric circuit is about 3 per cent., medium coupling 10 per cent., and close coupling 47 per cent. With the pendulums, couplings from 0 to 60 per cent. have been obtained.

It has been found that for the double-cord pendulum with bobs of equal mass and lengths equal, the ratio of the superposed vibrations formed by coupling them is identical with that for the electrical case having the same couplings.

In the present paper the two types of pendulum are described with some of the results which have been obtained with them. In a later paper it is hoped to deal shortly with the mathematics involved and show how theoretical results have coincided with and been fulfilled by experiment.

The Cord and Lath Pendulum.

The model here called the cord and lath pendulum consists essentially of two pendulums, *PR* and *QS*, one suspended by cords from a movable point, *R*, on the lath of the other, as shown in Fig. 1. The bobs are shown by *P* and *Q*, the movable and fixed points of the suspensions by *R* and *S*. The cord pendulum is shown by *PR*. When the apparatus is used for giving double sand traces, a system of four cords and three stretchers is used so as to clear the upper board which takes the trace of the bob, *Q*. Each cord is provided with a tightener for adjusting its length. The point

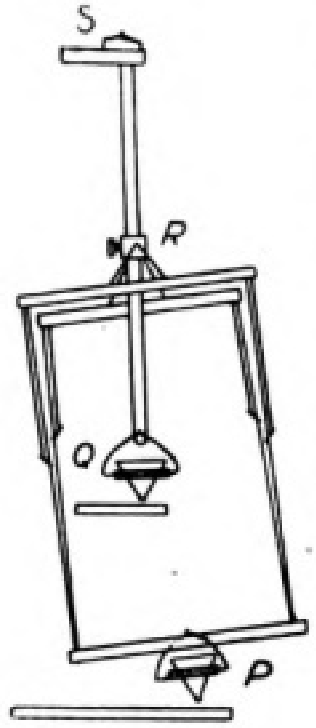


FIG. 1. CORD AND LATH PENDULUM.

of suspension, R, is adjustable on the lath of the pendulum, QS, by a small sliding metal sleeve, with studs to adjust the cords. This sleeve is set where required and then fixed by a screw-clamp. The suspension, S, of the lath pendulum consists of two screw points resting in a hole and slot in a metal plate. The two bobs, P and Q, are metal rings, with glass funnels for sand. The boards shown just beneath the funnels are fixed on the same wooden carriage and are capable of simultaneous slow motions on horizontal rails perpendicular to the plane of the diagram. This motion is effected by the rotation of a wheel whose axle winds a cord attached to the carriage. The whole arrangement is shown in the photographic reproduction, Fig. 2.

In the work carried out with this pendulum, the lengths of the suspensions were equal, and also the masses of the bobs. If the length SR is small, the pendulum is said to be loosely coupled; in this case the ratio of superposed frequencies of vibrations is only slightly different from that of the separate pendulums. But as SR is increased, the coupling also is increased until, when SR is about two-thirds of SQ, the coupling is 48 per cent. and the frequency ratio 2 : 1. It is difficult with this arrangement to get really loose coupling, as for 15 per cent. (*i.e.*, medium) coupling the lower bob is just clear of the upper board. Fig. 3 presents four sets of traces obtained with various couplings. Of these (1) to (3) show single traces from the lower bob when the upper bob was struck; the couplings vary from 15 to 45 per cent. In the fourth trace (4) the coupling was about 48 per cent., and a trace was obtained from the upper bob simultaneously with that from the lower bob. The two boards were placed side by side to be photographed together.

On examining photograph (1) of Fig. 3 it is seen that the bob has no amplitude at A, and in three vibrations it has reached a maximum, and then, after the same number has again fallen to zero at B. The vibrations occurring within the distance AB may be called a beat cycle. The greater the number of variations to a beat cycle the more nearly alike are the two superposed vibrations of the pendulum. Thus in the first the ratio of the frequencies is about 5 : 6.

Photograph (4) of Fig. 3 shows in the upper curve what appears to be almost simple harmonic motion, but with successive amplitudes, alternately long and short. The lower curve has vibrations of

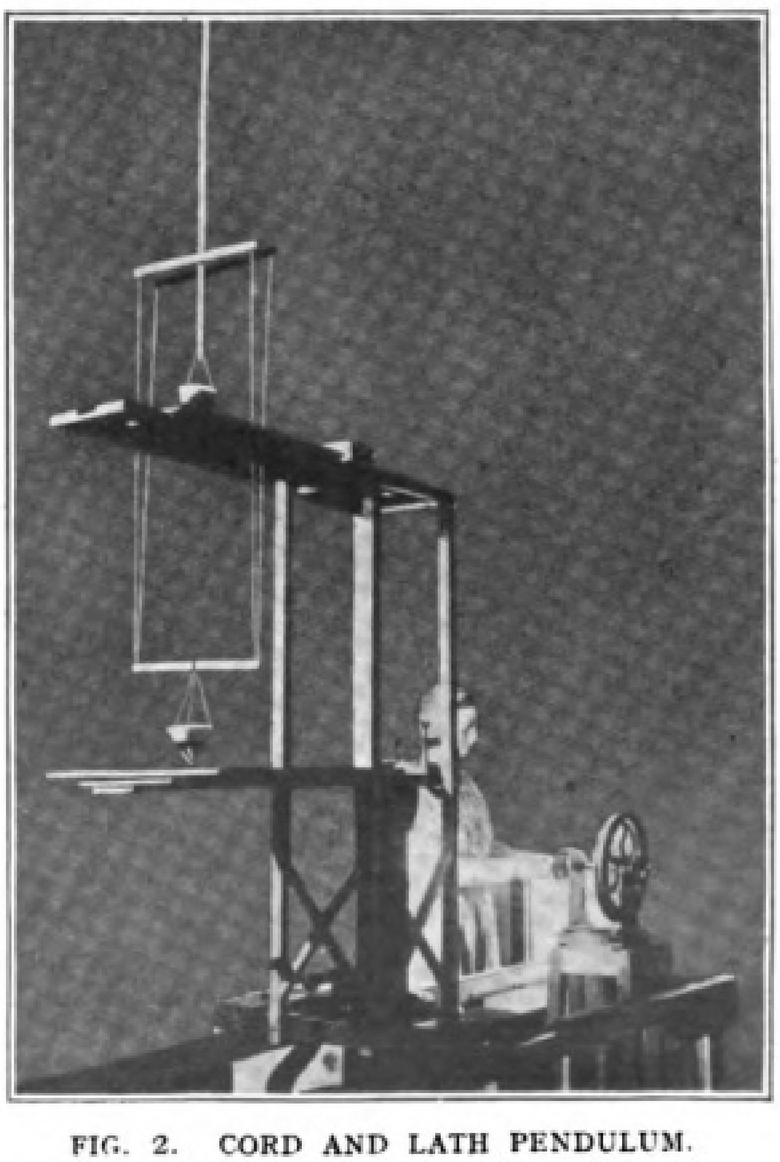


FIG. 2. CORD AND LATH PENDULUM.

frequency half that of the one above, but with a wandering kink. Both these are due to superposed vibrations, of which the frequency ratio is 2 : 1. In the top curve the amplitude of that with the greater frequency is predominant, and in the bottom one that with the less frequency.

This pendulum is very good for quickly demonstrating how change of coupling affects the ratio of the frequencies of the superposed vibrations. Yet, while it is fairly simple to arrange a rising movable stand so that sand traces from the lower bob may be obtained, it is more difficult to get a stand which can receive curves from the upper and lower bobs simultaneously.

THE DOUBLE CORD PENDULUM.

This pendulum was first rigged up with extremely simple apparatus and most

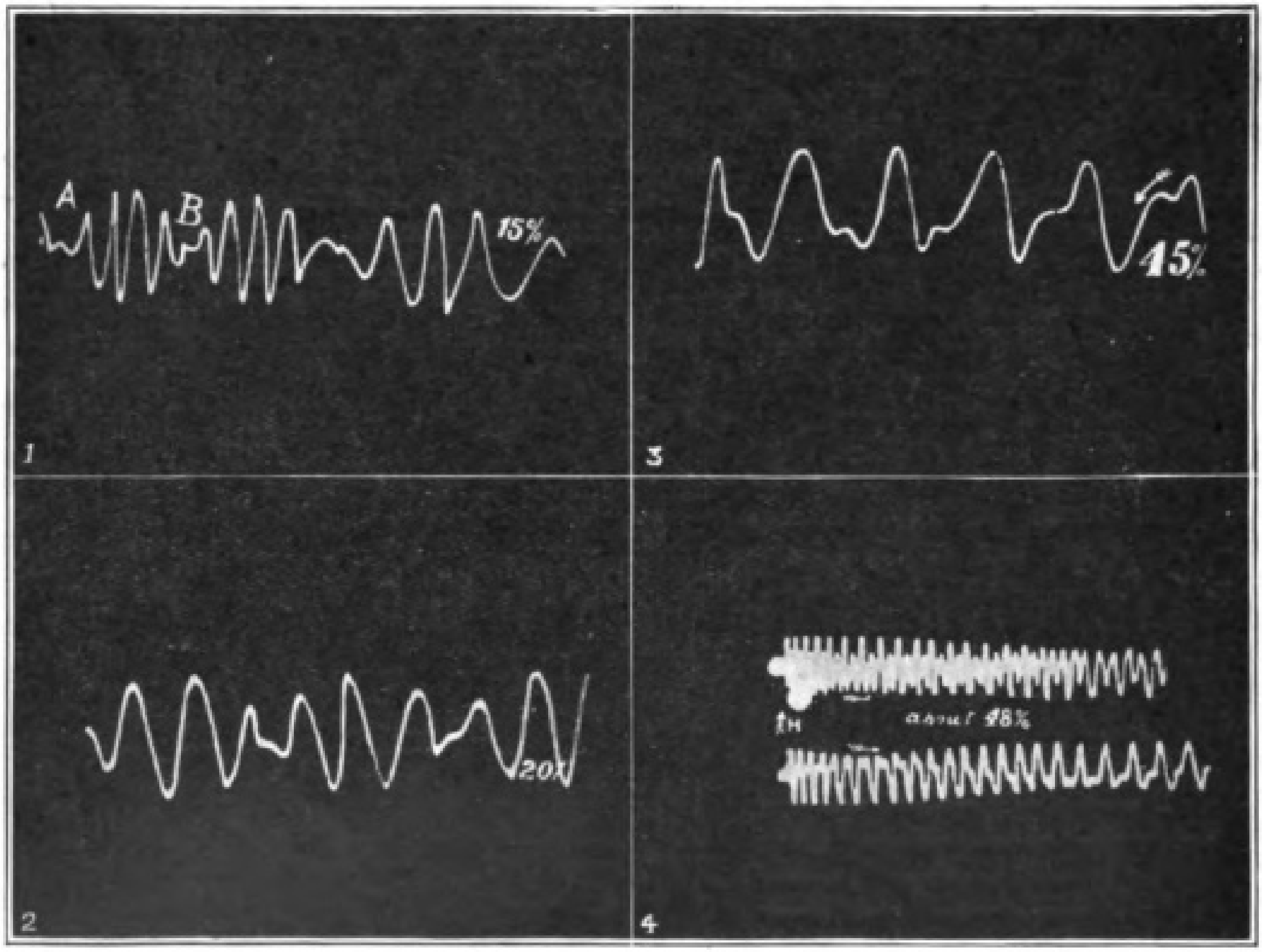
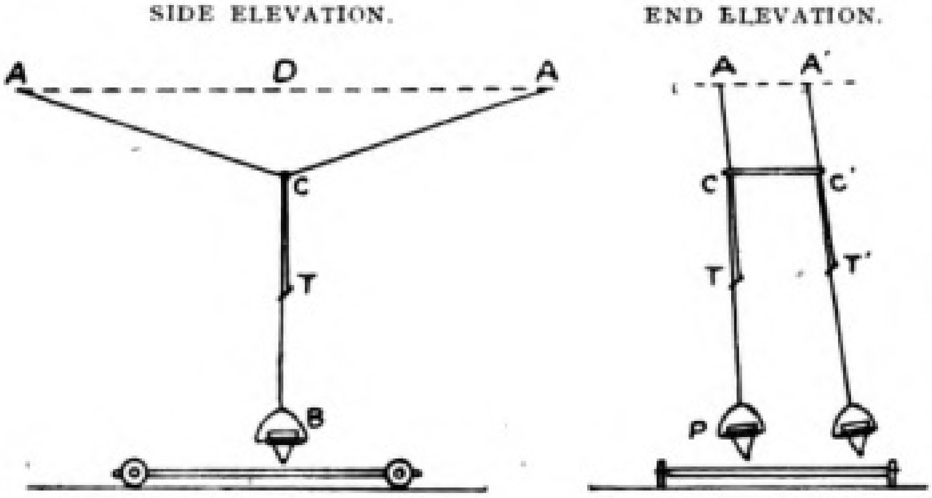


FIG. 3. TRACES FROM CORD AND LATH PENDULUM.

of the work was done with this. Later it was desired to make a portable apparatus with certain refinements for quicker and more accurate work. Figs. 4 and 5 show the original design in elevation. In the normal use of the pendulum the oscillations occur in the plane of Fig. 5. In this figure is shown a stiff connector, CC^1, which forces the bridles, ACA and $A^1C^1A^1$, to swing together. The bridles were attached at A to beams in the roof.

One bob consisted of a heavy metal ring holding a glass funnel, the other bob was either the same as the first or simply a cardboard funnel with weights to make it the required fraction of the mass of the heavy bob. Each contained sand to give the vibration trace on the blackboard. This was mounted on wheels and was slowly pulled along the floor below the bobs. The length of each pendulum could be



FIGS. 4 AND 5. DOUBLE CORD PENDULUM.

adjusted by a sliding tightener (T, T^1) and the bridles set to any desired droop by adjustments at their end A or A^1.

When ACA was nearly straight the coupling was very small, but as the droop ACA was increased the coupling increased. For pendulums with equal bobs and equal lengths 1, the droop was $\beta\ 1$ and the coupling was equal to $\frac{\beta}{2+\beta}$. Also theory shows that for any one coupling the ratio of the frequencies of the superposed vibrations is identical with the ratio for the electrical case, in which the circuits have the same frequencies when separate.

The Portable Apparatus.

This apparatus is shown in Fig. 6. It consists essentially of a braced framework of deal, $1\frac{1}{2}$ inches square, the main rods being each 6 feet long. The bridles are of whipcord and are fastened off on cleats or blind-cord fasteners. The suspensions in actual use are of wires of different lengths, with hooks at each end, the fine adjustment being altered by a thin cord and tightener (as for tent ropes). In order to get a clear photograph the bridles and suspensions were replaced by coarse white cords. The two longitudinal rods at the base of the apparatus are provided with rails made of hoop iron set into saw gates along their length. These rails carry four ball-bearing door sheaves which are fixed on the under side of the board arranged to receive the sand traces. To draw this board along, a cord passes from the centre of one end through two tension eyes to a bobbin on the frame. Attached to the bobbin is a long arm which can be rotated by hand as slowly or as quickly as desired. A little practice enables the operator to turn regularly and at the rate best suited to the traces in view.

In the early experiments with this pendulum the vibrations were started by giving one of the bobs a blow. Later one bob was held aside, the other, for small couplings, being allowed to rest in its more or less displaced position, or for large couplings held undisplaced; both bobs were then freed simultaneously.

When the masses of the bobs are equal the method of starting has very little effect on the nature of the vibration for couplings up to

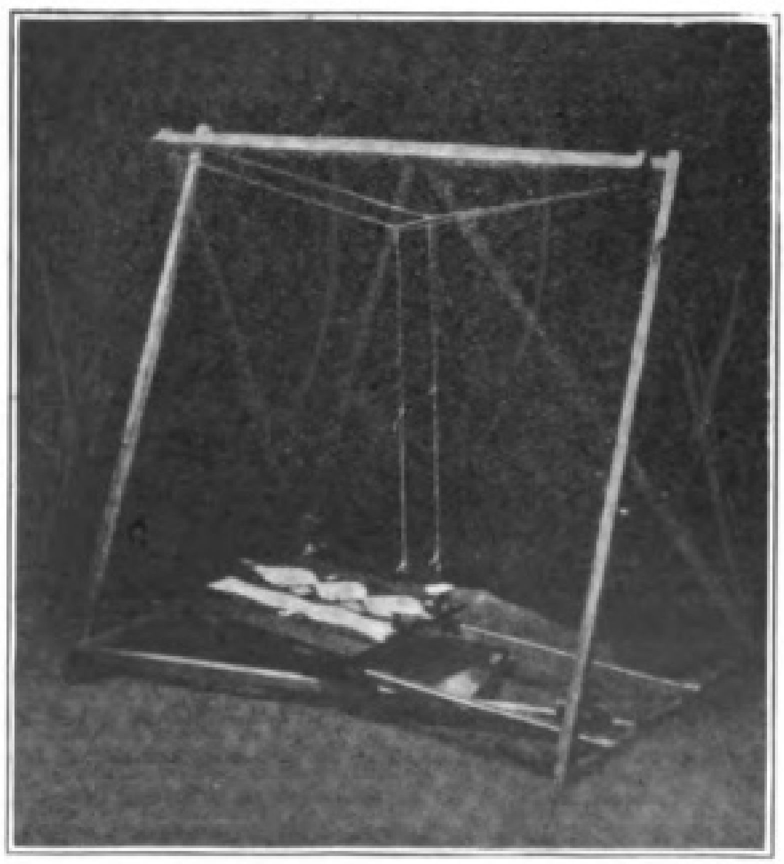


FIG. 6. DOUBLE CORD PENDULUM.

40 per cent., but for greater couplings the one bob held undisplaced and the other drawn horizontally aside gives the most striking result, as may be seen from the last photograph of Fig. 7. The photographs indicate by signs or figures how the motions were started.

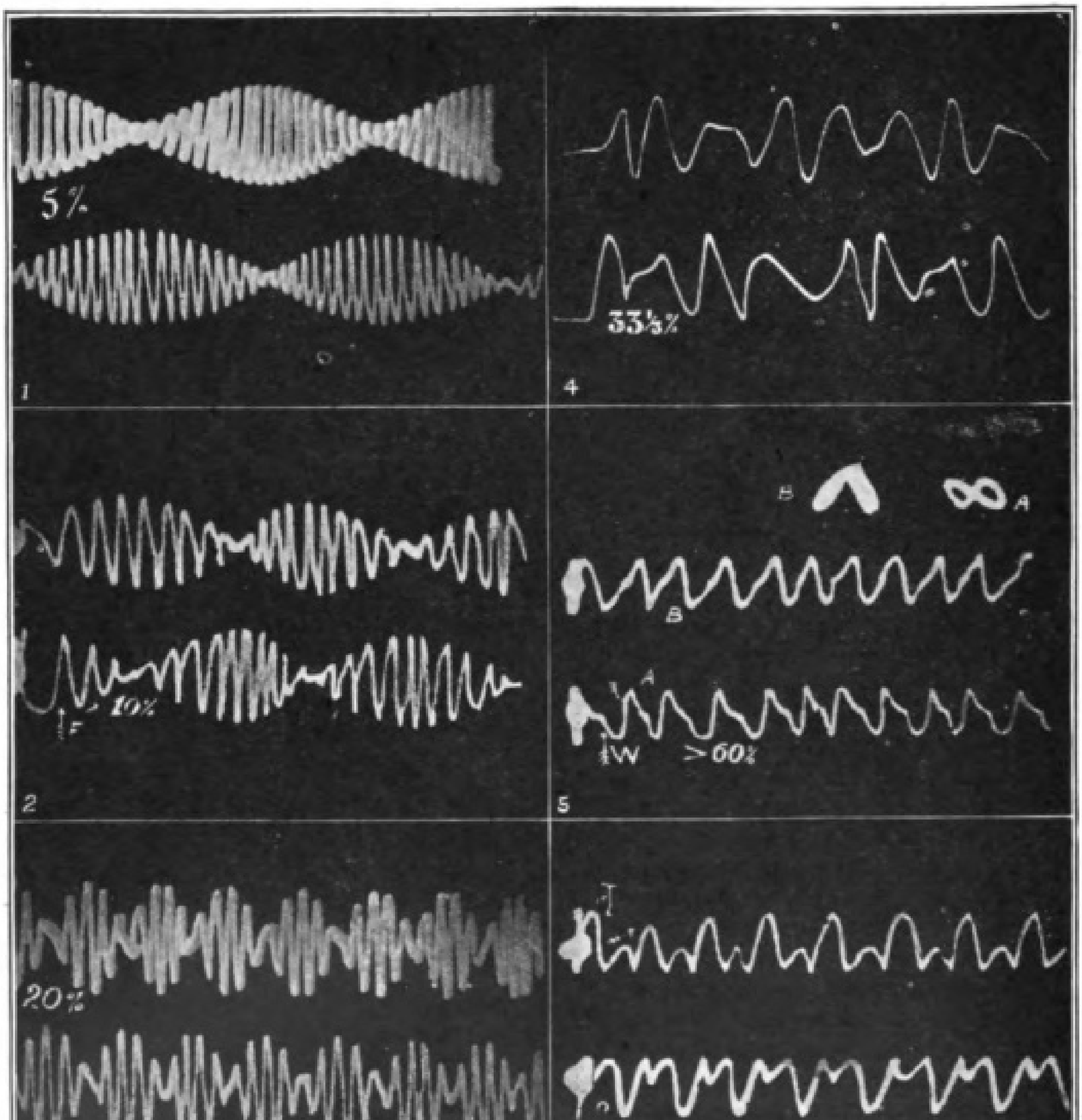


FIG. 7. TRACES FROM DOUBLE CORD PENDULUM.

Photographs (1) to (4), Fig. 7, show the gradual change from loose to tight coupling. The couplings are indicated on each photograph as percentages. Traces (1) to (3) show loose and moderate coupling and exhibit the phenomena of beats and the slow surging of energy to and fro between the bobs. The vibrations appear to be simple harmonic throughout, but of slowly changing amplitude. This is the natural consequence of the superposition of vibrations of only slightly different periods. Also it is striking how one bob gives up the whole of its energy and the other just attains the amplitude with which the first one starts, and then in its turn transfers its energy to the first bob. These cases are like coupled electrical circuits with equal inductances and periods.

For tight coupling, over 30 per cent., it is noticeable that the beats have disappeared and are replaced by simple vibrations with a kink in each one or in every other one. This is because the frequency ratio is nearly 2 : 1. In photographs (5) and (6), Fig. 7, the frequency is exactly 2 : 1. For traces *A* and *B* on photograph (5) the board was also turned through a right angle and left stationary while the pendulums were used as Blackburn's pendulums. They thus gave simultaneously the patterns in the top right-hand corner, which were retraced almost perfectly about ten times.

The Quenched Spark.

Fig. 52. p. 714, of Prof. J. A. Fleming's *Principles of Electrical Wave Telegraphy and Telephony*, Second Edition, shows " the electric beats produced in the primary " and secondary circuits when a sustained primary spark is used and the single periodic " oscillations in the secondary circuit when the quenched spark is employed." The mechanical analogue of beats was obtained and is described above. Photograph (1), Fig. 7, shows it. The damping was not so marked as in Prof. Fleming's case because our damping factor was almost negligible.

To produce the effect of the quenched spark the masses of the bobs were equal and also their separate frequencies, the coupling being 10 per cent. One of the bobs was drawn aside and the other allowed to hang in its slightly displaced position. The bob was then freed and its oscillations were quickly diminished by the transference of its energy to the other pendulum, which in about six vibrations had attained an amplitude equal to that with which the other pendulum started. The first pendulum had at this instant lost all amplitude, and it was then suddenly raised by the hand and held in this position, while the other bob oscillated with a single period. Fig. 8 is a photographic reproduction of the sand trace thus obtained. The lower trace represents the quenched spark and the upper the vibrations set up in the secondary or antenna.

In a later paper it is hoped to deal briefly with the theory and show how experiment fulfils it ; also to show traces taken with the double-cord pendulum when the bobs differ in mass and the suspensions in length.

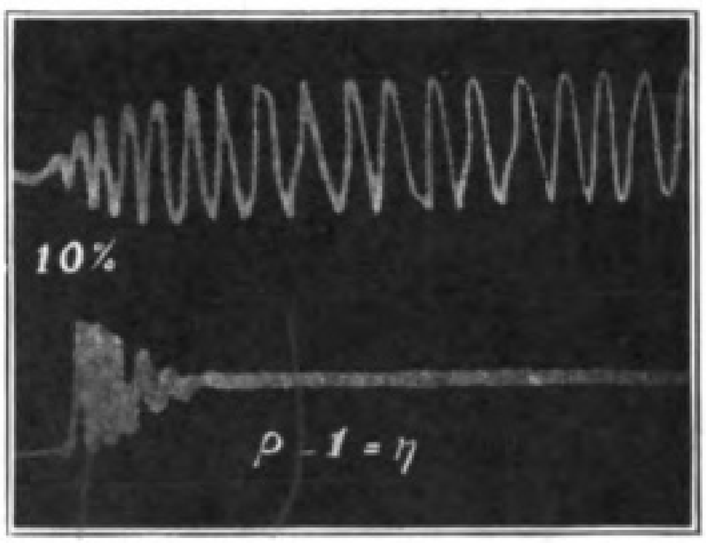


FIG. 8. QUENCHED SPARK.

Correction

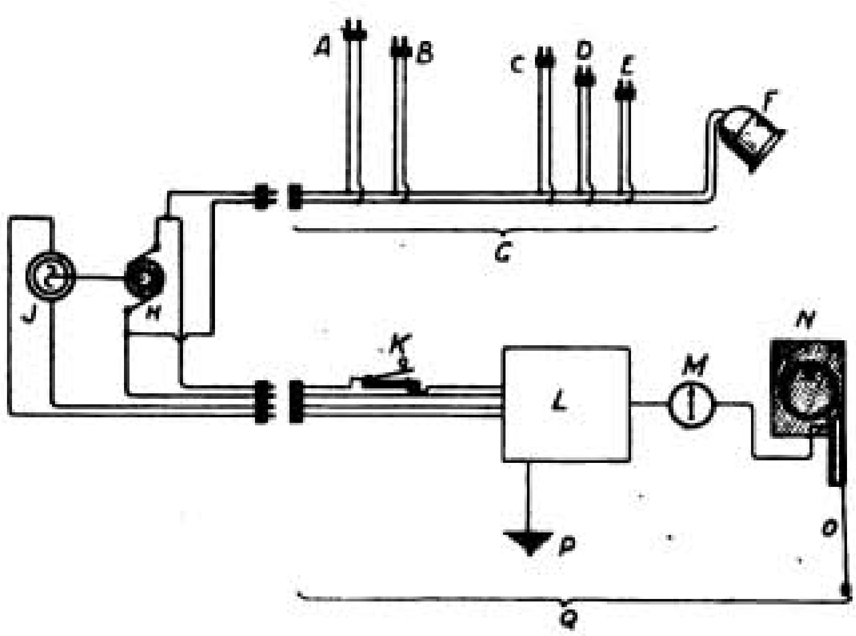
Professor Paul Baillie advises us that the nomogram, Fig. 4 (page 44), in his article printed in our April issue, contains an error. The gradations of the " frequency *n* " scale are not in accordance with those of the λ scale. Instead of 10^7 (in front of 300m) 10^6 should be read, and everywhere instead of 10^6, 10^5 should be read. Those of our readers who use this scale will probably have noticed the error and corrected it accordingly.

Digest of Wireless Literature

German Wireless Apparatus on Aeroplanes.

Writing in a recent issue of *La Nature* on the evolution of German Aviation, Lieutenant Jean-Abel Lefranc states that for some little time the enemy machines have been occasionally equipped with continuous wave receivers of the valve type. Describing the transmitting apparatus, he says that the generator produces alternating current (270 volts 3 amps.) and continuous current (50 volts 4 amps.). The machine is driven either by a small airscrew rotating at 4,500 revolutions per minute, or by the motor. The alternating current produced by this generator is utilised by the "oscillating circuit" which gives rise to the oscillations creating the Hertzian waves. The Telefunken "sender" consists of a rectangular box containing a transformer, a condenser, a plate discharger and a wavemeter. Special arrangements permit of variation of wavelength and intensity of transmission.

The aerial consists of a copper wire approximately 35 to 40 metres in length. On the ground this wire is rolled up on a bobbin. During flight it is suspended from the machine.



The range of these sets is about 30 km. and their weight in all 26 kg. The latest giant aeroplanes guide themselves at night by radiogoniometers, as the Zeppelins do.

It will be noticed from the diagram reproduced herewith that the generator supplies current for several purposes. Thus the leads A go to the electric warming apparatus in the pilot's clothes; B to the lamps on the instrument board; C to the observer's clothes; D and E to heating apparatus on the camera and machine gun respectively. F is the searchlight for night landings. All G is therefore concerned with lighting and heating. H and J are the D.C. and A.C. sides of the generator, while K is obviously the transmitting key. L contains the Telefunken transmitters; M and N and O are the aerial ammeter, the aerial bobbin and the antenna itself. All Q is the purely "wireless" apparatus.

Future Radiotelephone Legislation.

Writing in the *Wireless Age*, Dr. Alfred N. Goldsmith says :—

"There is one direction in which radio legislation properly conceived can "greatly assist the radiophone field. This is by providing a system whereby every "ship and its corresponding shore station have available not one or two but a "considerable number of wavelengths. These wavelengths, which should be "designated by letters or numbers for the sake of brevity, would all be available "for communication except those that were in actual use *near the receiving station.* "That is, the receiving station, after listening for a moment, would dictate to the "transmitting station the suitable wavelength for communication without inter-"ference. Naturally all calling would be done on a common wavelength which "might be, for example, the present-day 600-metre wave. This system of a multi-"plicity of legal wavelengths and the choice of one of them for communication in "accordance with traffic conditions at the receiving station has great possibilities "and should be carefully considered for future action.

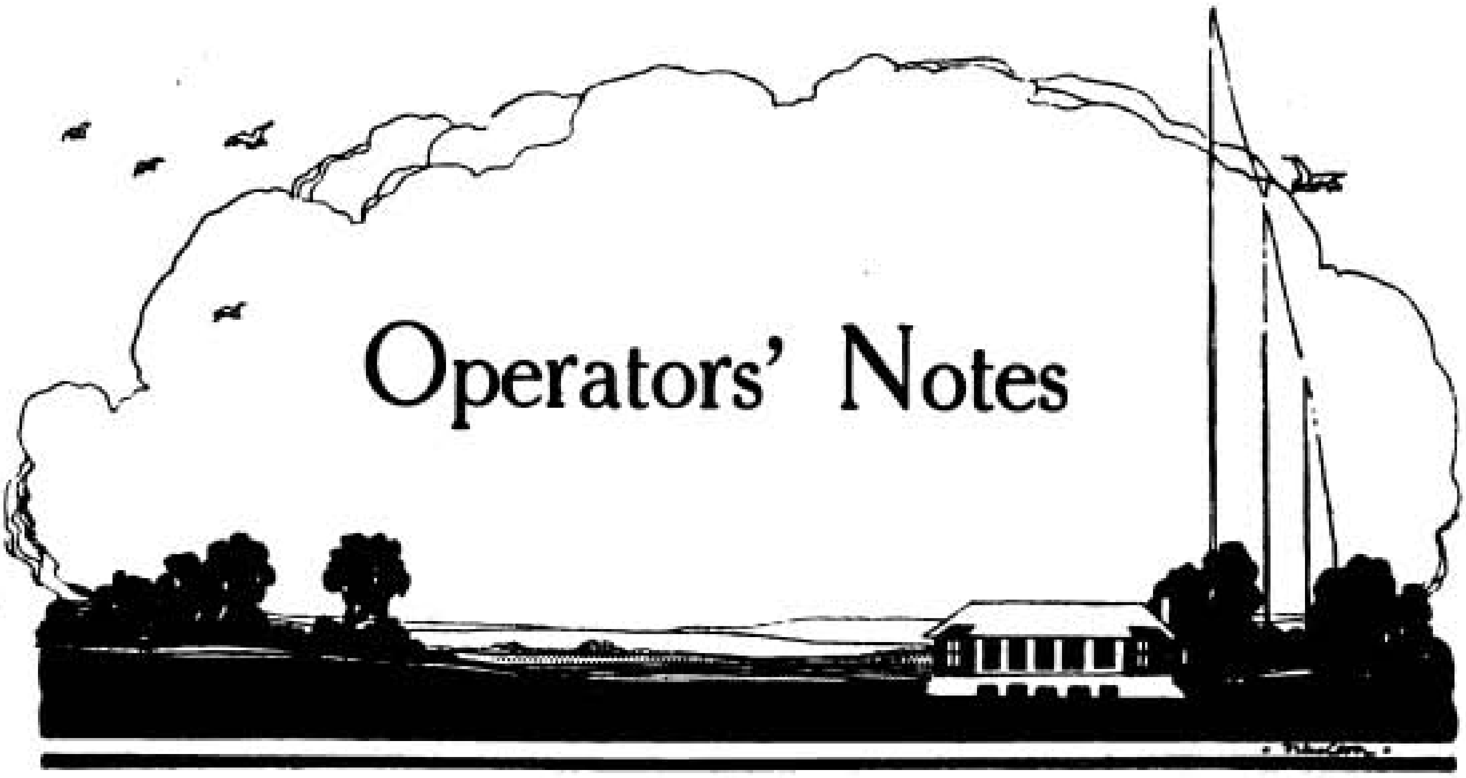
"One further interesting possibility of radiotelephony on board ship may be "mentioned. A simple phonograph recording and reproducing device run by a "small motor might be provided so that, in case the passengers and crews are "forced to desert the ship after a serious accident, the phonograph can continue "to repeat into the radiophone transmitter the necessary call for help, the name "of the ship, its location, the type of accident, and the action taken by the passengers "and crew. This would, to some degree at least, relieve the operator from the heroic "but frequently fatal stand which up to the present he has always taken. With "this simple device installed, he has at least the same chance of rescue as the other "officers of the ship."

METHOD OF GENERATING HIGH FREQUENCY CURRENTS.

The Compagnie Générale Radiotelegraphique describes in French Patent 444,356, and Supplementary Patent 16,369, methods for generating high frequency currents. According to the methods described it is possible to prevent arcing at the spark gap by means of a condenser connected in series with the gap.

In the usual methods an alternator is connected through inductances to the spark gap that forms at the same time part of an oscillating circuit containing inductance and capacity, and arcing is prevented by resonant charging of the feeding circuit, by cooling the electrodes of the spark itself, by the use of spark gaps in which the length of the gap is altered synchronously with the supply frequency, or by the use of generators supplying alternating voltages of peaky wave shapes.

In the methods now described a second condenser is connected between the spark gap and one of the supply mains. This arrangement enables supply voltages to be used of any frequency without the necessity of adjustment for each frequency. The arrangement may also be used in association with the anti-arcing devices already referred to. It is calculated that to obtain a maximum of energy the capacity of the condenser in the branch containing the gap should be slightly greater than that of the condenser in the capacity inductance branch connected across the mains in parallel with the branch containing the gap and the anti-arcing condenser. For shock excitation at high voltages rotating gaps should be used, and by provision of teeth and synchronous rotation of the gap it is possible to obtain a spark discharge every 1, 2, 3 or 4 half-periods. If, on the other hand, the gap is driven non-synchronously irregular sparking is produced that gives rise to characteristic tones by which the sending station may be easily recognised. In the supplementary patent similar arrangements are shown in which commutated direct current is used instead of alternating current.—(*Jahrbuch der Drahtlosen Telegraphie und Telephonie*, August, 1917.)



Operators' Notes

The Operator at Sea (II.)

By F. B. RUSHWORTH

NOT only is the operator making his first trip, at sea literally and metaphorically, but he is introduced to many new conditions, amongst them being a language strange to his ears. This language is often referred to as "nautical terms," but perhaps a more correct way of putting it would be "land terms" translated into nautical language. Most sea-going men are familiar with the landsman who, speaking of a ship, referred to her bow as the "sharp end" and her stern as the "blunt end," wondering meanwhile at the grin on the sailor's face. Ignorant of sea language, he described what he saw in the only way he could express himself. To gain some familiarity with common sea parlance and customs, then, on putting to sea is an advantage.

Time at sea is divided into "watches," during which the crew, equally divided into the "port" and "starboard" watches, go alternately on or off duty. Each watch (with two exceptions) lasts four hours, so throughout the day and night the men work or rest alternately for that period, but in order to prevent their always having exactly the same hours, the watch from 4 to 8 p.m. is divided into two, called the first and second "dog watches," and as these "dog watches" last only two hours, the men then get time for a little social recreation. There are seven watches in the course of twenty-four hours, called respectively the first, the middle, the morning, the forenoon, the afternoon, and the first and second dog watches. The first watch is from 8 p.m. till midnight. Not the striking of a clock, but the striking of a bell, marks the flight of time on board ship. One bell is struck at the end of the first half-hour in each watch, two bells for the next half-hour, and so on increasing a bell each half-hour, till the striking of eight bells indicates the end of the four hours' watch. Of course, only four bells are struck at the end of each "dog watch."

To be on "watch on deck" is to be on duty, and when off duty, on "watch below."

The captain, or, properly speaking, the master, is, of course, supreme in all and over all aboard ship. Some commanders may object to smoking on deck. It is always improper and against discipline to smoke on the gangway when entering or leaving a ship, and a punishable offence to smoke on dock premises. If allowed to smoke on deck, never do so near open hatches. See that cigarette or cigar ends are properly extinguished and carried to an ash tray, not thrown on the deck or overboard. Fires are easily started, but terribly hard to extinguish. All spoiled official forms must be torn up and then burnt. The chef will generally allow this to be done in the galley fire.

"C.O." is a short term for chief officer, whose slang title is the "Mate." He is practically the staff captain, and is responsible to the captain for the whole of the deck department. The word "mate," prefixed in the order of rank, is commonly given to officers above the rank of fifth officer, whose slang term is "Fiver," or, amongst his familiars, "Dog's Body." The second mate is the navigating officer. In addition to keeping their watches, the third mate is responsible for the correct receipt and delivery of the number of mail bags, etc., from and to the Post Office authorities, and the fourth mate is in official charge of the passengers' baggage. The boatswain (pronounced bo'sun), a very important petty officer, is in charge of the sailors and deck-hands, and the bo'sun's mate is his assistant.

A steamship does not possess a "chimney"; the smokestack, or funnel, carries away the smoke from the fires.

What the kitchen is on shore the galley is on board ship. A "head wind" is against the ship and a "soldier's wind" is a following wind. The "Fiddley" is the part of uppermost deck where the smokestack and ventilators emerge, and the "hold" is the lowermost compartment of the ship. A "hatch" is an opening to a deck below, also the planks used to cover it, and a "booby-hatch," a temporary structure leading to the deck below. The hatches are numbered consecutively forward to aft. The intermediate decks, upper, middle and lower, are known as "'tween decks." There are no walls, floors or ceilings within a ship, but "bulkheads" and decks. Bilge means the waterways in the bottom of a ship and bilge tanks are compartments for storing water, salt or fresh. "Chips" is the slang name for the carpenter, who performs the vital duty of sounding the tanks and recording the depth of water they contain.

One does not "go to bed" or "get up," but "turns in" and "turns out." To go from one deck to another is not spoken of as going up or downstairs, but up or down the companion. A ship is not so many feet broad, but has a beam of so many feet. Forward (pronounced for'rad) is the fore end of the ship and aft is the aftermost part. A sailor does not climb the mast, but "goes aloft," and by the "ratlines," not ladders. The rope ladder by which a pilot often boards a ship is called a "Jacob's Ladder." A log, besides being an official record, is also the name given to a mechanical device for recording distance travelled by a ship. The port side is on the left-hand looking forward and the starboard on the right hand. The weather side is the windy side, and the lee, the sheltered side—and incidentally anything allowed to be thrown overboard must be thrown over on this side. If put over the weather side it will be either blown back on deck or through some port hole that may happen to be open. To go to leeward (pronounced loo'ard) means away from the wind.

The forecastle (pronounced fo'c'sle) is the forward end of the ship, and in it are situated the living quarters of the crew.

Messages on ship's business for transmission and delivery will mostly be conveyed between the bridge and wireless room by quartermasters.

These are men who have been promoted from A.B. (able-bodied seaman) and come under the immediate supervision of the fourth officer. Two are on watch at the same time, one taking a "trick at the wheel"—*i.e.*, steering—or at the helm, and the other standing by the officer on watch on the bridge. The shining brass and spotless condition of the bridge generally and the hoisting and dipping of the flags and ensign are their care. When the ship is at anchor, or tied up alongside in port, they relieve one another standing by at the gangway.

Wireless Telegraphy In the War

The Progress of Aerial Wireless.

We make no apologies for our constant reference to the ever-increasing influence exercised by aircraft in warfare. The poets and writers of old days showed the true spirit of inductive reasoning in likening the atmosphere, which floats around the surface of the globe, to the sea, and in speaking of the "Ocean of Air." It is largely on account of this similarity that Wireless assumes the same all-important rôle in the one case as it has over a considerable period done in the other. It was impossible for the development of aircraft to attain its present position till means had been found of utilising radiotelegraphic means of communication for the thousand and one purposes which it fulfils under modern conditions. Until a pilot could regularly communicate and receive communications in mid-flight he was in the position of the old-time navigators at sea. The moment he had climbed into the aerial regions and disappeared from sight he became a lost unit, up to the time when he once more emerged and landed. Without radiotelegraphy, aerial tactics, to say nothing of strategy, would have been impossible.

Accounts of the present critical clash of arms upon the Western Front are filled full of references to aerial efficiency. At Fère-en-Tardenois an artillery column was put out of action by aircraft fire as it advanced towards the Allied lines. On another occasion the officer in command of an air squadron launched some fifty machines against an enemy column that was occupying over three miles of road. The onslaught of the aeroplanes was like a cavalry charge; it consisted of a swoop made at an elevation of but ten or twenty yards above the level of the ground, and resulted in the pouring upon the enemy column of a hail of machine-gun fire which only ceased after the Boche had been completely dispersed. One of our contemporaries, the *Motor*, recently went so far as to discuss the possibility of landing a force behind the enemy's lines through the instrumentality of a large fleet of aeroplanes, pointing out that there are already machines capable of transporting twenty-two men each. It is obvious that if 1,000 such machines, operating as a military unit, could land troops equipped with machine guns behind the enemy's lines, such a method of attack would prove even more dangerous than an outflanking movement. The control of squadrons of planes like those envisaged in movements of this character must be conducted on similar lines to those of fleets at sea, in which radiotelegraphy habitually plays a vastly preponderating rôle.

As was recently pointed out by the well-known expert, Captain H. B. C. Pollard, at the time when our present struggle commenced the aeroplane's wireless apparatus was a very elementary thing, but little more, in point of fact, than a laboratory

Photo] *[Newspaper Illustrations.*

IN THE "OCEAN OF AIR."

toy, although useful in its way. At that stage the pilots were not trained signallers, and—as a rule—those fliers who made it their business to "spot" for the guns were accompanied by an artillery officer who acted as an observer. The latter assumed the responsibility for signalling to the battery with which the aeroplane was working.

To-day all pilots and observers alike are trained in wireless work. It forms part of their professional qualifications, and the radio equipment of a modern aeroplane makes a wonderful advance upon the primitive outfit formerly used. The perfecting of aircraft wireless goes hand in hand with the rapid forward development of the craft themselves. Radiotelephony, when it comes into more extended active practical employment, will—like many other improvements concerning which silence must at present be maintained—still further increase the potentialities of the Air Service.

TRAINING AND ORGANISATION.

A visit to the class rooms which form an important part of aerodrome organisation would show you a number of embryo airmen seated along benches fitted with small practice sets of Morse keys, buzzers and flash signalling lamps. There they practise sending messages until a certain standard of efficiency is reached, after which they move on to the second stage in their Pilgrim's Progress. This stage centres round the inspector's table, where the instructional apparatus is much more complicated and the tutorial arrangements include the recording of pupil's messages by an automatic tape machine, which relentlessly discloses every slip and error which occurs in the sender's work.

We find the third scene in this drama of systematic training set amidst scenery which reproduces something like the actual conditions of an aeroplane in flight. The men are clothed in their flying garb and have to work their keys with gloved fingers as in the air, whilst instruments, specially designed for that purpose, reproduce the complex noises of a machine in flight. The final touches to the "Complete Airman" are naturally "laid on" in actual machines. Pupils who have passed the preliminary tests set out on long continuous flights with instructions to keep themselves in wireless contact with the operator at the aerodrome throughout their period in the air.

AMERICANS ALSO.

The above sketch, for the main features of which we are indebted to Captain Pollard, refers more particularly to British conditions. Our American cousins are following on similar lines. The illustration which we reproduce on page 216 shows a lady instructor, Miss Elise Owen, in the act of administering radiotelegraphic tuition to a number of selected men belonging to Class A, the scene being laid at the Murray Hill Evening School, New York City. Not until the pupils, whom we see at work, have attained a minimum speed of ten words a minute, are they inducted into Brother Jonathan's service and transferred to a Radio Camp for the completion of their training. After completing their course, the young Americans are afforded opportunities of securing commissions in the Signal Corps, and this branch of the service over there (as on our own side) proves specially attractive to young men of an enterprising type. Incidentally, it may be remarked, our picture illustrates the way in which American corporate bodies of all kinds are throwing themselves into the prosecution of this crusade against the Hun. The class depicted was instituted by the New York Board of Education with the object of helping such men effectively to prepare for their army careers.

Wireless for Coastal Defence.

The exploit of the *Vindictive* and her consorts on St. George's Day, naturally and rightly, completely captured public imagination, and has been dealt with so fully elsewhere that but little remains for us but to add our quota to the chorus of admiration so justly earned on that occasion by our glorious Navy. There is one point, however, which was referred to by Colonel Repington in his critique upon this naval feat which deserves some passing comment from ourselves. Writing on the difficulties which had to be overcome, the well-known critic says :—

> "Sound-ranging, and the easy discovery of the position of any ship by "intersection on wireless stations of the assailant's resorts to wireless, add "fresh dangers to an approach to the coast, and the enemy may well have "regarded his defence as impregnable."

For a gallant officer who would appear to claim that "his pen is mightier than his sword" the above passage is not remarkable for its clarity of expression. What we presume he meant is that the enemy has organised a system whereby—employing direction-finding receivers at coastal wireless stations—he can easily discover the

Photo] [*Topical*.

AMERICAN AVIATION PUPILS RECEIVING WIRELESS INSTRUCTION FROM A LADY TEACHER.

position of approaching vessels through the instrumentality of the wireless messages which the latter must perforce radiate at intervals if acting in concert. Of course the moment that the position of an approaching vessel is localised by *any* means whatsoever, that vessel is immediately liable to be overwhelmed by accurate gunfire. Such an organisation as the Colonel refers to is perfectly feasible, and would fully justify his inclusion thereof amongst the most formidable obstacles with which our naval units were obliged to wrestle on that memorable day. Against such a radio-telegraphic defence our smoke screen would lose a large part of its value. Smoke does not interfere with wireless waves. Nothing but the most superb handling on the part of the British naval commanders could possibly have countered this scientific means of protection.

As a matter of fact, the more we investigate in detail our Navy's wonderful feat of organisation and seamanship, the more unbounded becomes our admiration for every one who planned or took part in it.

German Submarine Wireless

THE report of the War Cabinet for 1917 contains some information concerning recent developments in "U" boats, the later type of which possesses a surface speed up to 18 knots and a submerged speed from 10–11 knots. Our contemporary *The Army and Navy Gazette*, in commenting on the items contained in the report quotes the statement of an American writer that by means of small balloons a submarine can raise her wireless to the height of 1,000 feet or more. According to the same authority the receiving range of these underwater craft may, in favourable conditions, be estimated at 3,000–4,000 miles; so that, by a system of "relaying" from one submarine to another, the distances which can be covered in the way of message-transmission might total up to a very considerable figure.

A Novel Application of the Valve

The New Marconi Double Note Magnifier

FRESH applications of the three-electrode valve are ever-increasing in number, and this month we are able to present our readers with a couple of diagrams which illustrate a case in point. These figures, which will be found on pages 224 and 225, depict the new Marconi Double Note Magnifier, as applied to the magnetic detector and the crystal receiver respectively. Briefly, the instruments consist of two three-electrode valves connected in series with one another in such a way that the telephone currents from the magnetic detector or crystal receiver are magnified in two successive stages before being led to the telephones themselves. The valves thus act not as detectors but as amplifiers. All circuits have been simplified to the highest degree so as to remove the need for adjustments. Electrically there is no difference between the model for the magnetic and that for the crystal except in the design of the first transformer, the primary for which has, of course, to be of lower resistance for the magnetic detector than for the crystal. In one model a switch takes the place of three sets of terminals, and is connected in such a way that, when working direct without magnification, the valve filament circuits are broken. When using first magnification, *one* valve only is in circuit, whilst for second magnification *both* valves are in circuit. Otherwise the arrangements are the same.

The total magnification obtained with this new instrument is such that signals from the magnetic detector are at least three times as strong as those obtainable with a crystal receiver. It will be noticed that a 200-volt battery is used for the plate circuit.

By the addition of the note-magnifier to the magnetic, we have available a receiver which possesses the notable reliability of the magnetic, and far greater sensitiveness than the crystal, which—with the exception of the more complicated forms of valve receivers—has hitherto formed the most sensitive commercial type.

"Clean Bowled!"

A Scientific Fantasy

BY WILLIAM D. OWEN

The sound of music and laughter that floated in through the open porthole singularly annoyed me. It was wretched luck that this particular night of all nights should have been chosen for the fancy-dress ball just when I needed absolute quietness for the success of my experiments. Last night's Press bulletin at 1,850 miles was certainly an achievement, but if I could copy it to-night at 2,215 I could undoubtedly claim the record for this route.

Of course, the portholes might be closed, but then it is no joke working in a hermetically sealed cabin with the thermometer standing at 90° to begin with. However, I was keen to prove the merits of my "Show us a lite" detector, even at the risk of suffocation, so grumbling I screwed up the ports, divested myself of as many of my garments as I could with decency, and settled down to work.

Eagerly I moved sliders across inductances, varied the capacity of tuning condensers and adjusted the coupling between the different circuits of my receiver, straining my ears all the while for Poldhu's familiar note, but not a sound of it rewarded my efforts. Again and again did I go over the connections, test the insulation of the aerial and switch in various specimens of the precious crystal so carefully mounted beforehand, but all without avail. For the fourth time I pulled out my watch and compared it with Greenwich mean time, as indicated by the cabin clock, thinking that something might be wrong with my allowance for difference in longitude, and still no clue.

Disappointed in my hopes and exhausted by my frantic efforts, I laid my head on my arm and made a mental survey of all the factors bearing on the subject. How long I lay thus I know not; but suddenly I became aware that I was not alone; in fact, someone was speaking to me.

I looked up sharply at the intruder, annoyed that he should have entered without knocking. He was a youngish looking man, tall and thin. His features were sharp and rather melancholy. The straggling black hair upon his face had plainly never felt the caress of a razor, and his frock coat and black Alpine hat gave him the appearance of a Mormon elder or an undertaker's mute.

"I hope you will pardon this intrusion," he was saying, "but really I could not contain myself any longer. Everybody seems to have gone mad. They are all dressed up in absurd costumes and are pirouetting around the deck yelling like a lot of Apaches. I understood one of them to say that they were 'lancers' or something of the sort, and one charming lunatic actually asked me to 'make a set,' whatever that might mean. So I ventured in here because this is the only sane spot on the ship."

"Why not try the engine room?" I said, sullenly.

"Engine room!" he spluttered. "I never see a steam-engine without burning with shame and indignation. Of all the insane products of a mad age the reciprocating steam-engine is the worst."

He was so earnest, so emphatic, and his eyes glowed with such unnatural zeal that this talk of madness merely recoiled upon himself, in my estimation.

"The chief engineer would be interested in your remarks," I suggested.

"The Chief is at this moment disguised as a sergeant of the marines," he replied, with irony, "and if his accomplishments in engineering are at all comparable with his skill in mimicry he will already know that his beloved engines and their accessories waste nine times as much energy as they usefully employ."

"You don't say so!" I said, aghast.

"I certainly do," was his reply. "In fact, I go further and say that the energy continually wasted up the funnel of this ship alone is sufficient to run a fleet of sixty such vessels if utilised strictly in accordance with modern scientific discoveries."

To say that I was amazed at this assertion is to express myself feebly. Of course, it could not be true, I thought, and I'm afraid I must have shown my doubts, for he launched out into a long dissertation upon the efficiency of fires, boilers, steampipes and engines. He proved, at least to his own satisfaction, that only 10 per cent. of the heat energy of coal is converted into useful energy at the crankshaft, and to my feeble protests he merely replied, "You can verify this by referring to any standard treatise on the subject. Even the Chief will not deny it."

"Well, what of it?" I flared up at last. "If these things worry you why don't you get busy and show us how to improve matters? Our engines and our ships have literally brought the uttermost ends of the earth together. While some folks spend their time in destructive criticism others get busy with the crude tools at their disposal and get the world's work done."

"Young man," he said, gravely, "your shafts fall wide of the mark. I have discovered a storehouse of energy so vast and so revolutionary in its effects as to reduce the value of our best engines to that of scrap iron."

"My dear sir," I said, with excessive politeness, "I am not even impressed by your assertion. That storehouse of energy has been repeatedly discovered at seemly intervals ever since I was a child in short frocks. Once it was called 'liquid air' and later it was called 'radium.' I don't know what you are going to call it, but I venture to guess that it won't get much farther than the pages of the sensational section of the lay press, where so many of these wild-cat schemes lie in their graves."

"Your remark, if you will forgive my saying so, is an ignorant one. It suggests that you get your scientific information from the lay press. What, for example, do you know of radium?"

"Oh, the usual," I said, recklessly. "One teaspoonful will propel the *Mauretania* across the Atlantic in nine seconds. An ounce will yield enough energy to send a twenty-car Pullman backwards and forwards from here to the moon for ever. That sort of thing went down all very well when I was a gawky schoolboy, but I've got beyond that nonsense now."

LIKE A MORMON ELDER OR AN UNDERTAKER'S MUTE.

"And do you know why your boyish anticipations were not realised?" he asked.

"Yes," I answered. "Simply because, in my ignorance, I anticipated the impossible."

C

"Oh, no! not at all!" was his retort. "The pent-up energy within one teaspoonful of radium, as you so scornfully put it, is sufficient to do what you say, allowing, of course, for your obvious exaggeration; but the difficulty in the past has been *to release that energy fast enough.* The disintegration of the radium atom takes place so slowly that thousands of years must elapse before the process is complete, yet even at that rate it yields an appreciable amount of energy *all the while.* Power, as you should know, is the rate of doing work. It is evident, then, that the power developed by a piece of radium is very small—almost negligible. Stimulate the process of disintegration so as to allow the inter-atomic energy to be released at a greater rate and you have power enough to do all the absurd things you spoke of, in so far as they are practicable."

"Well, Professor," I said, jocularly, "what are you going to do about it?"

"It is ten years since I first asked myself that question, and now I have answered it to my satisfaction. I can disintegrate the radium atom by blowing it to bits with X-rays, and, what is more, I can control to a nicety the power developed by regulating the intensity of the X-rays with Coolidge's apparatus."

I was really impressed by this time, for my little stock of scientific knowledge enabled me to appreciate the validity of his principles even if I could not agree with his methods. At the same time I saw many obstacles and, after smoking in silence for awhile, I returned to the debate. "Even if you can substantiate your claim, sir," I went on, a little more respectfully this time, "you must admit that the amount of radium available is distinctly limited and that its price is prohibitive."

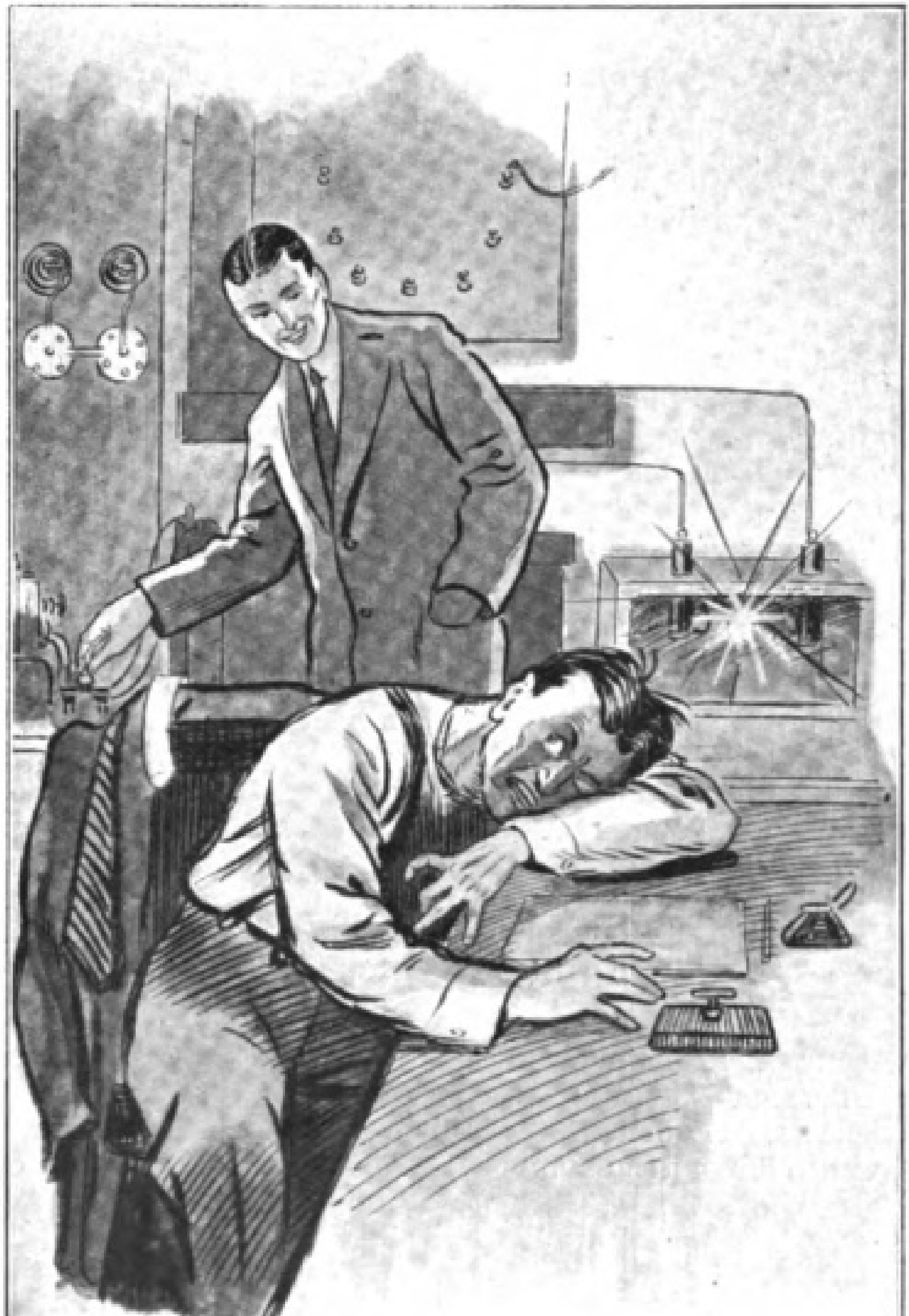
"Quite so," he said, smiling a confident smile, "but *all substances down to the commonest have this inter-atomic energy.* Radium happens to be one that yields energy to an appreciable extent without suasion. Radium is not stable, it is slowly disintegrating all the while, and it gave us the clue to this vast source of power. My researches prove conclusively that the disintegration of *any* substance involves the release of inter-atomic energy in quantities that make the thermal energy of coal and petroleum like a drop in the ocean in comparison, and I can disintegrate any substance, stable or otherwise, by my application of the X-rays."

THE "PONCEPHALUS" OR "BRIDGE OF BRAINS."

I was too excited now even to think of apologising for my previous rudeness. Undoubtedly he had made an amazing discovery, probably the greatest since Newton discovered the laws of gravitation.

" In what form is this energy released ? " I asked ; " and how do you propose to handle it ? "

" Well, it is obvious, is it not, that when the electron complexes which form the atom are broken up and the positive component absorbed into the earth we shall have a very powerful stream of electrons moving from the disintegrating body at a great velocity. This electron stream is, as you know, an electric current, but before it is used as such it is deprived of its purely mechanical energy by allowing it to impinge upon the blades of a specially designed turbine, the rotor of which is in vacuum and attains the enormous speed of a hundred thousand revolutions a minute. Centrifugal force is counteracted by magnetic attraction between the shaft and the blades of the rotor.



A RUDE AWAKENING.

" By Jove ! " I said, with genuine admiration, " you seem to have considered everything. Permit me to compliment you upon your wonderful foresight and, if I might say so, your abnormal mentality. Do you conceive these ideas as a result of inspiration or as the outcome of a laborious mental process ? "

" Mental force, of which the brain is the centre, is just as potent a thing as mechanical force or electrical force," he assured me, " and it follows precisely the same laws. In mechanics we learn that a number of forces acting in the same direction merge together to form one force equal in magnitude to the sum of the individual forces. Then, again, in electricity we obtain a large electromotive force by connecting generators in series. So in Super-psychology—the study of mental problems beyond the normal—I obtain an abnormal concentration of mental force simply *by connecting brains in series.* A number of assistants are thrown into an hypnotic trance, and in obedience to the suggestion that they are research workers engaged upon epoch-making discoveries they set to work with a vigour and concentration that is seldom attained in normal circumstances. I then couple them all up in series by means of an original device I have called the 'Poncephalus,' or bridge of brains, and loop myself into the group. My mind is then the objective mind of the circuit; it directs and stimulates the subjective minds. Thus, you see, I can get any degree of mental concentration by increasing the number of assistants, and can therefore solve any problem that is capable of solution."

In the circumstances it was natural that my mind should associate his last remark with my own particular problem—that of increasing the range of my receiver—and I made the most of the golden opportunity that presented itself.

"Perhaps you will be good enough to assist me in my endeavour to read Poldhu at a greater distance than has ever before been done on this route," I suggested; "already I am beginning to fear that I have lost him."

"That should not be a difficult matter," he said, musingly. "The strength of your signals depends upon two things—the amplitude of the waves that strike the aerial, and the sensitiveness of your detecting devices. You probably approach the problem from the latter standpoint, but I would prefer to look to the amplitude of the incoming waves. In fact, I am already engaged upon a similar problem in connection with my Automatic Thought-Recorder, which is destined to abolish the laborious process of writing down, letter by letter, thoughts that come and go like motes in a sunbeam. The greatest difficulty I had to overcome was the minuteness of the emanations from the thinking brain. A careful study of telepathy and thought-reading convinced me that these emanations were actual ætheric pulses, but the amplitude was too small to operate the recorder I had invented. I therefore devised the 'Amplitude-augmenter.' Fortunately I have one with me." So saying, he took from his pocket a little white-wood box and abstracted therefrom a small glass bulb with several protruding electrodes. Deftly disconnecting the aerial he inserted the device in the breach and, wonderful to relate, weak signals began to come in almost immediately, and as I listened they grew louder and louder. But what nonsense was this they spelt out? I grabbed my pencil and wrote:

"How doth the busy little bee delight to bark and bite.
He gathers honey all the day, and eats it up at night."

As my pencil skimmed over the paper, recording these mystic sentences, the intensity of the signals grew ever louder until it became impossible to keep the telephones on the ears. Grabbing frantically at them I tore them off as the volume of those signals swelled into a great symphony of sound, terminating in a crash—and I was awake!

* * * * * *

Gentle reader, I blush to confess it—I had fallen asleep on my watch, and, sad to relate, my junior had discovered me thus. Calling to mind the sound wigging I had given him for a similar offence, he paid me out by opening up the discharger box, which was close to my recumbent head, and tapping out that doggerel verse with full power on.

Dimly realising that I was the "busy little bee" given to barking and biting, and that the rhyme constituted a cleverly concealed taunt, I grabbed up a paper-weight with intent to hurl it at his head, but before I could carry out the intention I beheld his retreating back framed in the doorway and heard the echo of his parting shot:

"How's that, Umpire? CLEAN BOWLED!"

Notes of the Month

Official Recognition.

We observe amongst the list of honours recently published that Mr. W. W. Bradfield has been made Commander of the British Empire. We congratulate the genial Manager and Director of Marconi's Wireless Telegraph Company on his appointment, which constitutes not merely an acknowledgment of national indebtedness to him as an individual, but also as a representative of an institution which has, ever since the war started, been executing invaluable work in the interests of the nation.

His colleagues seized the occasion for demonstrating the high personal regard which Mr. Bradfield inspires in all who come into contact with him. A lunch at the Savoy on June 13th formed the occasion. Mr. Godfrey Isaacs took the chair, and representatives of the various branches of Marconi activities vied with each other in paying their tribute. The Chairman struck the note of fraternity and informality, which was well sustained throughout the gathering. The usual toasts were honoured and the usual speeches delivered.

A Tribute from the Foe.

The British daily press were able recently to publish the German General von Hutier's instructions on the preservation of secrecy, during the phase of preparation and approach marches of the German Forces, whilst the enemy was preparing the two latest offensives. From these instructions we extract the following item, which will not be without significance and interest to Wireless men.

After emphasizing the necessity of officers alone being in possession of any papers or maps marked 'secret,' Von Hutier proceeds :—

> No secret affair is to be discussed over the telephone, as the enemy can hear conversations for seven miles behind the German front line. No telephonic installations are to go further forward than the posts of commandants of sectors, and all other telephone lines are to be dismantled.

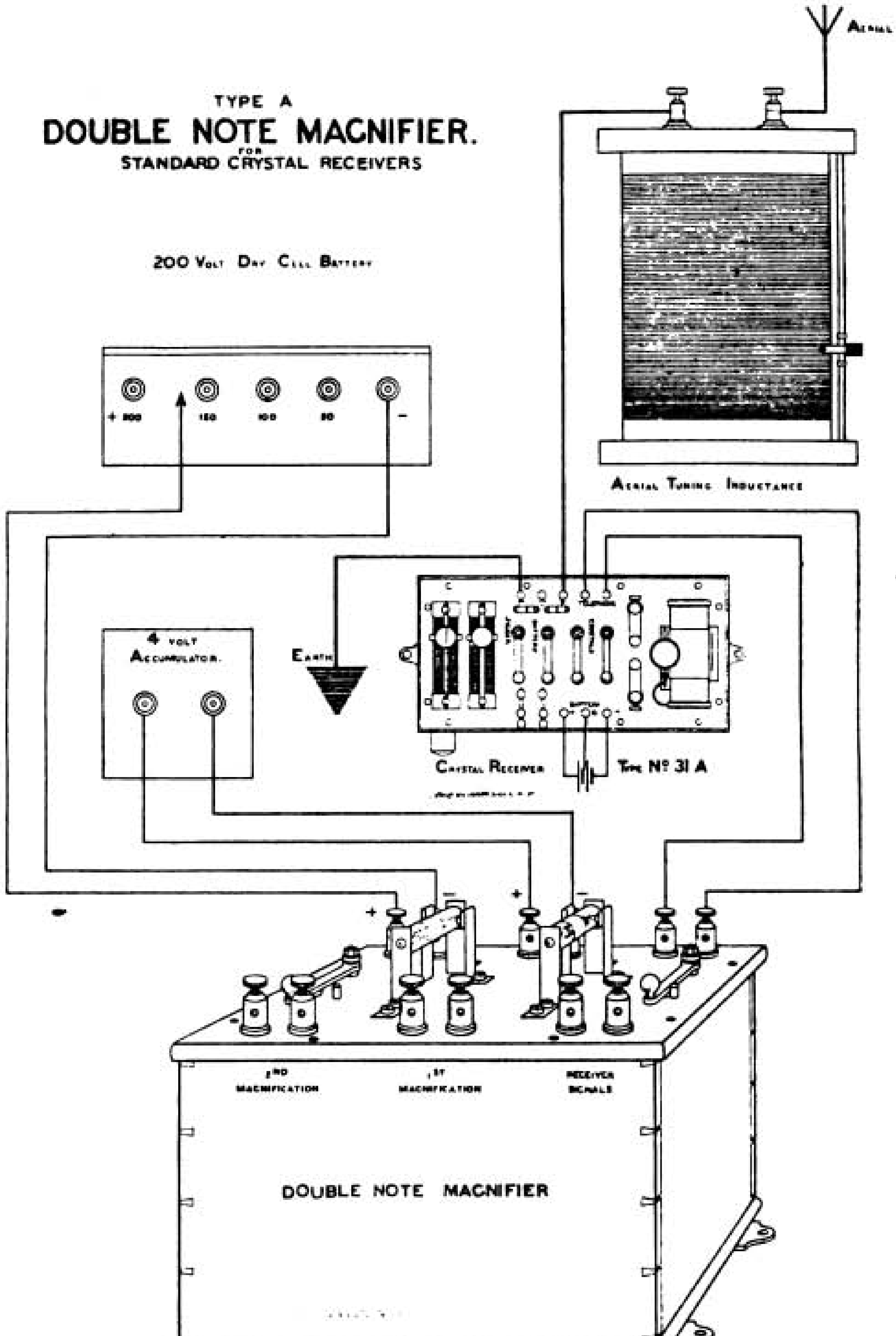
Death of an Eminent Scientist.

We have to record the death, at 68 years of age, of Dr. Ferdinand Braun, one of the most prominent German scientists of modern days, and a notable expert and inventor in Wireless Telegraphy. Dr. Braun's decease took place at King's County Hospital, Brooklyn, New York, on April 21st last. The eminent professor visited America in 1914 to give testimony in a Patent Law action, and found himself unable, after the outbreak of war, to return to his own country. His investigations into radiotelegraphy extend over a great many years, and in December, 1910, he shared with Senatore Marconi the honour of receiving the Nobel Prize for Physics. His death marks the close of a career of eminence in the world of Wireless.

TYPE A

DOUBLE NOTE MAGNIFIER.

FOR STANDARD CRYSTAL RECEIVERS

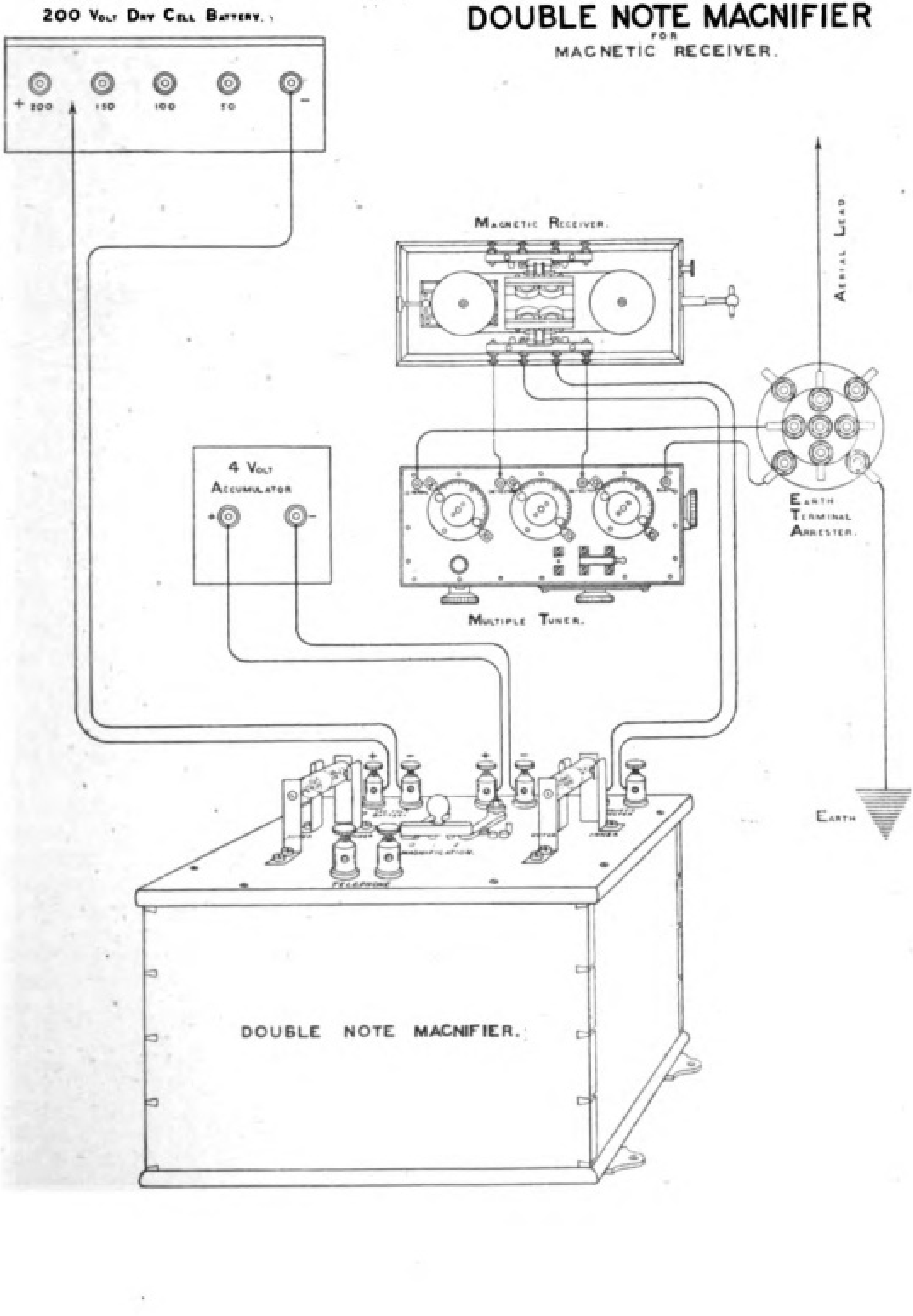


TYPE M.

DOUBLE NOTE MAGNIFIER

FOR

MAGNETIC RECEIVER.



Maritime Wireless Telegraphy

Convoys.

In the days when the safety of our shores was guaranteed by "the wooden walls of Old England," when "posting" by relays of horses was the most expeditious method of conveying men and messages by land, whilst fast-sailing frigates fulfilled similar functions at sea, our ancestors found it necessary to convoy their merchantmen to and from our harbours. In those days almost every trading vessel carried guns, and many were the doughty battles which were fought with enemy frigates or privateers. The great East Indiamen, as the ships trading with Hindustan were called, carried nearly as powerful an armament as men-of-war.

The old order changed, and men believed those days to have passed away for ever. But the hands of Time, like those of a clock, revolve in a circle; and we have once more returned to the conditions of a hundred years ago. We do, however, "wear our rue with a difference." Perhaps one of the most striking points of that difference consists of the introduction of wireless telegraphy. Think for a moment what this means to the naval shepherd in charge of the flock.

At the time when Nelson was blockading Cadiz he was obliged to establish a line of signal vessels to link him with his most advanced scouts. Over a distance of but fifty miles it took two hours and a half for the admiral to receive information that the enemy was putting to sea. The naval officer in charge of a convoy was similarly obliged to maintain his communication with the merchant vessels under his charge by means of fast cruisers; and these cruisers themselves possessed no other means of exchanging orders and information than flag signals by day and flashlights during the hours of darkness. Even in pre-submarine times the disadvantages of the latter were proved by experience over and over again. To-day signal flashing might entail fatal results.

Again, if the convoying of a fleet of merchantmen is to be adequately carried out, the whole miscellaneous collection must manœuvre in unison, and failure in this respect was mainly responsible for these "cuttings-out" of convoyed ships which figure so largely in fictitious and real adventures at sea a hundred years ago. To achieve the desired result, at the present time as in days of old, before leaving port, the masters of the merchant ships meet the officers of the escort in conference, and are carefully drilled by them with regard to the station of each vessel, the order of sailing, and details of route and speed. To ensure uniformity of signalling each unit must carry a trained signaller, and an experienced R.N.V.R. man is usually placed for this purpose on board.

Station keeping is comparatively easy for a squadron of battleships. In the first place they are in the habit of working together, and in the second place they are able to retain a few spare knots " up their sleeve " for an emergency or sudden order. But station-keeping in a convoy of merchant ships, differing in shape, tonnage, and speed, presents a totally different proposition. The strength of a chain is that of its weakest link, and the speed of a convoy that of its slowest member.

In an account recently published by one of our contemporaries we find two cases of ships dropping astern because the knottage of the vessel had been wrongly estimated. In another instance a vessel was observed to be miles behind her proper station and the commodore had to find out why. An interchange of wireless revealed that she was suffering from a leaking condenser, a matter which could be remedied in a few hours. She promised to be in station on the midday following, and kept her word.

The strain upon the king's officers in charge must be heavy indeed. The novels of Marryat and similar sea books of early nineteenth-century adventure abound in examples of critical situations and the " language " which they brought forth. Wireless telegraphy has materially lightened the strain, but those of us ashore, who owe so much to them, may well give a thought, from time to time, to these young men, but little past their boyhood, carrying on their anxious " watch," answering the wireless messages, and turning on the signalman to flash short concisely worded communications to consorts and convoys as occasion arises.

A vivid sketch of what goes on recently appeared in the public Press from a special correspondent who took part in a convoying cruise. The following extract may serve to indicate the intensity of life under such conditions:

Despite the utmost care lavished upon them, our charges had straggled and were covering a wide distance.

Crew of " Aurora," a relief ship to the Shackleton Expedition to the Antarctic, at Port Chalmers prior to her sailing on her last voyage to the South. Operator Condon (central figure with stick) paid a send-off visit to this famous Polar exploration vessel.

"Cannot effectively screen you if you scatter like this," we signalled.

An SOS from a hospital ship caused a momentary bustle, and a hasty calculation of her position. She was at least two hundred miles away, and, therefore, beyond our aid; but in a few minutes another wireless message arrived cancelling the SOS. This made us more easy in our minds, for it showed that the wild beast of the High Seas had once again been baulked of his prey.

Another marconigram announced the sinking of a small Norwegian vessel, and the rescue of her crew not very far away. Still another told of heavy fire west of ——, but this proved to be a patrol sinking a floating mine.

It was not "for fun" that the British authorities issued the orders that every vessel under their jurisdiction above 1,600 tons should be equipped with radio-telegraphic gear.

Again, apart from the regular daily routine of keeping the flock of convoys together, "Wireless" facilitates to a remarkable degree the "rendezvousing" which is necessary from time to time. We read a short while ago in our daily papers an account of the sinking of a "super U-boat" by a British submarine. The destroyed craft was one of those units upon which the German Navy specially prides itself, and silence on the part of our own authorities had rather led the public to believe that we ourselves were behindhand in respect of such vessels. But the fact that the British underwater craft was, according to the Admiralty announcement, *proceeding to meet a convoy* leads to a legitimate inference that our surmise was not justified, and that British cruising submarines, like other sea-going craft, are utilised to strengthen the protecting force of convoys at certain points. Now, in pre-wireless days such a vessel would have to cruise about in the previously arranged track of the convoy until she actually sighted those for whom she was waiting. Under wireless conditions, communication may be established at quite a long distance away, and the newcomer can proceed straight to her goal. The same factor holds good also with regard to any merchantman which from some cause or another has to drop out of her place and lose sight of the rest. So soon as she has repaired damages, she can advise the fact by radio-telegraphy, and learn through the same medium how to place herself as speedily as possible once again under the wing of the protecting squadron.

It is a strange and stirring picture for us to visualise, this revictualling of the Homeland and her resupplying with the necessaries of life. The task is difficult and arduous enough as matters stand; and it is scarcely too much to say that only radio-telegraphy renders possible and effective such a resuscitation of old-time methods for safeguarding the conveyance of supplies vital to our commissariat and industrial activities.

Paper Shortage

THE stringency of war conditions continues to increase progressively, and, in common with the rest of our contemporaries, THE WIRELESS WORLD is confronted with the necessity of instituting fresh economies with regard to paper.

A reduction in our number of pages proved inevitable, and we found ourselves confronted with two alternatives:—

(*a*) That of slightly closing up our lines and getting a larger number of words into each page by printing a little closer; and

(*b*) That of leaving the printing as it is and curtailing the reading matter.

We have chosen the former alternative, which will enable us to provide practically the same amount of illustrations and text as heretofore, and feel sure that the course will meet with the general approval of our friends and subscribers. Readers will be able to see for themselves from this issue how little the appearance of the magazine is affected.

The Evolution of the Thermionic Valve (IV.)

By R. L. SMITH-ROSE, B.Sc., A.R.C.S., D.I.C., Student I.E.E.

Read before the Students' Section of the Institution of Electrical Engineers on January 22nd, 1918.

NOTE.—The first part of this valuable paper appeared in our April issue, pp. 10 *et seq.*

(5) THE PURE ELECTRON DISCHARGE VALVE (*continued*).

IN ordinary use the temperature of the filament is so low as to prevent any appreciable evaporation or deterioration, giving the tube an almost unlimited life.

Dr. S. Dushman* has described other forms of the kenotron used for the rectification of alternating currents. These can be constructed with a thermionic current carrying capacity up to 0·5 ampère, the filament being run at a temperature in the neighbourhood of 2,500° K., at which the life of the valve is approximately 2,000 hours.

Since the characteristics of the kenotron are positive and perfectly stable, several of these can be run in parallel, and each one will take its proper share of the current. By this means the rectification of very large currents can be carried out. In his paper Dushman reproduces some oscillograms which show the limitation of the thermionic current, firstly by the potential applied to the anode, and, secondly, by the temperature of the cathode. These oscillograms also show the perfect rectification obtained with this type of valve. A typical form of the kenotron for use up to 50,000 volts is illustrated in Fig. 13, the filament being mounted between two parallel plates, together forming the anode ; this arrangement is used in order to balance as far as possible the electrostatic forces between the anode and the filament, which may become very great at high voltages, and tend to pull out and break the filament.

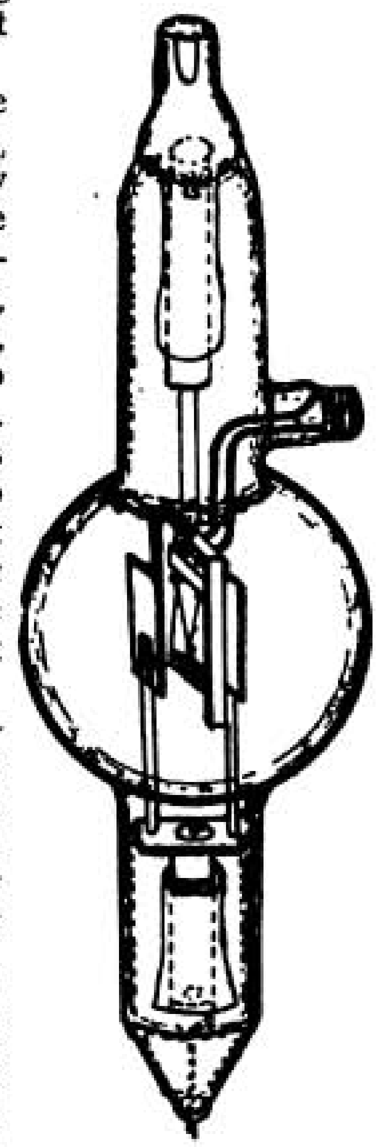


FIG: 13.

The general construction and use of the pliotron, containing three electrodes, is described by Dr. Langmuir in his paper before the American Institute of Radio Engineers in April, 1915,† and also in the patent‡ covering this invention. The general arrangement of the three elements is very similar to that employed in the De Forest audion, the details being modified according to the use for which the valve is required. The filament is of tungsten wire and is usually either in the form of an inverted V or stretched straight between the supporting wires. The second and third electrodes are of nickel wire and plate respectively, and with the V-shaped cathode are arranged on either side of this in parallel planes as illustrated in Figs. 14 and 15. In the other form the grid is formed of a cylindrical spiral of nickel wire around the filament as axis, the plate forming a co-axial cylindrical sheath surrounding both grid and filament.

* S. Dushman (*General Electric Review*, March, 1915 ; *Electrician*, lxxv., p. 276 (1915)).
† I. Langmuir (*General Electric Review*, May, 1915 ; *Electrician*, lxxv., p. 240 (1915)).
‡ British Patent 15,788, 1914.

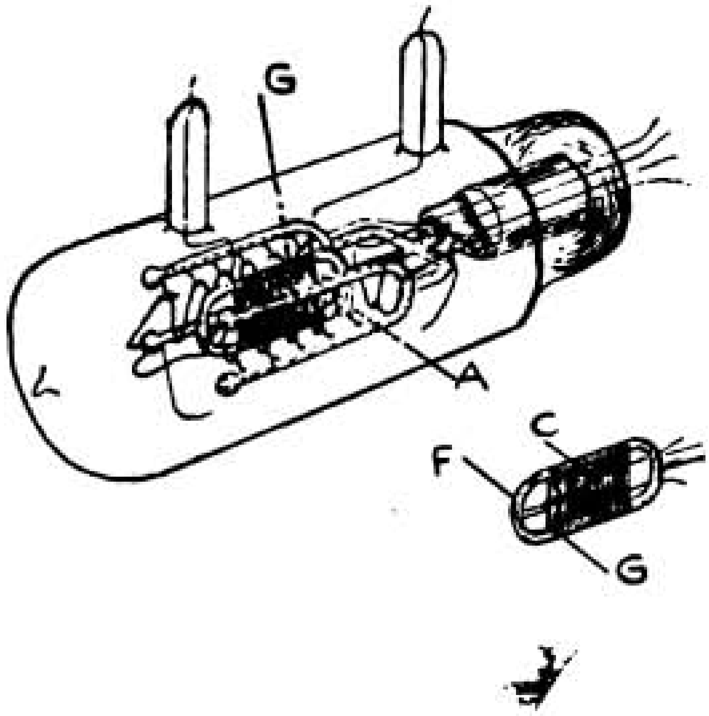


FIG: 14

When these elements have been mounted in the tube the latter is evacuated by the most approved methods of electric lamp exhaust, using either the Gaede molecular air pump* or, better, the mercury condensation pump as developed by Langmuir.† The first evacuation is carried out with the whole valve heated in a suitable furnace to the highest temperature that the glass will stand without softening, in order to remove as much as possible of the gas and vapour occluded on the walls of the vessel. It is desirable, too, that all the electrodes should be heated electrically if possible to a temperature of about 2,500° C. But this heating alone will not remove all the gas, and the first electron discharge to which the tube is subjected will liberate a considerable amount of gas from the surface of the metal. To complete the evacuation to the required degree, the pump is maintained continuously operated while the tube is subjected to an electron discharge between cathode and anode at a voltage which is gradually increased to a value somewhat greater than the normal working voltage of the valve. Care must be taken at the commencement of this operation not to use a voltage sufficient to cause the blue glow effect which will result in disintegration of the cathode ; but towards the end of the operation the electronic bombardment of the anode must be very intense in order to completely free the metal electrodes from occluded gas.

By this means the bulb is exhausted down to a pressure of the order of 1/100,000 millimetre of mercury, and no deterioration of this vacuum takes place during the normal operation of the valve.

As has been previously pointed out, the characteristics of this type of valve are perfectly smooth and regular, and quite free from all the disturbances and points of instability which often accompany the other types of gas-filled valves.

The characteristics of the pliotron depend upon the length of filament used, the distance between filament and grid, the spacing between the grid wires, the diameter of the grid wires, the distance between grid and anode, and the size and shape of the anode.

The important characteristics of a pliotron to be observed are, first, the variation of the current flowing between the anode and cathode with the potential on the anode and with that on the grid, and, second, the variation of the current flowing to the grid with the same potentials of anode and grid.

The characteristics of a pliotron of the type shown in Fig. 14 are shown in the diagram, Fig. 16, the curves showing the variation of the current flowing to the plate and grid as the voltage on the grid is varied, while the anode potential is maintained constant at 220 volts. For different potentials

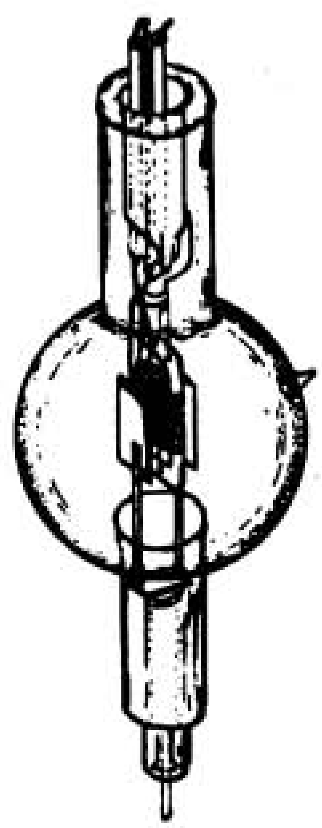


FIG: 15

* *Engineering*, xcvi., p. 379 (1913).
† *The Electrical Review* (London), lxxx., p. 41 (1917).

applied to the anode, these curves are shifted vertically, by amounts proportional to the change in anode potential. Dr. Langmuir has found that these curves can be approximately represented by the formula :—

$$i = A\ (Va + kVg)^{\frac{3}{2}}$$

where i is the current flowing to the anode, Va is the voltage on the anode, Vg the voltage on the grid, and k and A constants which depend upon the dimensions of the valve and the relative shapes and positions of the electrode.

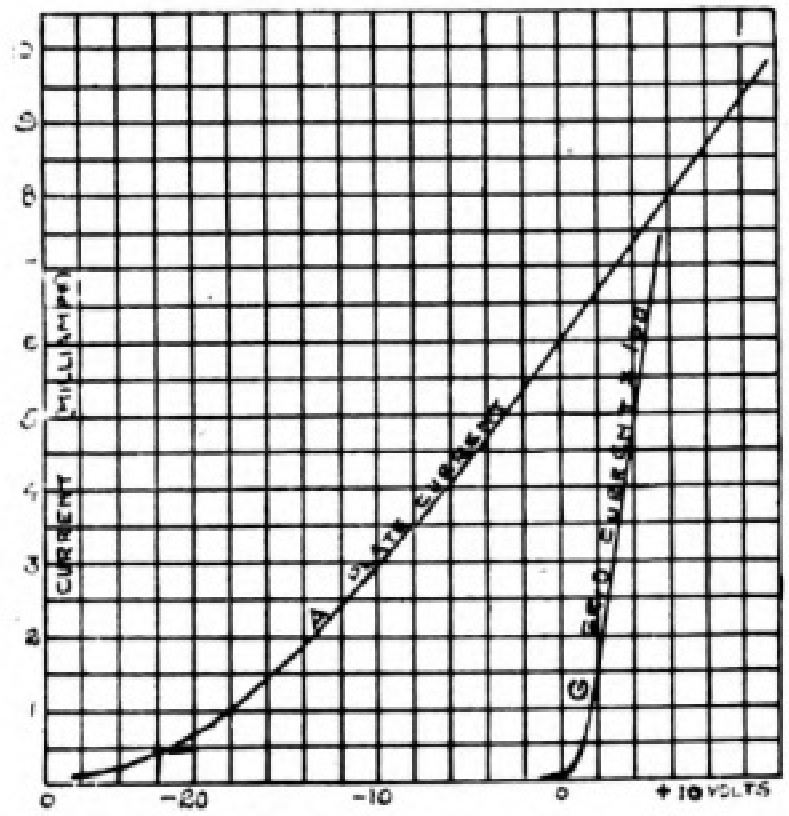


FIG: 16

In order to pass through the vacuum the currents at which this type of valve normally operates, the potentials which must be applied to the anode are considerably greater than those used in the case of the audion, but, if it be necessary, one can increase the voltage up to several thousand, without any evidence of positive ionisation, such as the blue glow effect being observed.

Owing to the extensive commercial use of thermionic valves for various purposes at the present time, there is naturally considerable development and improvement continually going on, but it may safely be said that all the valves in use belong, in principle, to one or other of the types described above. A review, by Dr. W. H. Eccles, of the recent patents applied for on this class of apparatus shows that the chief improvements which have been made are slight modifications in the arrangement of the electrodes and also alterations in the operating circuits to obtain increased sensitiveness.*

(*To be continued.*)

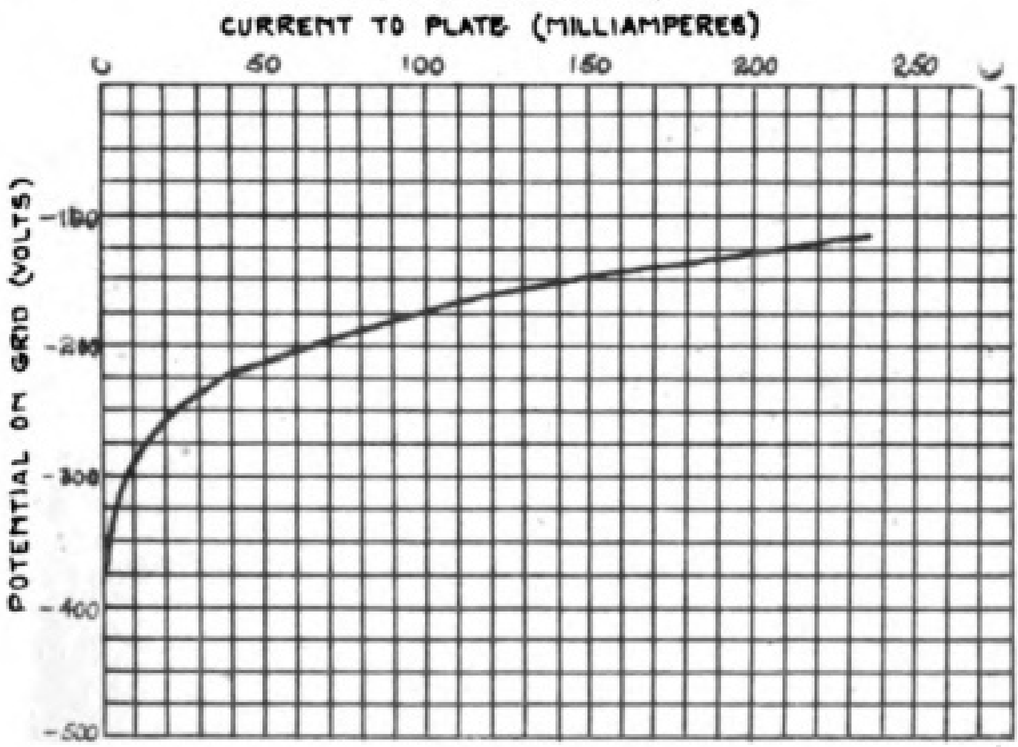


FIG: 16 A

* W. H. Eccles, *Electrician*, lxxvii., pp. 571, 594 (1916).

Among the Operators

It is our sad duty month by month to record the deaths of the brave operators who have lost their lives at sea by enemy action, and other causes, in the wireless service of their country. Owing to the necessity of preventing the leakage of information likely to assist our adversaries, the names of ships and localities of action cannot be published. With the exception of Mr. M. J. McGrath, taken prisoner, and Mr. D. P. Smart, who is in hospital at New York, the lives of the operators whose photographs we publish this month have been sacrificed as the result of hostile activities. Both on our own part, and on that of our numerous readers, we extend to the parents and relatives of these young men, who so nobly uphold the "wireless tradition," the deepest sympathy in their sad bereavement.

Mr. PHILIP DANIEL BOLT, who was born at Forest Gate, was eighteen years of age, and received his education at George Green's School, Poplar, and at the High School, Southend-on-Sea. On completing his education he took an interest in wireless telegraphy, and entered the Marconi Company's School, for training. On completing his course and receiving the P.M.G. Certificate he was appointed to the operating staff in November, 1916.

A Lancashire lad, Mr. JAMES CRAWSHAW was born at Worsley in 1900. Educated at Deykin Avenue Council School, Witton, Birmingham, and Lewis's Street Council School, Manchester, he was employed by the Wolseley Sheep Shearing Machine Company, Limited, Birmingham, in a clerical capacity after leaving school. Trained in wireless telegraphy at the City School of Wireless Telegraphy, Ltd., Birmingham, he qualified for the P.M.G. Certificate, and received an appointment in the Marconi Company in March of this year.

Mr. WALTER HERBERT OLIVER was born at Tibbermore, Perthshire, on January 8th, 1900, and went to the Ferryhill Public School for his education. Commencing his career in the Post Office, he was appointed messenger at Aberdeen, and from there entered the Scottish Wireless College, Aberdeen, where he was trained in wireless telegraphy. On gaining the P.M.G. Certificate Mr. Oliver was placed on the Marconi Company's operating staff in March, 1917.

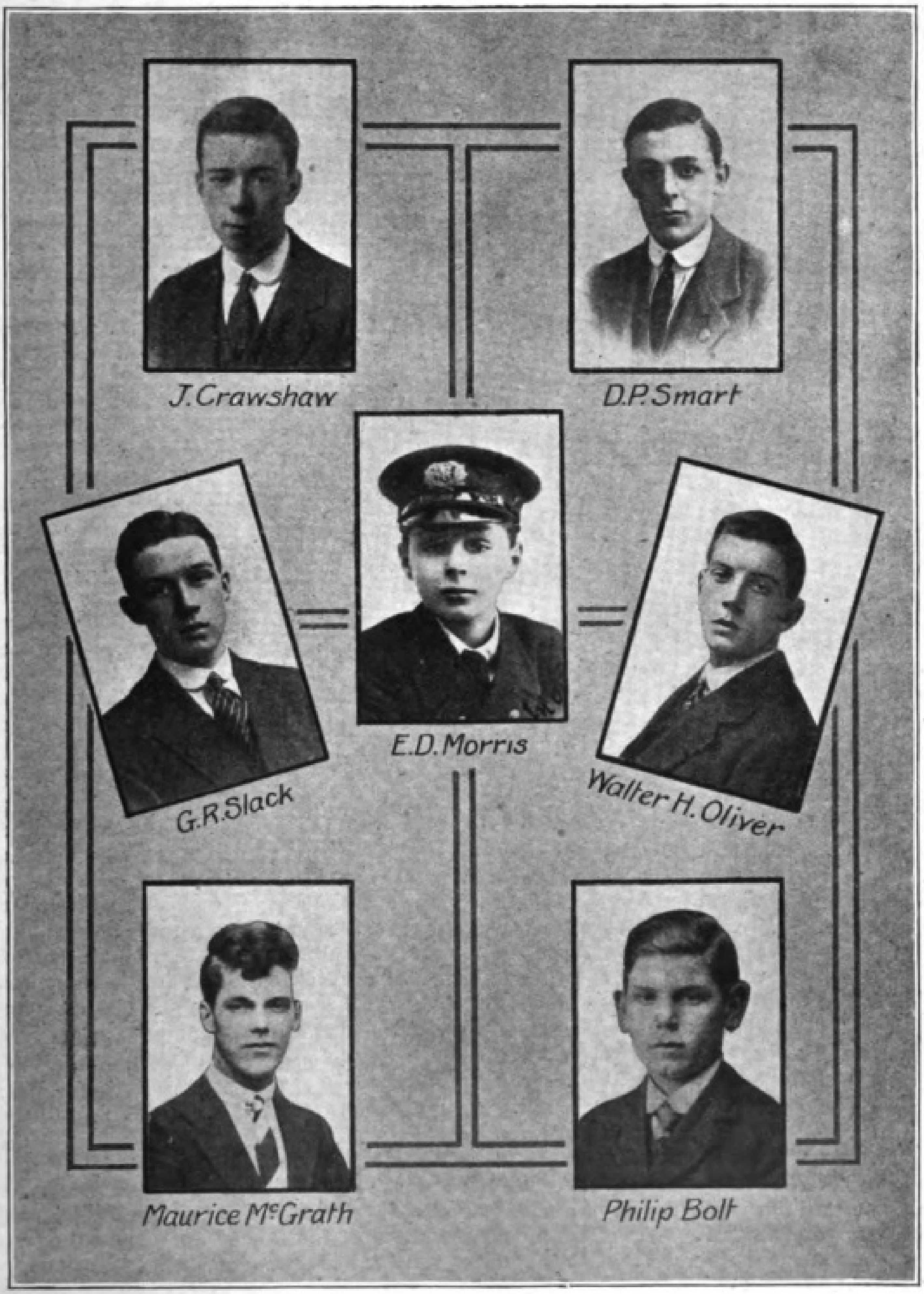
Born at Cleckheaton, Yorkshire, on January 26th, 1899, Mr. GEORGE RONALD SLACK pursued his studies at the Wakefield Grammar School. He then entered the service of the Lancashire and Yorkshire Railway Company as junior clerk in the office of the goods superintendent at Wakefield, and was so employed until he commenced training at the North-Eastern Schools of Wireless Telegraphy, Leeds. After being granted the P.M.G. Certificate Mr. Slack joined the Marconi Company's service in May, 1916.

Mr. ERNEST DAVID MORRIS, who hailed from St. Asaph, was born on March 17th, 1902, and received his schooling at Candottan Council and the Neath County Schools. Wireless telegraphy having a great attraction for him, he successfully studied under the tutelage of the South Wales Wireless College, Ltd., at Swansea, and was awarded the P.M.G. Certificate. Mr. Morris joined the operating staff on January 21st, 1918.

News is to hand that Mr. MAURICE JAMES MCGRATH has been taken prisoner by the Germans. Mr. McGrath joined the service in 1916, and served on several ships previous to the one from which he was captured, presumably by a submarine. As previously mentioned in our pages, a number of Marconi telegraphists are interned at the Ruhleben Camp, in Germany, so that we trust Mr. McGrath may meet friends, and his captivity thus be lightened.

Advice has been received that Mr. DAVID PEARSON SMART, who left England for the United States and joined a ship in New York last December, was taken ill

ROLL OF HONOUR.



shortly afterwards, and removed to hospital to undergo an operation for appendicitis. We trust this has been successfully performed, and wish him a speedy recovery.

GRATUITIES TO OPERATORS.

In our May issue, under "Maritime Wireless Telegraphy," we referred to "The Merchant Ships' Gratuities Committee," which sits at the Admiralty, and awards sums of money to merchant officers and seamen for devotion to duty when in action with enemy forces. We have pleasure now in printing the names of 60 operators whose conduct has been recognised in this way by the authorities to date :—T. F. Alton, J. Angas, A. Arklay, S. Austin, A. Beatty, C. Bovey, P. P. Brehoney, F. J. Bruce, A. T. Campbell, Thomas Carney, W. J. Charles, W. S. Crabbe, A. E. Cruse, P. Crawley, A. R. Day, J. T. Dunbar, H. B. Elder, S. G. Evans, J. F. A. Ford, E. W. Gardiner, G. C. Gaughan, W. F. Gray, P. J. Harrington, S. A. Henderson, J. K. Holland, G. Hutchinson, G. H. Jarrett, J. A. Johns, T. Killeen, J. V. Kinnimonth, R. H. Lea, D. S. Lewis, A. McNair, G. D. Martin, H. C. Masters, G. Midgley, J. Montgomerie, J. Mongey, W. T. Munro, M. W. Murphy, W. J. C. Murray, A. A. Newbery, F. A. Nixon, G. O'Hallaran, E. P. Pearce, F. Pearson, R. Priestley, E. Rattue, M. Santuy, M. Shea, J. Shearer, H. Smith, H. Sneath, J. Vincent, N. Walton, T. Ward, H. J. West, J. Whittaker, C. W. Wilde, E. N. M. Wroughton.

New Wireless College at Auckland

THE most recent manifestation of radiotelegraphic activities in the Australasian Dominions consists of the official opening and installation of the Marconi wireless apparatus at the Dominion College of Radiotelegraphy in Auckland, the capital city of the North Island of New Zealand. The ceremony of initiation was recently performed by the Rt. Hon. Sir Joseph Ward, Postmaster-General and Minister of Telegraphs.

In the course of an interesting speech made on that occasion, Sir Joseph stated that this college, in common with others, had for a considerable time been working under difficulties, inasmuch as it found itself *minus* the necessary equipment, and —under the war regulations—this could not be installed until special permission had been obtained. Official leave was finally granted, and arrangements were made with the Amalgamated Wireless, Ltd., for the installation of four complete sets of Standard 1½ kw. Marconi apparatus. Provision had also been made for giving students at the Dominion College priority for appointments to the Amalgamated Wireless operating staff. The college was incorporated as a private company on February 23rd, 1917, and—in the course of the first year—250 pupils had received instruction ; 89 students having taken up appointments, for the most part in war work. During the last twelve months four of the latter had made the supreme sacrifice, and laid down their lives for the Empire.

The eminent New Zealand statesman proceeded to give a brief summary of the history of wireless telegraphy, and enumerated a number of examples indicating the wonderful development of the science under the stimulus of war conditions. He expressed the opinion that before many years wireless telephony would have come into her own, and would have reached the stage of universal use. He wound up by congratulating the directors and managers of the college upon the enterprise and efficiency displayed by them, pointing out that efforts such as theirs not merely redounded to their personal credit, but constituted valuable assets in the progress of Imperial Development.

Instructional Article

NEW SERIES (No. 4).

EDITORIAL NOTE.—Below we give the fourth of a new series of twelve Instructional Articles devoted to PHYSICS FOR WIRELESS STUDENTS. *Although at first sight the subject of physics would not seem to have a very intimate connection with wireless telegraphy, yet a sound knowledge of this subject will be found of the greatest use in understanding many of the phenomena met with in everyday radiotelegraphy. As in previous series, the articles are being prepared by a wireless man for wireless men, and will therefore be found of the greatest practical value.*

PHYSICS FOR WIRELESS STUDENTS.

Law of Inverse Squares.—Every body attracts every other body with a certain force the direction of which is that of a straight line joining the bodies; the same statement applies to the *particles* of matter. The law of inverse squares, which has a wide application in physics, is a more precise expression of the law governing this force and may be stated as follows. **For small bodies the force of attraction is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.** This, expressed in symbols, is usually written:

$$F \propto \frac{m_1 m_2}{d^2}$$

where m_1 and m_2 are the masses, d the distance and F the force. If the masses are equal, $F \propto \frac{m^2}{d^2}$, m being the mass. In order to change the formula to an equation a constant must be introduced and the full expression is then

$$F = k\frac{m_1 m_2}{d^2},\ k \text{ being a constant.}$$

Inverse Square Law for Electric Charges.—Two positively charged bodies repel each other with a force which is determined by the inverse square law:

$$F = K\frac{Q_1 Q_2}{d^2}$$

where Q_1 and Q_2 are the charges and K is a constant depending on the nature of the medium separating the bodies. *Numerically*, K in the present case is equal to the reciprocal of the dielectric constant of the medium and the equation can be written

$$F = \frac{1}{k}\frac{Q_1 Q_2}{d^2}$$

where $\frac{1}{k}$ represents K, *k being the dielectric constant.* If the medium is air or aether the dielectric constant is taken as 1 and the equation becomes

$$F = \frac{Q_1 Q_2}{d^2},$$

d usually being expressed in centimetres and F in dynes.

D

If the charges are equal, d is 1 cm., and F (in air) is 1 dyne, then the charges are *unit charges*. From this the reader will be able to express for himself the definition of unit electric charge.

If the dielectric be other than air or aether F is less than it would be for those media. A comparison will make this clear.

(1) When dielectric is **air,**

$$F=\frac{1}{k}\frac{Q_1Q_2}{d^2}\text{ dynes}=\frac{1}{1}\frac{Q_1Q_2}{d^2}\text{ dynes.}$$

(2) When dielectric is **ebonite,**

$$F=\frac{1}{k}\frac{Q_1Q_2}{d^2}\text{ dynes}=\frac{1}{3{\cdot}15}\frac{Q_1Q_2}{d^2}\text{ dynes}$$

or 1) $$F=\frac{Q_1Q_2}{d^2}\text{ dynes,}$$

(2) $$F=\frac{Q_1Q_2}{3{\cdot}15d^2},$$

where $3{\cdot}15=k=$ dielectric constant of ebonite. Clearly (2) will be of lower value than (1).

Inverse Square Law for Magnetic Poles.—If two similar and equal magnetic poles are placed 1 cm. apart in air and the force they experience is 1 dyne, then the poles are of *unit strength*. If m_1 and m_2 are strengths of two poles expressed in the unit just defined, then in air

$$F=\frac{1}{\mu}\frac{m_1m_2}{d^2}$$

where d is their distance apart and μ the *magnetic permeability* of the intervening medium. For empty space, air or other *non-magnetic* material μ can be taken as 1; for any one *magnetic* material the value of μ is not constant.*

As further examples of the application of the law of inverse squares the following may be noted.

Light.—The intensity of illumination due to a source of light considered as a point **varies inversely** as the **square of the distance** from the source.

Sound.—The intensity of sound due to a given source **varies inversely** as the **square of the distance** from the source.

FORCE (concluded).

It has been pointed out repeatedly that force is not a physical *thing* and stress has been placed upon this because too often the word force is invested with an incorrect significance. In advanced electrical and magnetic theory, in the region of "lines of force" and "tubes of force," this ultimately inexplicable "force" is apt to become rather materialised by sheer familiarity with the use of the word and the conventional, convenient diagrams, and it is just as well to remember that, physically, force is non-existent. In a physical action the important factor is the *energy* involved or *the work done*. Force is made manifest in many ways but its results are always the same—*i.e.*, to move or to change the movement of matter. Its immediate cause may be muscular, mechanical, chemical, electrical, magnetic or gravitational, but after a physical action has taken place the "force" **disappears**; but the energy, the conserved, enduring *thing*, only **changes.**

* To follow up this point read about magnetic permeability in a book on Magnetism and Electricity.

MOTION.

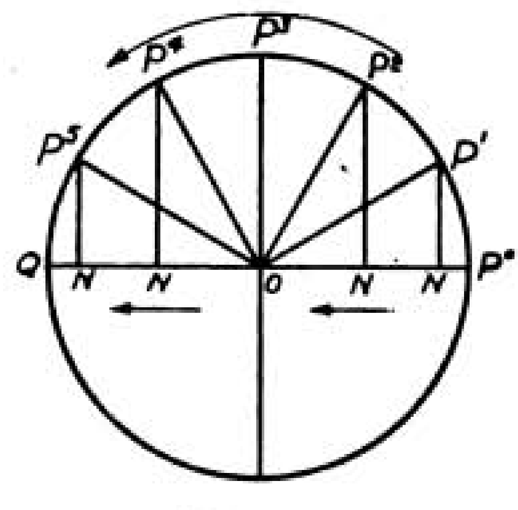


FIG. 15.

Considerations of space and the elementary nature of these articles permit us to treat only of one form of motion, harmonic motion, which is the most interesting and probably the most important to the student of radiotelegraphy. It is worth while to point out that Nature presents a remarkable number of periodic phenomena and that many of these have influenced and continue to influence, because of their periodic nature, life on this planet from that of organisms far down the biological ladder to that of the human race. This influence can be traced in the laws, religions, and customs of men and even in the common round of our daily life and habits. The ebb and flow of the tides, the regular recurrence of the seasons, the alternation of day and night, the monthly " waxing and waning " of the moon, the pulsation of the heart, the rhythm of breathing, the sea waves, sound and light are all examples of periodicity in some form or other.

Simple Harmonic Motion.—Referring to Fig. 15, imagine that a point P, starting from the position P^0, moves round the circumference of a circle in a positive direction at an uniform speed. The centre O being fixed, the line OP will sweep out 2π radians during every complete revolution of P. Now suppose that P has reached the position P^1. A line has been drawn from P^1 perpendicular to OP^0 and meeting OP^0 at N; this point N is the projection of the point P^1 upon the horizontal diameter of the circle. It should be clear that before P begins to move from its position at P^0, ON will coincide with OP^0, that is to say, the projection of P upon OP^0, if it could be made, would be the point P^0. It should be equally clear that as P moves round the circumference to Q the point N will move towards Q along the diameter QP^0. Note in Fig. 15 the progress of N towards Q as P reaches P^1, P^2, P^3, P^4, P^5, and that P and N will evidently reach Q together. Note also that when OP has swept out 90° and P has reached P^3, the point N has reached O. The reader's attention is also directed to the fact that by the time OP has swept out 180°, that is, when it lies along OQ, N has travelled along the entire diameter from P^0 to Q.

In Fig. 16 we follow the continued movements of P and N. Both are moving back to the point P^0, but, whereas P is still moving in a positive direction, *N has reversed its direction of motion* and is moving back over its first track. When both points reach P^0, P has completed one revolution and N has performed one complete swing. As P continues to move round the circumference so N will continue to *oscillate* between Q and P^0.

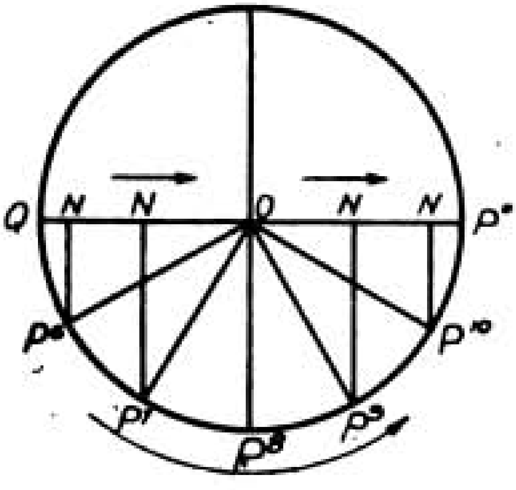


FIG. 16.

It was assumed that the speed of P is uniform, but it should be noted that the velocity of N is *not* uniform since *at the points Q and P^0* the direction of the motion of N is reversed, and the velocity *at the points Q and P^0* is zero, because before the *sense* of a velocity reverses there must occur a slowing down eventually resulting in a stoppage at the instant before the reversal takes place. In the unlikely event of the reader being unable to grasp this idea let him move a pencil backward and forward along a straight line at any velocity he pleases; he cannot then fail to realise that having reached one end of the

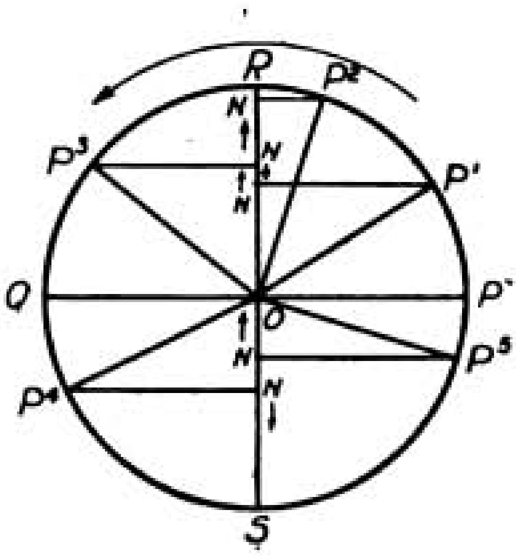


FIG. 17.

line the point of his pencil is bound to stop moving for a small fraction of time before it can "turn round and go back."

If instead of projecting P upon the horizontal diameter OP^o we project it upon the vertical diameter RS (Fig. 17), N will oscillate between R and S. It is important to notice that

(1) In the case of the projection of P upon the horizontal diameter (Fig. 15) the point N is at the *beginning of its swing* when OP starts to move—*i.e.*, when it lies along OP^o.

(2) In the case of the projection of P upon the vertical diameter RS (Fig. 17) the point N is at O when OP starts to move, and is at the *mid-point* of a swing.

The point N, moving as described along the two diameters, is said to move with **Simple Harmonic Motion** and we can say that **the uniform motion of a point round the circumference of a circle can be resolved into two S.H. motions at right angles to each other.**

The chief characteristic of S.H. motion is that it follows a **sine law.** It is true that it can be represented by a *cosine* formula, but the difference is only a matter of phase and depends upon whether the time factor is considered to be zero when the moving radius OP is in line with the direction of the S.H.M. or when it is vertical to the direction of the S.H.M.

Case I.—See Fig. 18. The direction of the S.H.M. in this case is considered to be along the vertical diameter. If $t=o$ when OP lies along the horizontal diameter, as shown in the figure, then the S.H. motion is represented by a **sine formula.**

Case Ia.—By the simple sine law the distance from N to O measured along the vertical diameter is at any time proportional to the sine of the angle which has been swept out by OP, *time being taken as zero at the instant when OP lies along the horizontal diameter, that is, along OP^o* (Fig. 18).

The angle swept out by OP at any time t is the **angular displacement** θ, which, it will be remembered, is equal to $2\pi nt$.

We have, then, $i \propto \sin\theta$, where i is used to denote any instantaneous value of the distance from N to O. In order to turn this expression into an equation we can write $i=k\sin\theta$, k being some constant. The constant actually employed is the *maximum value* which ON can reach, and this, as can be seen by examining the diagrams, is equal to that particular value ascribed to the radius of the circle, for ON can never be greater than the radius. To remind us what k represents it is convenient to call it I_{max}.

$$i = I_{max}\sin\theta \quad . \quad . \quad (1)$$

Let us test the truth of this equation. For simplicity we will make I_{max} equal to 1 and we will take θ as 30°, which is the angle swept out by OP in Fig. 18. Draw PN^1 perpendicular to OP^o and PN perpendicular to OR. Now, we are trying to find the value of the distance of N from O along the

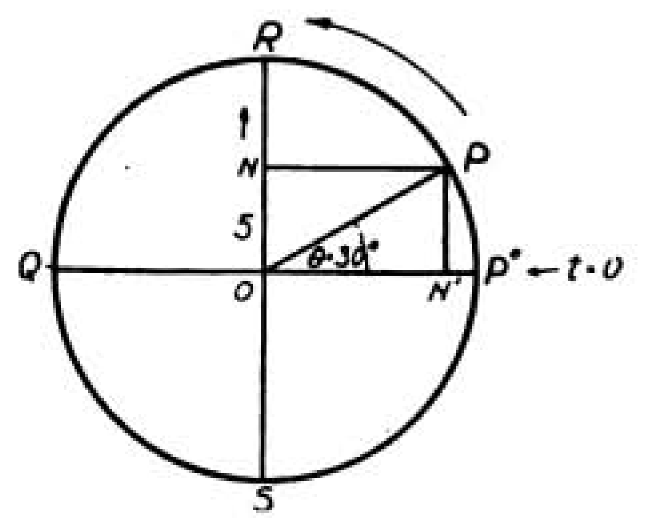


FIG. 18.

vertical diameter at the moment when $\theta=30°$, so that if $i=I_{max} \sin \theta$ then NO should be equal to $1 \times \sin 30°$. The sine of the angle θ is equal to the ratio $\frac{PN^1}{OP}$ and as PN^1 equals NO we can say that $\sin \theta = \frac{NO}{OP}$; but OP equals 1, hence $\sin \theta = NO$. The angle θ being 30° its sine is ·5 (a value which can be found in a table of sines), so that NO ought to equal ·5. By measurement on the diagram it will be found that this is so, taking OP as 1.

$$i=I_{max} \sin \theta$$
$$NO=1\times \cdot 5=\cdot 5.$$

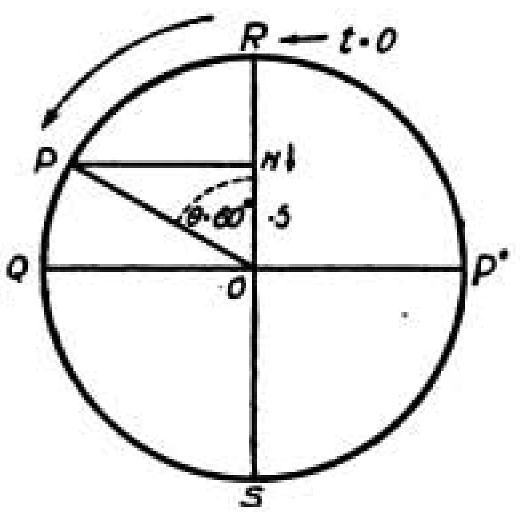


FIG. 19.

Hence at any instant, if t is considered to be zero when OP lies along the horizontal diameter, the value of NO on the vertical diameter is equal to $\sin \theta$, I_{max} being taken as unity.

Case II.—The direction of the S.H.M. is considered to be along the vertical diameter. If $t=0$ when OP is *in line* with the direction of the S.H.M. as shown in Fig. 19, the motion is represented by a **cosine formula.**

Case IIa.—The distance NO, measured along the vertical diameter, is at any instant proportional to the cosine of the angle which has been swept out by OP, *time being taken as zero at the moment when OP lies along the vertical diameter*, that is, along OR (Fig. 19).

$$i=I_{max} \cos \theta.$$

Again taking I_{max} equal to 1 it is seen (Fig. 19) that $\theta=60°$. What we wish to find is the value of NO at the instant when $\theta=60°$. Draw PN perpendicular to OR. Then $\cos PON=\frac{NO}{OP}$; but $OP=1$, so that $\cos PON=NO$. The cosine of PON (60°) is ·5, therefore $NO=\cdot 5$. This can be verified by direct measurement on the diagram, taking OP as 1.

$$i=I_{max} \cos \theta$$
$$NO=1\times \cos 60°$$
$$=\cdot 5.$$

Hence at any instant, if $t=0$ when OP lies along the vertical diameter, the value of NO measured along that diameter is equal to $\cos \theta$, I_{max} being taken as unity.

In cases *I.* and *II.* we took $I_{max}=1$; but if I_{max} should be greater or less than unity then i will be greater or less than the sine or cosine of θ.

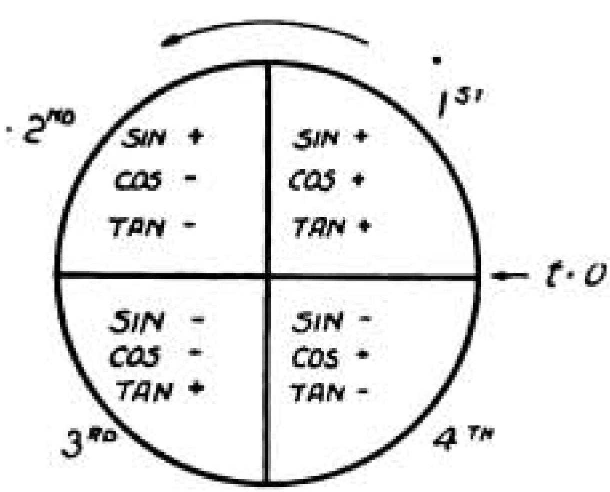


FIG. 20.

Twice during every revolution i will be *equal to* I_{max}, and its value at these times is called the **amplitude** of the motion.

It should be noted that in practical examples θ is generally expressed *in radians*, so that if the reader is dealing with an equation of the form

$$i=I_{max} \sin 2\pi nt$$

he will have to multiply $2\pi nt$ by 57·3, thus obtaining the angle in degrees. He can then find the required sine from his tables.

To go fully into the cases where θ is an angle in the second, third, or fourth quadrants would encroach too much upon the subject of mathematics but the student is advised to manufacture examples of such cases and to work them out, giving various values to I_{max} and θ. For reference during such work Fig. 20 shows the signs of the trigonometrical ratios in all quadrants.

Sine Curve.—A simple sine curve is the curve of the equation $i=I_{max} \sin \theta$, which is sometimes met thinly disguised as $y=a \sin (cx+g)$ or an equation of similar form but with different letters. The two forms are, however, just two ways of expressing one fact. Fig. 21 shows a sine curve (A). It was obtained by taking various values of t and finding the corresponding values of i above and below o. Above and below the base line these values of i were indicated by lines drawn from the points marking the corresponding values of t. The tops of the lines were then

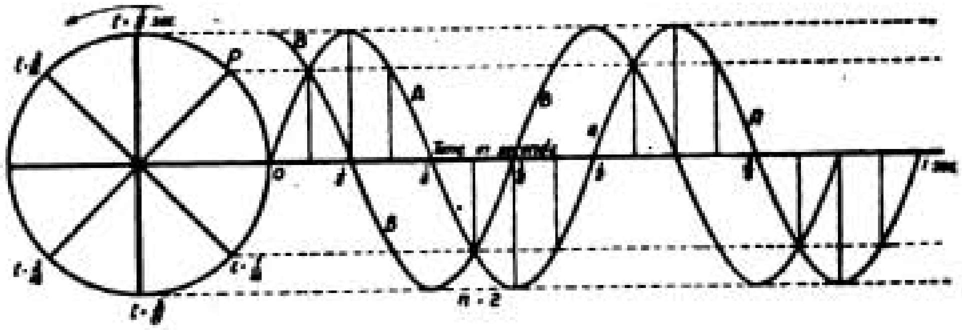


FIG. 21.

joined by the curve. A cosine curve (B) has been drawn in the same diagram in order to show graphically that it is of exactly the same type as the sine curve, but that it *leads by a quarter-period*. The full period in this case is half a second, OP making 2 r.p.sec.

The current in an alternating current circuit can be represented by a sine curve, in which case i means "the current in the circuit at any instant t"; or i may be the instantaneous value of an alternating E.M.F. A sine curve may also represent undamped H.F. oscillations. The reader should make an exhaustive study of these curves, actually drawing them on squared paper, obtaining his ordinates (*i.e.*, the distances of the curve above and below the base line at various times) both by calculation from the equations and graphically by taking various positions of OP.

(To be continued.)

German Post-War Preparations

A STATEMENT recently appeared in the *Neue Hamburgische Borsen Halle* to the effect that:

> A company, under the style of Drahtlose Ueberseeverkehr, A.G. (oversea Wireless Communication Company), has been formed at Berlin with a capital of M.10,000,000 to establish a wireless news service. The main station at Nauen will be utilised in the new undertaking. The board of directors includes Count von Arco, Dr. Franke (director of Siemens-Schuckert works), Herr Heinemann (director of the Deutsche Bank), Councillor of Commerce Mamroth (Algemeine Elektrizität Gesellschaft), Herr Müller (Councillor of the Finance Board of the Dresdner Bank) and Herr Hans Bredow.

This announcement goes to form a fresh indication of the seriousness of our enemy's intentions with regard to the establishment of a Teutonic "Lloyd's" after the war, to which we referred on page 260 of Volume V. British shipping men, and, indeed, all concerned in this vital industry, will do well to take the menace very seriously indeed.

THE SHIPPING WORLD YEAR BOOK, 1918, *edited by E. Rowland Jones. Published by "The Shipping World," Arundel Street, Strand, W.C. Price* 10s. *net.*

Amongst the various annual publications devoted to special branches of industry the *Shipping World Year Book* occupies an honourable and assured position. The volume which has just come into our hands is the thirty-second edition issued by the Press of Effingham House; and the only adverse remark we have to make is that—owing, doubtless, to superabundance of matter—the editorial text occupies no fewer than 2,066 pages; with the result that the volume "bulks" somewhat in handling.

The variety of information contained in this and similar volumes is too often overlooked; it has frequently fallen to the lot of the present writer to be asked some question quite impossible for him to answer "out of hand," and which the inquirer could just as easily have turned up for himself in works of reference open to all. The shortcoming of individual initiative lies, of course, in a failure of sufficient acquaintance with the material for reference available.

The *Shipping World Year Book* centres round two principal features:—(*a*) A Port—and Harbour—Directory, covering the whole world; and (*b*) the Tariffs of all Nations. These two leading features are brought up to date annually, and, we presume, constitute the items which are recalled by the mind of every consultant whenever occasion arises for the information to be sought, and memory stirs some recollection of what is to be found between its covers. But there are a large number of miscellaneous items which in their way are just as useful from the point of view of reference.

We notice, for instance, Conversion Tables for foreign weights, measures, and money; as well as tabular matter connected with the compass; weather, and degrees of latitude and longitude. A place is found for the Board of Trade Tables of Free-Board, together with the rules and instructions for applying them, and we are furnished with the text of British regulations affecting load-lines, and the rules of international classification. A digest of the various Merchant Shipping Acts occupies 155 pages; whilst the Aliens Act, the Factory and Workshop Act, the Workmen's Compensation Act, and that part of the National Insurance Act which applies to the Mercantile Marine, are given in full. We find, moreover, a number of miscellaneous items, such as the fees and other arrangements affecting Masters' and Mates' Certificates; Seamen's Discharge and Naturalisation Certificates; the Standing Rules for vessels at sea and in port; an explanation of ships' tonnage, and a list of His Majesty's Consular Certificates Abroad. The List of Customs

Boarding Stations undergoes an annual revision ; and a number of tables, such as those of distances, time and knot, coal consumption, etc., combine with the aforementioned features to complete an extremely handy book of reference.

The Shipping Map of the World, contained in a pocket fitted to the back cover, is printed in colours ; and shows the various regular steamship routes, marked as clearly as is possible with so complex a nexus. We notice, by the way, that the vast territories still included under Russian Rule continue to be labelled " Russian Empire," a term more redolent of Tsardom than of present conditions.

"RADIOTELEPHONY." By Alfred N. Goldsmith, Ph.D. New York: The Wireless Press, Ltd. Inc. $2.00.

Radiotelephony, strangely enough, has never taken any great hold upon the popular imagination. This is the more remarkable, seeing that the transmission of speech through ether without any connecting wire is really a far more wonderful achievement than the sending of dots and dashes. This oversight on the part of the public may be due in a large degree to the measure in which radiotelephony has been overshadowed since its inception by its elder sister, radiotelegraphy, in whose track it has so closely followed.

So far as technique is concerned radiotelephony is closely allied to its sister art, the fundamental principles underlying both branches of radio activity being the same. Thus both utilise high frequency oscillations, both make use of ether waves for the transmission of their signals ; while for reception purposes the methods of the two sciences are so nearly identical that one may receive the signals of the other. The student, therefore, who sets out to master the principles of radiotelephony has his path cleared of all preliminary obstacles if he possess a previous acquaintance with the technique of the wireless telegraph.

Whilst every standard manual of wireless telegraphy has its chapter or chapters briefly outlining the principles and progress of the wireless telephone, we have hitherto lacked an authoritative manual dealing exclusively with modern radiotelephony. In making this statement we are far from desiring to cast any aspersion upon the well-known treatise of Ernest Ruhmer, so ably translated by Dr. Erskine Murray. That work, excellent so far as it goes, was written long before any of the modern methods were introduced.

It has fallen to the lot of America, ever well to the fore in wireless research work, to produce such a book as that which is required, and all wireless men will give a hearty welcome to Dr. Goldsmith's treatise. The book is designed on an excellent plan, and we are glad to find the first chapter devoted to a consideration of the uses of radiotelephony, including a comparison of the wired and wireless forms of speech transmission, and the broad problems involved in radiotelephony.

At this point it may be advisable to point out that, in order to obtain the fullest benefit from the book, it is necessary for the reader to have some acquaintance with the principles and practice of radiotelegraphy. Had the author not assumed such knowledge to be possessed by his readers, the present volume would inevitably consist largely of a recapitulation of previously published work—a method of duplication not to be desired from any point of view. Chapters II., III., IV. and V. are devoted to the various forms of sustained wave generator used in wireless telephony. Here we find collected together for the first time full descriptions of modern Poulsen arc apparatus, radio-frequent spark systems, vacuum tube oscillators, and high frequency alternators. Any student who approaches radiotelephony for the first time through Dr. Goldsmith's treatise will be surprised at the multiplicity of devices for obtaining sustained waves ; and we feel sure that there are but few, even amongst wireless men of experience, who realise the amount of research work which has been devoted to this branch of the art.

For several years scientists have been well acquainted with a number of methods of producing continuous waves suitable for the transmission of speech, but it is only quite recently that they have been able to modulate the radiated power in accordance with the sound waves of the voice. The energy controlled by the microphone in the ordinary wired telephone is in the order of micro watts; but, if we wish to radiate ether waves modulated to carry wave formation of speech, we must be able to employ other means of varying the heavier powers. In chapters VI., VII. and VIII., Dr. Goldsmith deals with this side of the question, the crucial problem of radiotelephony, and shows how the difficulties in the way have been overcome. This has been effected very largely, as a matter of fact, by means of amplifiers. The formidable character of the problem which faces us in this direction will be realised when we consider that the transmission of a single word over a long distance by radiotelephony requires that the speech of the operator should cause a momentary variation of several kilowatts in the aerial!

The section dealing with oscillation valves is particularly well treated, and although the author wisely refrains from touching upon such controversial points as priority of invention, he is yet able to do justice to much of the work of the numerous inventors in this field. We find, for example, a fuller recognition of the work of Captain H. J. Round than is usually given in text books. This inventor, together with A. J. Franklin, has contributed far more to the development of the three electrode valve than is customarily acknowledged, and we are glad to notice that Dr. Goldsmith has recognised their claims.

The recently introduced high-vacuum valve of the General Electric Company, known as the *pliotron*, and the circuits designed to work with this instrument, receive adequate treatment and illustration. A comprehensive description of the still later "dynatron" also finds a place. This device depends on a principle hitherto not utilised in this connection, namely, secondary emission; and our author's explanation of its working is interesting in the extreme. When employed as an amplifier, voltage amplification to the extent of a thousandfold has been obtained, and one hundredfold amplifications are readily available. When employed as an oscillator, the dynatron has shown itself capable of producing all frequencies between less than one cycle per second and 20,000,000 cycles per second (corresponding to a wavelength of 15 metres). The output of a single bulb has been as much as 100 watts.

In the final chapters the Author deals with aerials and ground connections, reception phenomena, and radio-phone traffic in general, while the book concludes with an index of investigators and topics, exceptionally well compiled.

We cannot conclude our remarks without some reference to the numerous excellent illustrations, both photographic and diagrammatic. These are numerous and important, and we would suggest that the Author might well consider in any future edition the advisability of including a list of illustrations for reference purposes. As a whole, the volume is excellently produced, and this suggestion constitutes the only corrective criticism which we have to offer.

"*THE AVIATION POCKET BOOK FOR* 1918." *By R. Borlase Matthews, A.M.I.C.E., M.I.E.E., F.Ae.S. Sixth edition. London: Crosby Lockwood & Son. 6s. net.*

The well-deserved popularity of this excellent annual will undoubtedly be enhanced by the publication of the 1918 edition now before us. In itself it constitutes no mean achievement under the present *régime* of rigid censorship, to have been able to produce an Aviation Pocket Book combining practical and useful knowledge with interesting and up-to-date reading matter. The success, therefore, of this handy volume forms the subject of well-deserved congratulation to all concerned in its production.

So far as general design is concerned, the new edition follows closely upon the model of its predecessor, although we notice that a certain amount of rearrangement has taken place. There are fifteen divisions of matter in the work, dealing with such a variety of subjects as Air Pressure and Resistance, Aeroplane Design, Materials, Airscrews, Engines, and so forth; and within their compass Mr. Borlase Matthews has collated a vast amount of practical information. The general reader will set especial value upon the sections devoted to Typical Aeroplanes, Piloting and General Navigation, and the Glossary of Terms, and will appreciate the numerous illustrations distributed through the book. To those who desire to understand the meaning of such words as "Fuselage," "Landing Skid," "Elevator," and the like, we can specially commend the large folding illustration facing page 190, in which the appropriate terms are printed against the various parts of a typical machine.

Whilst Divisions II., III., V. and VI., covering the practical data needed by designers and others who have to come into contact with actual machines in the course of their daily work, will naturally fail to make so *general* an appeal, they nevertheless contain a large amount of matter of considerable interest to the "layman." The student of aviation will find Division XII. of great assistance, as it provides a key to the latest literature on the subject.

Amongst the more recently introduced items we notice that parachutes come in for specific treatment. This subject has only recently attracted close attention; and, in view of the increasing importance of these devices, we may look forward to a considerable extension of this section in the next edition. The meteorological section has also been improved and new information appended.

Apart from its all-round excellence of printing, paper, and general "make-up," this useful publication still maintains a high level in its format, and the volume can be confidently recommended to all who study aviation, either for business or for pleasure.

New Mexican Station

WE observe reported in the pages of *Lloyd's List* the establishment of a new Wireless Station on the island of Lobos, off the coast of Tampico, erected mainly for the purpose of affording facilities to the various petroleum companies for communicating with their vessels over great distances at sea. This station is said to be provided with some of the most powerful apparatus available, and is expected to establish communication with the Wireless Stations at Mexico City, Tuxpan, Tampico, Vera Cruz, Progreso, Frontera, Mazatlan, Santa Rosalia, La Paz, Queretaro, Monterrey, Saltillo, Torreon, and by way of Havana with various stations in the United States.

Share Market Report

LONDON, *May 14th*, 1918.

DEALINGS in the shares of the Marconi group have been marked by increased activity during the past month, and prices show a marked firmness. The closing prices as we go to press are as follows: Marconi Ordinary, £3 7s. 6d.; Marconi Preference, £2 13s. 9d.; American Marconi, £1 3s. 3d.; Spanish and General Trust, 9s.; Canadian Marconi, 10s.; Marconi International Marine, £2 12s. 6d.

Personal Notes

TORPEDOED BELGIANS.

NONCHALANCE.

THE photograph here reproduced shows a party of seamen who have just pulled away from a Belgian ship, which is sinking after being torpedoed by the enemy. Amongst them are Messrs. V. J. N. Rigaux and J. Belthasar, of Société Internationale de Télégraphie sans fil, operators of the unfortunate vessel, the latter of whom is seen fingering the flute. It is refreshing to have evidence of such nonchalance under conditions so trying.

AN ITALIAN LOSS.

We much regret to report the death, following an attack of bronchitis, of Mr. Stanislao Sarti, aged 27, which took place on March 25th last, at Castel San Pietro, Italy, his native town. After taking his degree at the School of Commercial Studies, Bologna, winning first honours, he received appointment as secretary to Senatore Marconi, in London. In 1911 Mr. Sarti transferred to the accounting department of the Rome office, where he was a valued member of the staff, his loss being deeply deplored by superiors and co-workers alike.

STANISLAO SARTI.

CONGRATULATIONS.

We congratulate Captain W. G. Vickers, late superintendent of messengers at the Fenchurch Street office of Marconi's Wireless Telegraph Company, Ltd., whose promotion to commissioned rank we noted last month, on obtaining his captaincy. Captain Vickers hopes to be able to pay a visit home shortly.

CONVALESCENT.

We are glad to learn of the very favourable progress made by Lance-Corporal Frank Saville, after undergoing an operation in the military hospital at Lewisham for the extraction of shrapnel from a wound in the leg, received in action in front of Hangar Wood.

CORNELIS ZOUTENDYK.

Now in the London Regiment, Lance-Corporal Saville was, before the war, with Marconi's Wireless Telegraph Company, Limited.

MOTOR BOAT ACCIDENT.

A regrettable accident occurred recently at Baltimore, Md., U.S.A., when Mr. C. A. Zoutendyk, operator of the *Westerdyk*, was drowned. Fifteen of the ship's company in a motor boat were returning from shore leave, when she struck a submerged log, heeled over and sank, six lives being lost. Mr. Zoutendyk had been in the employ of Société Internationale de Télégraphie sans fil since 1915. We sincerely sympathise with his bereaved parents.

AWARDS.

The King has been pleased to award the Silver Medal for Gallantry in Saving Life at Sea to Wireless Telegraphist (A.M.II) Bertram Harley Millichamp, in recognition of his services in rescuing two men from an upturned float in the North Sea on May 29th last.

Sergeant A. E. Isles, wireless operator, R.A.F., has been awarded the Military Medal for devotion to duty under heavy fire. Sergeant Isles hails from Battersea.

Hearty congratulations to Sergeant A. Shepherd, of the Messengers' Department, Marconi House, who has been awarded the Military Medal whilst serving with the Oxford and Bucks Light Infantry in France.

Lieutenant Walter Stanworth, R.E., son of Mr. James Stanworth, J.P., of Blackburn, has been awarded the Military Cross for conspicuous gallantry and skill. When in charge of the wireless section from March 22nd to April 2nd he erected forward stations under heavy shell fire. Enlisting in the East Lancashire Regiment in 1915, he later transferred to the Cheshires and was drafted to France, being subsequently gazetted to a commission in the Royal Engineers.

The Distinguished Conduct Medal has been awarded to 11559 Corporal C. J. French, R.F.C., for conspicuous gallantry and devotion to duty on many occasions, when the vicinity of his wireless mast has been heavily shelled, causing damage to the mast and aerial. In every case he has repaired the damage promptly and well, although still under heavy shell fire.

OBITUARY.

Mr. Bridgwater, High Street, Brierley Hill, has received intimation of the loss, by drowning, of his elder son, wireless operator, Arthur Clifford Bridgwater, whilst serving on one of H.M. minesweepers, which struck a mine, and sank. We offer our condolence with his family.

We are sorry to learn that Lance-Corporal Arthur Butler Hutchinson, R.E. (wireless section), son of Mr. and Mrs. R. W. Hutchinson, 3, Harehills Place, Leeds, formerly employed at the Leeds Corporation Electricity Works, has been killed in action, and express sympathy with the bereaved parents.

The *Electrician* reports that a canoe accident at Bedford was responsible for the sad death of Second Lieutenant M. P. McLachlan, R.E., Wireless Signal Corps. Mr. McLachlan served his apprenticeship to electrical engineering with a Bootle firm, and had been some months in the Army.

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.* (6) *All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom-de-plume."* (7) *During the present restrictions the Editor is unable to answer queries dealing with many constructional matters, and such subjects as call letters, names and positions of stations.*

P. S. T. (Inverness).—See the "Maintenance of Wireless Telegraph Apparatus," by P. W. Harris, for particulars of how to adjust the disc d scharger. If you are not obtaining a good clear note from the disc of a ½-kw. set it is because the adjustments are wrongly made. The note frequency is dependent upon the speed at which the converter is run, and for this reason any change of note outside the limits of speed variation of the machine is, of course, impossible. It is found in practice that the note given by the ½-kw. disc discharger is high enough to carry well through atmospheric interference, but not so high that it causes the fatigue of the ear, found when working with signals of a frequency in the neighbourhood of a thousand.

Wal (Norfolk).—(1) As we have stated before in these pages, there is no one rank for the wireless operator in the Navy or R.N.V.R. There are various ratings ranging from boy telegraphist to warrant telegraphist, and a number of commissioned officers of various ranks are specially engaged on wireless work. (2) In many cases the men are trained by th authorities themselves, although any qualifications which the applicant may have will count in his favour. On the question of transfer we can only refer you to your commanding officer.

P. O-K. (H.M.S. ——).—(1) The fact that you are a qualified telegraphist in the Royal Navy does not in itself entitle you to the Postmaster-General's First Class Certificate, although we have no doubt whatever that you would obtain one on sitting for the examination. We understand that naval men can sit for this examination by arrangement, and we would suggest that, if you so desire, you apply to your superior officer for permission to do so. (2) Practically no mathematical knowledge is necessary to pass the P.M.G. Examination. If you have a sufficiently good knowledge of wireless theory to understand the principles and working of ordinary ship's wireless apparatus, this should be sufficient for the theoretical side.

H. L. G. (Bridlington).—In our May issue we published an article dealing fully with how to become a wireless engineer. This answers your first question. With regard to the second, if you wish to become a wireless operator on board ship it is necessary for you to undertake a course of training for the Postmaster-General's Certificate, without which no person is allowed to operate wireless telegraph apparatus on board ship. The course of training occupies from six to nine months, and therefore as you are now 17, it would be well to start at once. If you leave matters too late you may not complete your training before you reach the age of 18, at which time you will become liable for military service. If, however, you gain your Postmaster-General's Certificate and obtain employment as a wireless operator on board ship you will receive exemption from military service so long as you remain so employed.

Sigs. (Suez).—(1) We do not think this would debar you from acceptance by the Marconi Company if you were otherwise suitable. (2) and (3) The qualifications you mention would certainly be very valuable, particularly in connection with land station work. (4) Your writing is none too good, but you should soon be able to improve it sufficiently to make sure of passing the test.

J. M. (Cuba).—The fatigue of the muscles which you experience is very likely due to your method of holding the key knob. If you hold the key rigidly and with the arm stiff you will soon get tired. Try holding the knob in a different way and in such a manner that the wrist is quite loose and free. (2) Probably you experience difficulty in sending the letters H and V and the figure 5 through attempting too high a speed of formation. We would suggest that you practise a long series of dots starting quite slowly and gradually increasing in speed until the formation of three, four or five dots in perfect uniformity becomes as easy as making other signals.

BARTIMEUS (Long Eaton).—(1) No one but an employee of the Marconi Company is entitled to wear the Marconi uniform. With regard to braid, the senior stripes are worn only by men in charge of a Marconi ship installation, and assistant operators, whether they hold a First Class P.M.G. Certificate or not, must wear the single braid. (2) The question of saluting and receiving salutes from members of His Majesty's Forces is readily understood when it is considered that the Marconi operator, not being in the Navy, is neither entitled to a salute nor required to give one when passing members of His Majesty's Forces on shore. If, however, the operator is serving on board ship on which there are naval officers, the position is different and a salute should be given where necessary. The Master of a merchant ship is usually saluted by the operator. (3) This depends entirely upon circumstances. At the present time holders of the First Class Postmaster-General's Certificate go to sea within a very few days of the time they gained the certificate. (4) Yes; but a man is only sent to sea with a second or third class certificate when no first class man is available. Thank you for your good wishes for the success of our magazine. In these times when the difficulties of production are far greater than most of our readers imagine we deeply appreciate these kind remarks.

J. J. R. (Dover).—The formula is quite correct as you give it, but it should be remembered that there is an excess of copper sulphate in the cell and both copper and copper sulphate are present before and after the reaction. Probably this is the reason why the formula is printed in the particular manner quoted.

F. B (Rochdale).—Although we naturally cannot say definitely, we should imagine that as the strain is so slight you would have no difficulty in passing the Company's doctor. Nothing but an actual test by the Company's doctor *at the time you put forward your application* will finally decide this point.

J. S. E. (Carlisle).—We can find no trace of your previous letter. The conditions under which the men are accepted for the branches you mention seem to vary considerably from time to time. You might apply to—(1) Major Handley, R.E., Wireless Training Centre, Worcester; (2) Royal Air Force, Hotel Cecil, Strand, London, W.C.2. We are surprised to hear that the local representatives can give you no information regarding the last branch of the service you mention. If you do not get satisfaction please write to us again.

P. B. H. (Liverpool).—The detector used by the Marconi Company in all its crystal receivers is carborundum. It is true that there are others slightly more sensitive, but this particular crystal was adopted after long experimentation for the following among other reasons:—(1) It is robust and easy of adjustment; (2) It is not put out of action by strong signals, atmospherics or impulses from the adjacent transmitter; (3) Large numbers of crystals can be obtained of uniform sensitiveness; (4) It can be worked with a firm pressure on a steel plate and is thus not shaken out of adjustment by the rolling and vibration on board ship.

It should be remembered that conditions on board ship or in a land station are quite different from those of the laboratory. An operator's first business is to get signals immediately and *keep on getting them*. He has not time to play round for several minutes on end in order to get what he considers the best adjustment. It is useless obtaining a highly sensitive point if all the signals for the previous five minutes have been lost and if the adjustment is liable to go off as a result of the next atmospheric or somebody slamming the cabin door. As a matter of fact, the actual carborundum crystals used by the Marconi Company are selected with great care and are highly sensitive—much more so than those generally obtained by amateurs in peace time.