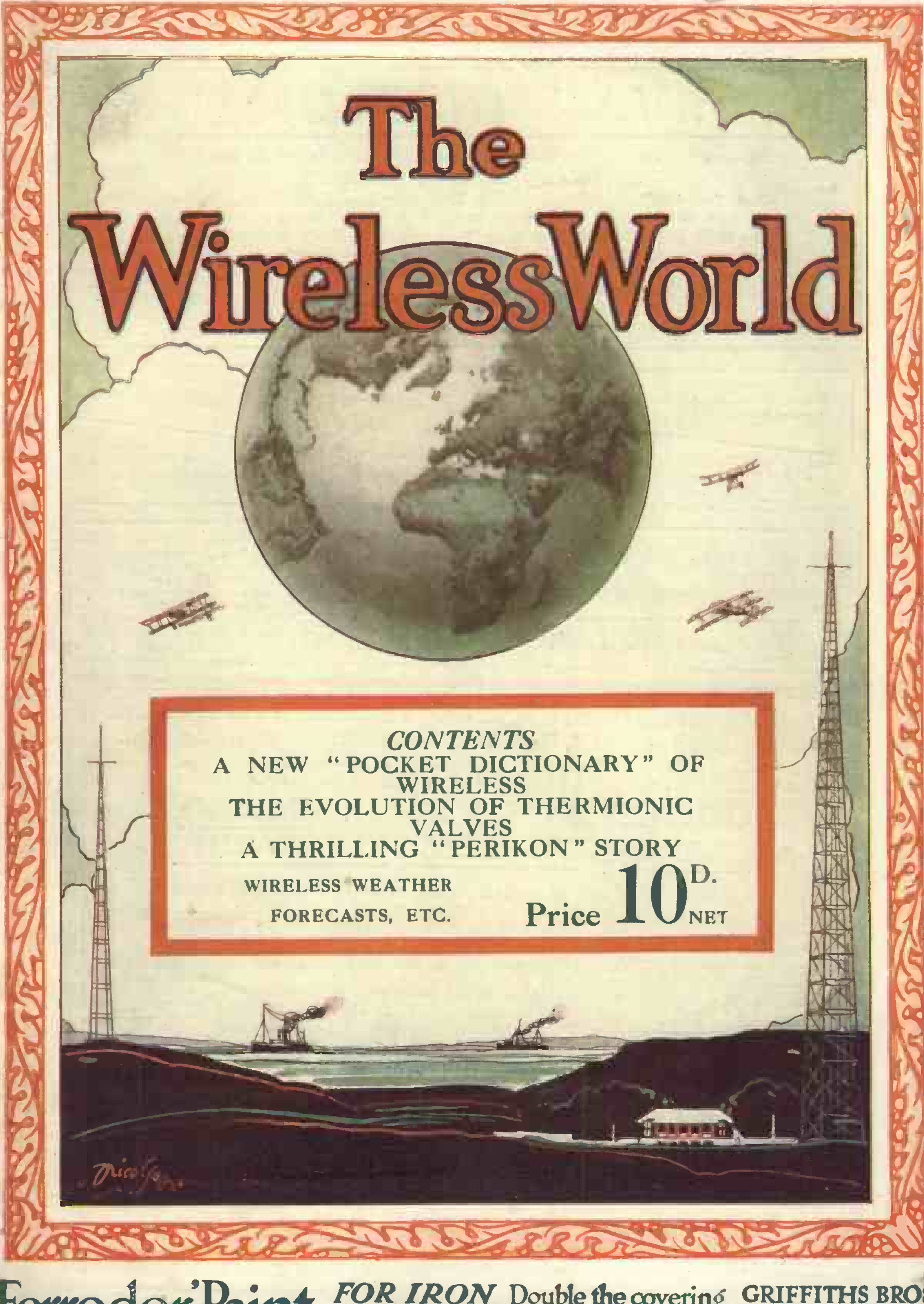
VOL. VI. No. 63. JUNE · 1918



The Wireless World

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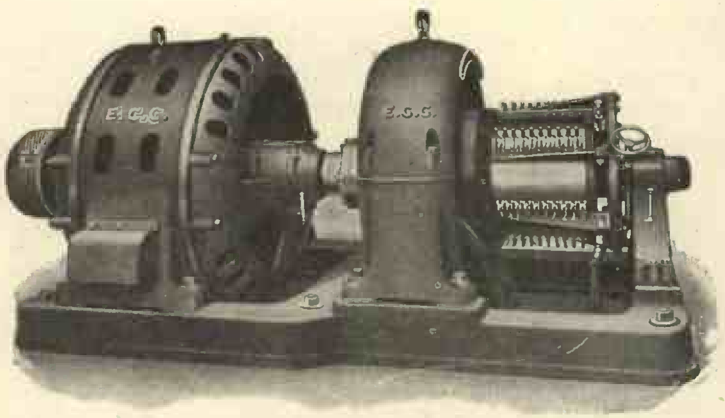

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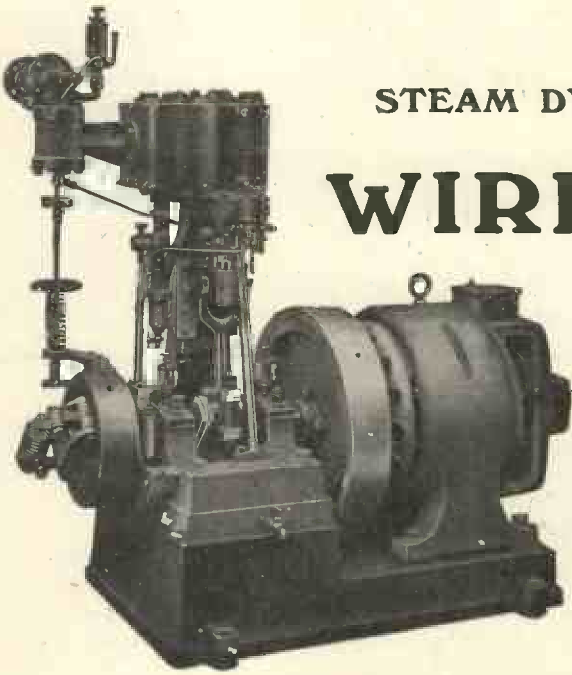

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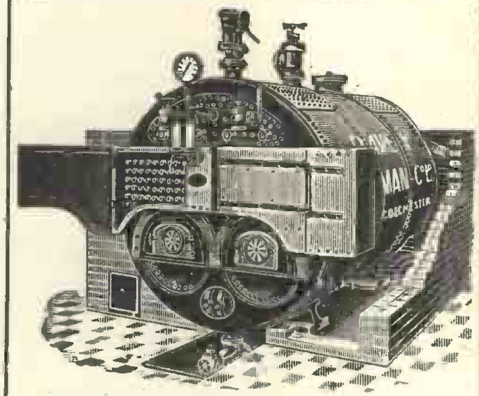

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The WIRELESS WORLD

Volume VI. No. 63. JUNE, 1918.

Reminiscences of an Operator

By W. D. OWEN

Seattle, Washington, U.S.A.

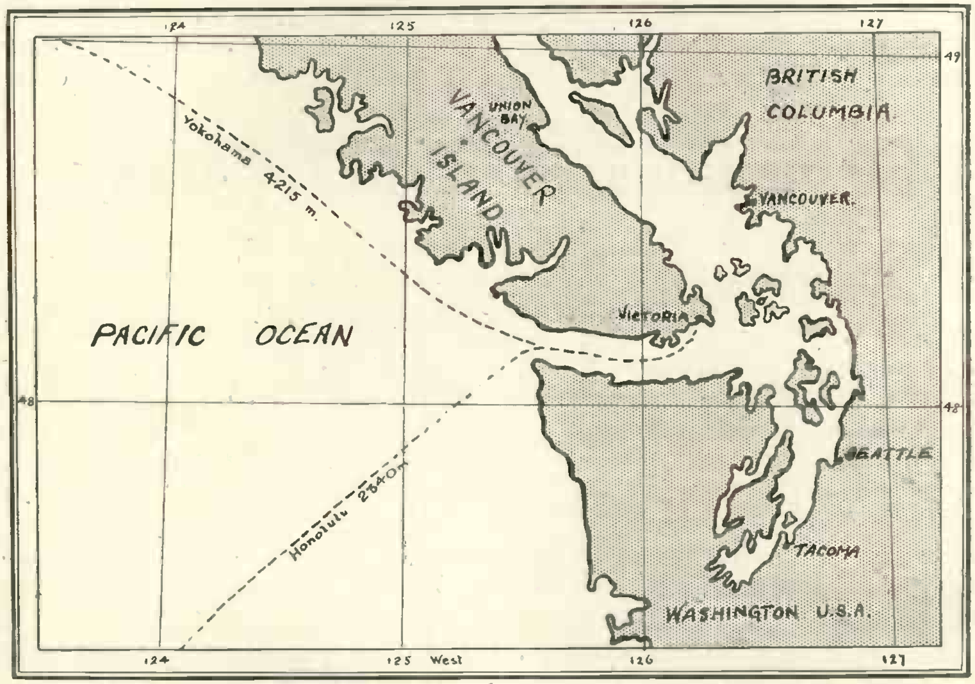
On passenger boats with anything like a claim to respectability there is invariably to be found a well-equipped shaving saloon. In fact, the "barber's shop," as it is called, is generally regarded as a rendezvous where the gentlemen gather in the mornings to swap confidences. But a tramp steamer cannot support such a luxury, consequently the members of the ship's company are compelled either to avail themselves of the services of the "lamp-trimmer," whose experience in trimming the wicks of navigation lights seems to be considered sufficient to qualify him for the job, or else to wait until reaching port.

Now some of us had tried the former plan, and had resolved in future to exercise the option. The result was that by the time we arrived at Seattle the doctor and I might have been mistaken for the band. That is why we could have been seen striding along Madison Street within a few minutes of tying up, with our noses towards the shop with the twirling serpent.

When we entered a white-coated gentleman detached himself from his newspaper with seeming reluctance and looked at us as a diligent business man looks at a book agent.

I asked if he'd mind cutting my hair. "Sure!" he said. "Sit down!" Well, all I could see was a row of dentists' chairs with levers, springs, wheels, pulleys and mechanical fittings too numerous to mention. So I meekly suggested that I wanted my hair cut, not my teeth drawn. He smiled a sickly, diseased sort of smile, and edged me into the nearest chair. I was too concerned about my own safety to follow the movements of the doctor; apparently he had been ordered to a distant corner of the operating room; but if he'd sounded the retreat at that moment I think I would have been out of there like a shot.

Suddenly, without warning, the chair gave a lurch and I found myself looking up into the face of the inquisitor, now bedecked with a great green eyeshade. His jaws moved sullenly and somehow or other reminded me of a tobacco factory I had once walked through. My speculations were cut short by the activities of the scissors, which flashed in the lamplight like summer lightning. Judging by the control he had over that chair he must have been a wizard. He made it twist and turn like a third-rate music-hall contortionist. Hair fell around me like grass from an overworked lawn mower, and my neck was shaved before I was aware of the nefarious intention. He then barked something at me with a tobaccoey voice the purport of which I failed to understand. Seeing, however, that he expected a



HE WHIPPED UP THE CHAIR AND SENT ME HEAD-FIRST INTO A BASIN OF WATER.

reply I answered with true British courage, "Go ahead!" Alas, I had agreed to submit myself to "cranial massage" and a shampoo!

When I recovered consciousness I found myself on my back with my head fixed in a relic of the Spanish Inquisition, while my tormentor was pommelling me with a pneumatic riveter. At first I didn't know whether to laugh or to call for help, but before I could make up my mind either way he whipped up that chair and shot me head-first into a basin of hot water where a confederate awaited with a fire-hose. The hot spray turned into cold so rapidly that my involuntary gasp might have been a protest against either extreme of temperature. After sundry duckings I was tied up like an Indian rajah, and hot towels were laid on my face. Thus arrayed, I was beguiled once again into the haunted chair which danced to any tune the fiend in charge desired. He then shaved me with a sort of "tornado" movement—very impressive to the onlooker, I should think, but deuced awkward for the victim. It reminded me of poor old Lafayette, who shaved one of his assistants on the stage preparatory to transforming him into someone else.

I remember thinking that if this movement were set to music it would be full of those inspiriting adjectives—allegro, pizzicato, prestissimo, fortissimo, furioso, etc.

In less time than it takes to tell he finished that shave and applied hot towels, fuller's earth, sandpaper, bay rhum and Florida water in quick succession. If he thought that the perfumes would disguise the fact that he chewed tobacco I fear he was mistaken.

Meanwhile electric brushes played havoc with the remnants of my departed locks, and when at last I was jerked to my feet I found in my hand a couple of small brass tokens. One bore upon its face the imprint "$1" and the other "50 c."

A VIEW OF THE HARBOUR, SEATTLE, WASHINGTON, U.S.A.

Looking up from the contemplation of these little strangers my eyes followed the outstretched arm of my tormentor and, guided by the pointing finger, finally rested upon the legend " Pay Here " in large gold letters. Then the truth dawned upon me: I was in debt to the extent of one dollar fifty cents! Six shillings and threepence for a haircut! My word!

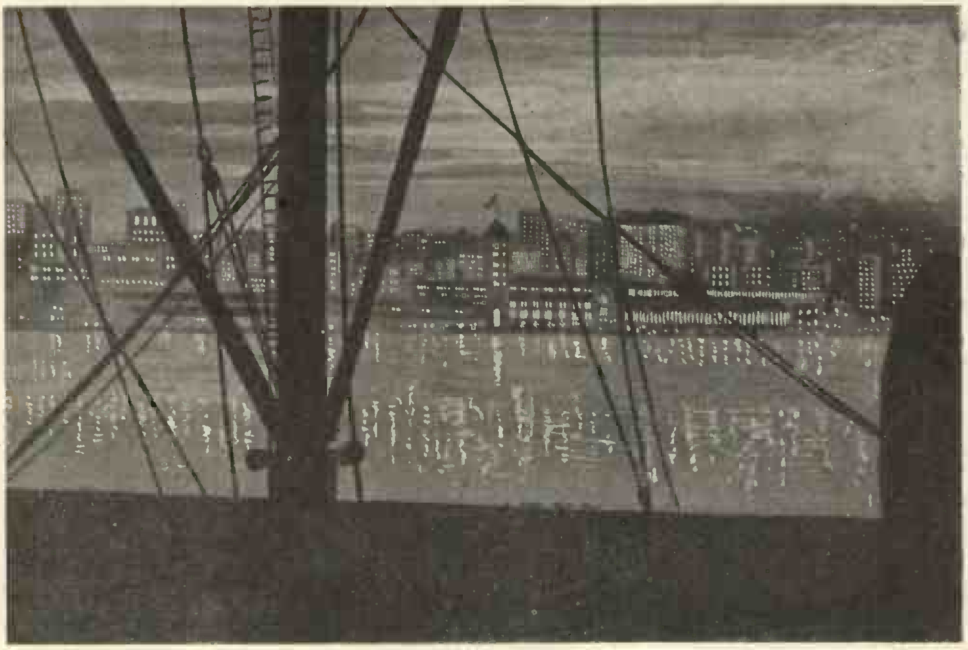
I met my colleague at the cash desk and, without enthusiasm, we paid up. On our way back to the boat we discussed plans for the formation of a society for the protection of hapless travellers.

First impressions, although notoriously misleading, are hard to eradicate, but eventually I became quite attached to Seattle. At the time of my visit the city had been very badly bitten by the wireless bug and aerial masts grew profusely in suburbia. Many hotels proudly flaunted aerials which, more often than not, bore evidences of originality on the part of the designer. Even the offices of shipping agents boasted of their wireless stations. Amateurs rended the æther from morn till night with hideous dots and dashes without let or hindrance, for in those days there was no official control over their activities. One expert of eighteen, normally a lift attendant, had a two-kilowatt set which he proudly told me he had made himself, " all bar the receiving 'phones." Another enthusiast had a fearful and wonderful installation which scaled no less than seven kilowatts and blinked all the lights in the neighbourhood.

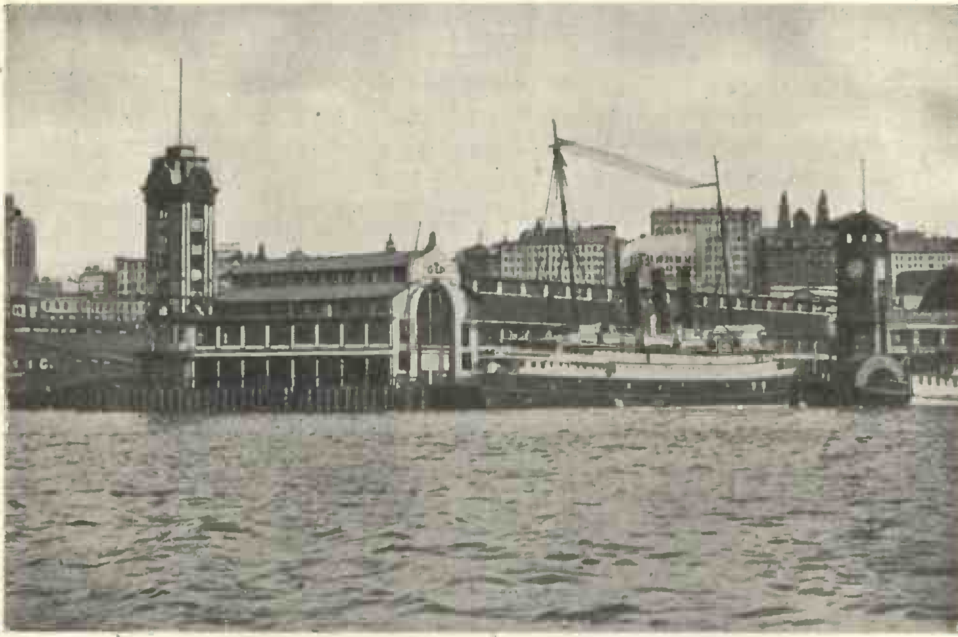
Considering that I had been doing 200-300 miles with a $\frac{1}{3}$-kilowatt set it is no wonder that I marvelled at this prodigality, but they assured me that electric power was so cheap that it did not pay to instal meters on consumers' premises. A few dollars a month secured an unlimited supply of electricity much in the same way as we get our water supply.

Seattle University had a fairly powerful station with a low-spark frequency, and on more than one occasion I had to tell the operator to "put the soft pedal on his thunder factory," after which he refused to work with me. This, of course, was of little consequence, as the place was bristling with wireless stations which recognised no laws, rules, or claims of priority, but it led to rather an interesting little incident.

A few hours after leaving Seattle an urgent message was handed in addressed to a resident in that city, and I couldn't get P.A. to take it. My call was picked up at one of these private stations by a gentleman who considered himself under an obligation to me for some reason or other, and he offered to put it through. I thanked him, sent the message, and asked him to rush it, as a reply was expected while we were still within range. He then made the brilliant suggestion that time might be saved by telephoning it through if the addressee happened to be on the 'phone and confirming the message later in the usual way. As luck would have it the sender knew the telephone number, and soon my ally knew it also. He said, "Hold on and I'll give you your reply right away." I thought he was a very confident young man, even for an American, but sure enough the reply came along in a very few minutes, much to the astonishment of the sender. So pleased were we all with the success of the manœuvre that we prolonged the conversation until cut off by the telephone exchange operator, who did not fully appreciate the honour of being a link in this wonderful chain. I need hardly say that the log-book



"THE NIGHT HAS A THOUSAND EYES, AND THE DAY BUT ONE."



THE BUSY WATER-SIDE, FRINGED WITH WHARVES AND BACKED BY GIANT BUILDINGS.

entry on this occasion was not exactly "gospel," but then, of course, one must occasionally make sacrifices in the interests of science, *n'est-ce pas?*

It is scarcely necessary to point out that this sort of thing is not permissible nowadays. Even before the war the U.S. Government had taken the ubiquitous amateur to task and limited the scope of his activities, but in the days to which these reminiscences refer wireless had become a cult with them.

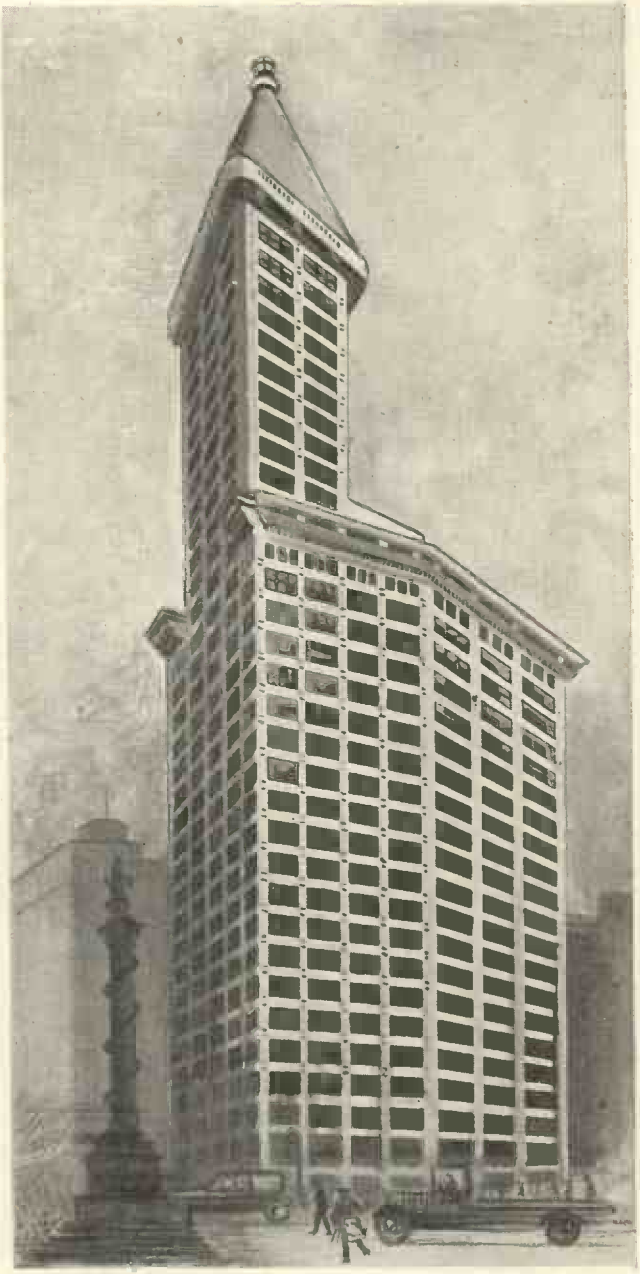
Several of the more enterprising followers of this wireless cult actually went so far as to endow themselves with high-sounding titles and solicit wireless business, trotting out gaudily printed telegraph blanks to prove their bona-fides. When the Marconi Wireless Telegraph Company of America was reorganised in April, 1912, they dropped out of business.

I shall never forget the agent's clerk in Seattle who tried to get medical advice on the cheap. The purser had pointed him out to the doctor as " . . . the meanest man in the United States. He'd squeeze a cent until it cried for help. Always thinks he's got something the matter with him, he does, and makes a bee-line for the ship's doctor, so as to get physic for nix."

Sure enough he came along later on in the day with his tale of woe, and the doctor, with his best professional manner, took him into his cabin and shut the door. The purser turned to me and said: "Who'd have thought that the doc would have fallen for it so easily after I'd warned him? That stiff is as right as I am." "You leave it to the doc," I replied; "perhaps he's going to teach him a lesson." "Maybe you're right, Sparks. I thought I detected a grin on the doc's face when I was telling him. Let's hang around and see if there's any fun," he suggested.

There was no excitement, however. The fellow came out a few minutes later looking very sorry for himself. My companion hailed him. "What's wrong this time, Charlie? Is it your pump or your bellows?" "You go to Elgin!" he retorted, with which cryptic remark he disappeared down the gangway.

We sought out the doctor, who told us that he complained of sore eyes and pains in the head. "So I examined him carefully," said that worthy, "and told him that his was a most remarkable case, as the brain was enlarging, and, being confined by the skull, was pressing against the back of the eyes, causing the pain and soreness of which he complained. I pulled out my instrument case, and said casually that I'd remove a small portion of the brain to ease up the pressure and save the eyes from being pushed out. But he wasn't having any! Said he'd like a day or two to think it over."



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For many years Assistant Secretary to the Post Office, and British Plenipotentiary to the International Radiotelegraphic Convention of 5th July, 1912.

A Notable Personality

THE public service in general, and the radiotelegraphic world in particular, have sustained a severe loss through the death of Edmund Waterton Farnall, C.B., who passed away at the age of sixty-three on April 14th last. It is forty-one years ago since he entered the service of the Post Office, at a time when the halfpenny postcard was but recently introduced, and only a very few years subsequent to the absorption of the wired telegraphic system by the G.P.O.

During the course of Mr. Farnall's career he was connected with many phases of Post Office activity, and attained the distinguished position of Assistant Secretary in 1906, continuing to discharge the duties of that post until his retirement at the end of 1917. In this capacity he was vested with the control of foreign and colonial posts and telegrams, including the administration of wireless telegraphy both in its national and international aspects.

His exceptional ability and energy found full scope in the discussion of many important matters affecting the International Postal and Telegraph Services; whilst his amiable qualities won for him the esteem of the representatives of other administrations with whom he came into contact from time to time. The officials of the steamship and railway companies concerned in the conveyance of foreign and colonial mails, as well as those of the cable and wireless companies, found in him an administrator always ready to treat sympathetically any proposals put forward with the object of securing improvements in the various services affected. Personality possesses a powerful influence in Affairs, and the good relations thus established proved fruitful in procuring concessions favourable to public interests.

Mr. Farnall's attention was first directed to wireless telegraphy when its importance from an international point of view had been firmly established, and he became one of the leading public officials dealing with the subject. His duties brought him into close contact with Senatore Marconi, as well as with other prominent men concerned in the development of the science; and, although his functions as an administrator necessitated at times a course of action which conflicted with their views, his personality and honesty of purpose gained for him their highest esteem. His eminent official position with regard to wireless is attested by his selection to act as one of the British delegates plenipotentiary at the International Radiotelegraphic Conference held in London on July 8th, 1912.

In Post Office circles Mr. Farnall gained the close friendship of all his colleagues, whilst the large staff under his control in the foreign and colonial branch of the Secretary's Office highly appreciated his kindness of disposition and easy accessibility.

He made his home at Blackheath, where his family had been established for many years, and in his private life took a large interest in charitable and other institutions. Born in 1855, he married in 1894 a daughter of Mr. Leonard Bidwell, who was for many years Chief Clerk to the Post Office. Like his brother, Mr. H. B. Farnall, C.B., C.M.G., lately a British Commissioner of the *Caisse de la Dette Publique* of Egypt, he was a brilliant linguist and a man of great personal charm.

The Evolution of the Thermionic Valve (III.)

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*.

THE "AUDION" DETECTOR AND AMPLIFIER (*continued*).

THE intensity of the sound depends upon the voltages of the batteries B_1 and B_2, and the best position can be found by adjusting these while listening to the note received. When the best adjustment has been obtained, it will be found that the intensity of the received signals is several times as great as those which would have been obtained by connecting the receiver directly in the receiving circuit, showing that this "audion" valve has acted in a true sense as an amplifier of the received signals, exerting a kind of relay action, quite distinct from the simple rectifying properties of the Fleming valve. The audion, however, differs from the most perfect contact relay device in giving a quantitative response—that is to say, up to the saturation currents for the gas space within the bulb, the change in plate current is approximately proportional to the grid voltage.

Lee de Forest made numerous experiments with tungsten and other filaments, with platinum coated with alkaline metals or salts, and with various gases and vapours in the bulb, but he did not succeed in increasing the sensitiveness obtained with a Tantalum filament, and with atmospheric air exhausted to the highest vacuum. He found the best value of the battery B_2 potential, required to produce the maximum sensitiveness, depended upon the degree of evacuation, being roughly proportional to the same.

When the voltage of this battery B_2 is sufficiently raised, the ionic discharge from the hot filament cathode becomes visible in the form of a blue glow, occupying practically the whole bulb. A similar blue glow may be brought about in normal working if a powerful spark discharge occurs in the neighbourhood of the audion, causing a momentary large potential to be impressed upon the grid. The appearance of this blue arc is always a sign that the bulb is being over-run, as regards the current passing from plate to filament. In this connection an interesting phenomenon may be observed in certain bulbs when the voltage of the battery B_2 in the plate circuit is adjusted until the blue glow is just visible round the edges of the plate. Then, when powerful impulses are received on the grid, a momentary flaring out of this blue aura can be observed with each signal so that it is possible to read the telegraphic signals by sight.

The possibility of this blue glow effect, together with other properties which arise from the presence of some remaining gas in the bulb, gives rise to certain irregularities in the working of the "audion" which set it at some disadvantage to a modified form, much more highly exhausted, to be described later in the paper. The presence of the blue glow is also very detrimental to the life of the valve, owing to the disintegration of the filament caused by the intense bombardment by the positive ions.

A great advantage which the thermionic valve amplifier has over any other relay device is that there is no lower limit of sensitiveness ; for, if the original impulse received is too minute to be directly discernible, it may be amplified one or more times, and the effect of the original impulse will be observed to exist. The simplest arrangement of connecting two amplifiers in cascade to obtain increased magnification is shown in Fig. 10.

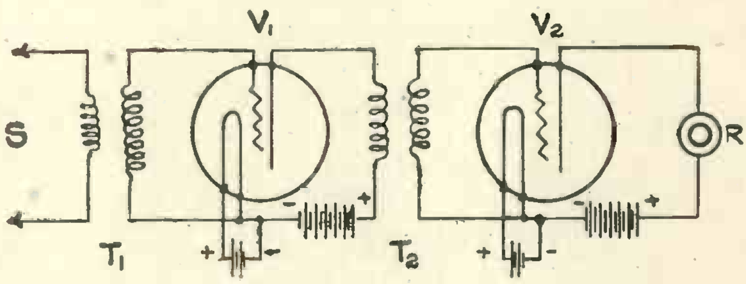


FIG. 10.

A step-up transformer, T_1, is provided if the original impulses coming from S are of low voltage, the secondary winding being connected across from the grid to the filament of the first valve as shown. In the plate circuit of this valve is included the primary of the transformer T_2, the secondary winding of which transfers the amplified impulses from the first valve to the grid circuit of the second. Similarly valve No. 2 may actuate a third, and so on, the successive steps requiring as a general rule larger bulbs with larger heating areas and electrode surface to carry the increasing currents. In this manner the received signals, after having been rectified to the form of impulses of audible frequency, may be further amplified several times, the alternating potential applied to the grid of each valve producing synchronous, amplified variations in the corresponding plate current in accordance with the sloping part of the characteristic curve in Fig. 9. The receiver placed in the plate circuit of the last valve will then be operated with the total amplified current obtained from the original impulse.

De Forest, making measurements of the amplification by the shunted receiver method, found that a good bulb gives an amplification of five times, and with three in cascade he obtained a magnification of 120 times, this including the losses in the three transformers in circuit.

The audion has a further advantage as a magnifier in the absence of any periodic or very delicate adjustment, and also in its freedom from the effects of mechanical vibration or disturbances.

The immediate use of this valve for amplifying and rendering readable signals which were previously inaudible will be obvious, giving, as it does, a greatly increased receiving range for any wireless station.

(4) THE LIEBEN-REISZ VALVE.

At the same time that De Forest was investigating the three-electrode valve Messrs. Lieben and Reisz were carrying out experiments in Vienna on a gas valve

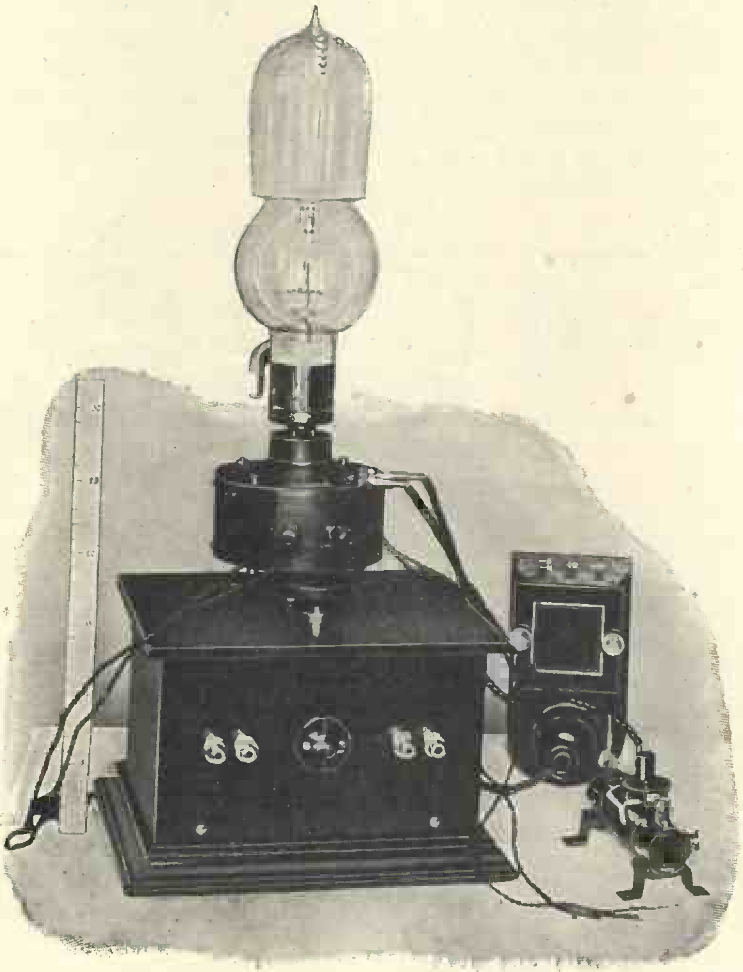


FIG. II. THE LIEBEN-REISZ VALVE.

containing a somewhat different form of ioniser, utilising the fact discovered by Wehnelt in 1904, that strongly heated oxides of certain metals, particularly those of calcium and barium, emit electrons at very low voltages.*

* Wehnelt, *Phil. Mag.*, x., p. 80 (1905).

Willows and Hill described some experiments in 1911, making use of this fact to obtain increased ionic emission and sensitiveness in a modified form of Fleming valve.* They used electrodes of platinum, both of which could be heated by a current. The cathode was coated with calcium oxide (lime), which emits negative electrons on being raised to a white heat, while the anode was covered with aluminium phosphate, which gives out positive ions when raised to a dull red heat. They found that this method gave improved rectification and greater sensitiveness than the ordinary Fleming valve.

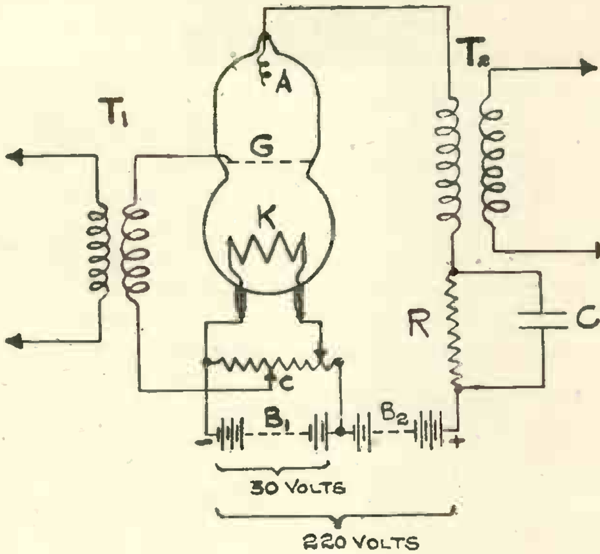


FIG. 12

The final form of the Lieben-Reisz valve was described by one of the inventors in 1914.† A general view of the tube and the arrangement of the connections are shown in the accompanying Figs. 11 and 12.

The Wehnelt cathode, *K*, consists of a platinum strip 1 metre in length, 1 mm. wide and 0·02 mm. thick, wound in a zigzag form upon a glass support, the strip being coated with a thin layer of calcium oxide or barium oxide. The grid, *G*, is a circular aluminium plate perforated with holes about 3·5 mm. diameter, while the anode, *A*, is a short spiral of 2 mm. aluminium wire.

The three electrodes are mounted in an evacuated glass vessel of the shape illustrated, the approximate dimensions of the valve being 16 inches long by 4 inches maximum diameter.

The cathode is brought to a bright red heat at a temperature about 1,000° C. by a battery, B_1, of about 30 volts. A certain steady voltage is impressed upon the grid from the sliding contact, *C*, on the potentiometer connected across the heating battery. The current to be magnified is led to the grid through the transformer T_1, the amplified current being drawn from the secondary of the transformer T_2. The necessary working voltage in the anode circuit is about 220, and a resistance, *R*, is included to prevent too great an increase in the discharge current, a condenser shunt being provided for the amplified alternating current.

In the early experiments it was found difficult to obtain a uniform discharge owing to the variation of the gas pressure inside the tube, this giving varying sensitiveness and entailing constant adjustment of the grid and heating voltages. It was therefore decided to replace the gas discharge by a vapour discharge by

* Willows and Hill, *Electrician*, lxviii., p. 302 (1911). † Reisz, *Electrician*, lxxii., p. 726 (1914).

introducing mercury vapour into the tube, constancy of pressure being obtained by keeping a small quantity of liquid mercury in a small side tube attached at the bottom of the main tube.

Actually in the final form of the valve an amalgam of mercury with a lower vapour pressure is used, as the vapour pressure of mercury rises rapidly at temperatures about 20° C., this giving rise to high current densities at the cathode sufficient to cause fusion of the platinum strip.

Although the discharge is maintained by the glowing oxide cathode, the majority of the current is carried by the mercury vapour, and thus the "ageing" of the tube, due to the occlusion of the residual gas, is very small, and a life of from 1,000 to 3,600 hours is obtained.

The inventors claim an amplification of 33 times for this type of valve, independent of the amplitude of the primary current, and that using four such valves connected in cascade, alternating currents of frequencies ranging from 2,000 to 8,000 cycles per second have been magnified 20,000 times with perfect reproduction of the original wave form.

This form of gas relay has been adopted by the A.E.G. and is used by the Telefunken Company as an amplifier for received radio-telegraphic signals ; but it is probable that the large size of the tube and the high voltages required to operate the valve will seriously limit its field of application in spite of the high value of the magnification obtained.

(5) THE PURE ELECTRON DISCHARGE VALVE.

In the types of valves already described, employing the thermionic currents obtained in an evacuated bulb, the latter always contained a certain amount of residual gas. In this respect we must state that a pressure of the order of 1–10,000th mm. of mercury indicates that a relatively large amount of residual gas is present in the bulb.

This residual gas, as we have seen, had a very considerable influence on the operation of the valve in supplying positive ions within the bulb, which neutralised to a great extent the space-charge effect of the electron currents between cathode and anode, and enabled comparatively large thermionic currents to be passed under potentials of 50 volts or less. But the presence of gas to this extent within the bulb has been found to carry with it certain disadvantages. In the first place, the characteristics of the valve tend to become very irregular, the current-voltage curve often showing decided kinks at moderately high voltages. In many cases also, when working at high cathode temperatures and at high anode potentials, the discharge becomes very unstable at certain points, and the characteristic for increasing voltages is somewhat different from that in the reverse direction. All these effects, moreover, vary with the composition and pressure of the contained gas, and both these vary with the intensity and duration of the discharge passing through them, the pressure decreasing considerably after a time similarly to the manner in which an X-ray tube becomes "hard" after prolonged use. Another effect of the positive ionisation within the valve is the tendency to disintegrate the cathode by the bombardment of the positive ions, and so considerably diminish the life of the valve.

Most, if not all, of these defects are absent in the pure electron discharge type of valve, which is the outcome of the investigations of Dr. Langmuir in the General Electric Company's research laboratory at Schenectady, N.Y. In this valve the evacuation of the bulb is carried out to the highest possible degree to eliminate all positive ionisation ; in which case, as shown by Langmuir, the electron emission from the cathode follows Richardson's equation absolutely, and the corresponding thermionic currents can be obtained, providing sufficient voltage be applied to the anode to overcome the space-charge effect of the electron stream from the cathode.

To distinguish this type of valve from those containing some residual gas, the term " Kenotron " has been applied to it, derived from the Greek " Kenos," signifying "a vacuum," and "Tron," " an instrument." This name has since become generally applicable only to the form of the valve containing two electrodes, and used as a rectifier, the term " Pliotron," signifying " an amplifier," having been designated to a kenotron provided with a third electrode or grid to convert it into an amplifier of alternating currents.

As an example of the first use of a kenotron, mention may be made of the X-ray tube invented by Dr. W. D. Coolidge in 1913.* In this tube the cathode is formed of a small flat spiral of tungsten wire surrounded by a cylindrical sleeve of molybdenum which serves as a focussing device, while the anode, or target, consists of a massive piece of wrought tungsten supported near the centre of the tube by a molybdenum rod. The tube is exhausted to the highest degree in the manner described below, and the vacuum is such that, unless the filament is heated, the tube shows no conductivity in either direction even with a voltage as high as 100,000. With the filament heated the tube can be used for the production of X-rays with voltages as high as 200,000, and the intensity of the discharge can be completely controlled by varying the temperature of the cathode. The current through the tube is absolutely unidirectional owing to the absence of gas, and there is no heating of the cathode by the discharge current, and no evidence of any disintegration of the cathode. These factors enable the tube to be run continuously at a high energy input, while the intensity of the discharge remains quite constant.

(To be continued.)

Long Distance Communication

An item which (if correct) illustrates the long distances covered under modern conditions, as a matter of course, by high-power installations, has recently been recorded in the pages of one of our contemporarie . The *Telegraph and Telephone Age* reports that Java and Holland are now in communication by wireless over a distance of 10,000 miles. The station at Bandoeng, Java, is—according to our contemporary—transmitting 5,000 words daily to Scheveningen, a seaside resort of the Hague. It is 2,800 ft. above sea level. The Java station was built by Mr. Van der Groot, a Dutch wireless expert of established reputation.

* W. D. Coolidge, *Electrician*, lxxiv., p. 505 (1915) ; British Patent 14,892, 1913.

Digest of Wireless Literature

The Dynatron and Pliodynatron.

The dynatron belongs to the kenotron family of high-vacuum, hot-cathode devices. It resembles the kenotron and pliotron in construction, but the action is fundamentally different. The kenotron rectifier utilises the unidirectional property of the current between a hot and cold electrode in vacuum. The pliotron utilises the space charge property of this current, which allows the current to be controlled by the electrostatic effect of a grid. The dynatron utilises the secondary emission of electrons by a plate upon which the primary electrons fall. It is, as its name indicates, a generator of electric power, and feeds energy into any circuit to which it is connected.

The dynatron is a vacuum tube containing a hot filament, a perforated anode, and a third electrode called the plate. The anode is placed near the plate and between it and the filament, and holes in the anode permit electrons from the filament to reach the plate. The anode may be in the form of a perforated cylinder, a spiral of wire or cylindrical network of fine tungsten wire. When the voltage of the plate with regard to the filament is sufficiently raised the electrons strike the plate with a velocity high enough to cause the emission of secondary electrons from the plate. These secondary electrons are attracted to the anode, which is kept at a more positive potential by a battery connected between the filament and the anode, and the net current received by the plate is the difference between the number of electrons that enter and leave it. As a result the characteristic relation between the current and the voltage is denoted by a curve for the current that rises from zero to a maximum at about 50 volts, thence decreases through zero at 100 volts to a negative maximum at about 150 volts, and then becomes positive again. It will be noted that in the region between 50 and 150 volts the current decreases with increase of voltage and the tube has the property of possessing a "negative resistance."

This feature of the tube renders it suitable for many important uses. If connected in series with a circuit containing a positive resistance the total resistance may be made as small as desired, and small change in the voltage applied to the whole circuit will cause a comparatively large change in the current flowing—*i.e.*, the circuit acts as a voltage amplifier. If connected in parallel with a circuit containing positive resistance the total conductivity of the circuit can be made as small as desired, and the circuit then acts as a current amplifier. If connected in a circuit containing resistance, inductance and capacity, the damping may be made very small, so that impressed oscillations may persist for a very long time, or the damping factor may be adjusted so as to be negative, in which case continuous oscillations will be set up. Oscillations of this type will arise if $Rr = L/C$, where R and r are the resistances of the circuit and dynatron respectively and L and C the inductance and capacity of the circuit. Tests are described that confirm these results, and it is found that a dynatron short-circuited by a couple of turns of heavy wire will generate at a frequency as high as 20,000,000 cycles a second or as low as 1 cycle a second. The wave-shape follows a sine law when $Rr = L/C$ and is distorted when this relation is not fulfilled.

The characteristics of the tube are greatly modified if a magnetic field is caused to act parallel to the axis of the anode. The spirally moving electrons are then stopped to a greater extent by the anode and less electrons reach the plate. Furthermore, the fields restrain the secondary electrons from leaving the plate. As a result the tube passes from having a negative resistance to having a positive one.

If an electrostatic field is impressed by means of additional plates inserted into the tube, the negative resistance of the tube may be controlled by the strength of the electrostatic field. The tube thus controlled is called a pliodynatron, which may be used as a powerful amplifier, as a radio generator, or, together with a transmitter, as a radiophone for wireless telephony, or as a sensitive detector in a telephone receiver circuit. A number of these applications are described in detail. (A. W. Hull, Institute of Radio Engineers, *Proceedings*, February, 1918.)

Subdivision of Conductors Carrying Alternating Currents.

An account of experiments carried out at the Physikalisch-Technische Reichsanstalt on the subdivision of conductors carrying alternating currents of great amplitude or high frequency, in order to reduce the eddy current losses resulting from uneven distribution of the current in the conductors. It has recently been shown that coils made of compound flexible conductors do not always have lower resistances than coils made of solid conductors of the same total section. In fact, above a certain frequency the subdivided conductor may have even higher copper losses than the solid one. The author investigates the effect of subdividing twisted bar conductors lying in slots, and of winding compound flexible cables into coils.

It is found that if the height of the bars is small their resistance is diminished by any subdivision, but if the height of the bars is great the reaction of the eddy currents is considerable, and the conductor must be subdivided beyond a certain limit if its resistance is to be thereby decreased. If a smaller subdivision than is fixed by this limit is made, the effective resistance is increased instead of decreased. There is a certain most unfavourable subdivision that increases the resistance to a maximum value. It will thus be seen that the resistance of flexibles increases as the conductor is subdivided more and more until a critical value of the subdivision is reached, after which further subdivision will decrease the resistance until it ultimately reaches the steady current value. Formulæ are given to determine the resistance of subdivided conductors from their dimensions, and their use enables stranded conductors to be so chosen as to be best suited to fulfil the conditions of any particular case. (W. Rogowski, *Archiv für Elektrotechnik*. No. 4, 1916.)

USEFUL RADIO INSTRUMENTS.

IN many circumstances, particularly during war time, it is inadvisable to test a wireless transmitter with the aerial connected in circuit. A recent issue of our American contemporary, the *Electrical Experimenter*, describes a form of "phantom" antenna, designed, as a matter of fact, for testing aeroplane wireless sets, although the principle can be applied to the testing of radio installations of any type.

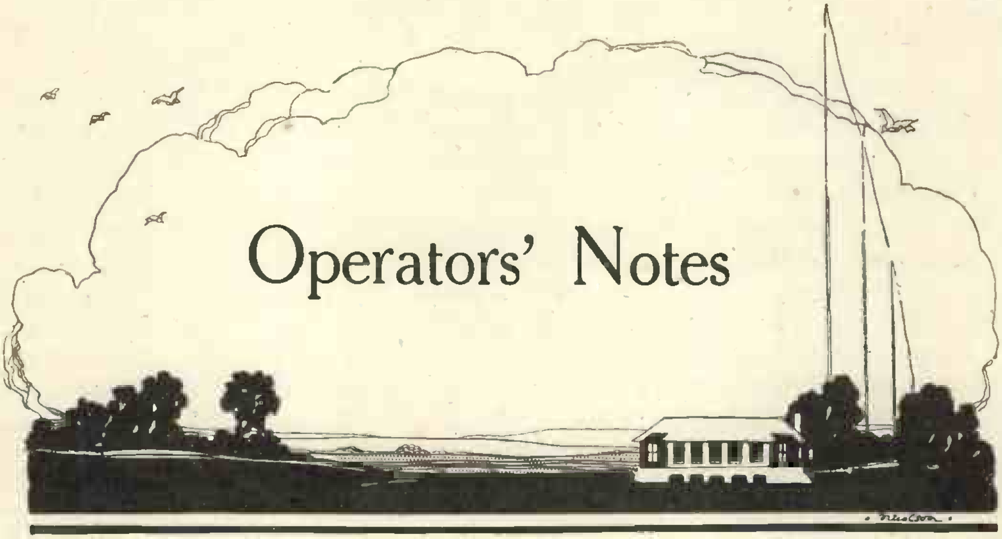
The instrument in question consists of what may be called concentrated capacity and inductance of the correct oscillating proportions, and so designed as to permit of passing through or into it the same amount of energy in watts as would be sent into the actual aerial under working conditions. The idea is somewhat similar to the connection of a water resistance to a dynamo under load test. The particular phantom antenna described comprises a mica condenser of ·004 M.F. capacity connected in series with a resistance of 4 ohms, which approximately duplicates the average *trailing wire* aeroplane aerial and has a carrying capacity of 1·5 amperes, as indicated by a hot-wire ammeter. It will stand normally a breakdown potential of 7,000 to 8,000 volts, and is said to be very useful for tuning and testing aeroplane or other radio transmitters on the ground.

Another new device described in the same article comprises a small inductance and large capacity in series with a crystal detector, with terminals provided for connecting a set of head telephones. It is useful as a tone tester for observing the quality of tone of a transmitter, but its greatest utility is said to be in its use in determining the point of resonance in oscillating circuits which are being excited by damped waves.

In measuring the natural period of an aerial the device may be coupled loosely to the grounded antenna, a buzzer-excited wavemeter being also coupled to the antenna at a point slightly removed from the instrument. When the wavemeter is then varied a loud response will be heard in the telephones when the wavemeter is in resonance with the natural period of the aerial. The article states that this is by far the quickest way to obtain the natural period of an aerial, although ourselves we cannot see that the method is any quicker or simpler than that used in this country with the Marconi Portable Wavemeter.

Philadelphia Honours Senatore Marconi

THE world-famous Franklin Institute of Philadelphia, one of the leading scientific foundations in the great Republic, which owes its initiation to the celebrated philosopher and statesman, recently awarded their medal, *honoris causa*, to Senatore Marconi. The formal presentation was made, in the absence of the "Father of Wireless," to Count di Cellere, the Italian Ambassador. The latter returned thanks in an eloquent speech, in the course of which he said: "This medal will always "remind Guglielmo Marconi of the admiration you men of science and all of us have "for him. In accepting, in his name, this token of your esteem, I thank you, "gentlemen. May the friendship uniting this great Republic and Italy be as lasting "as the medal on which the name of the inventor is indelibly engraved."



Operators' Notes

Tools and How to Use Them (II.)

By HAROLD WARD

SCREWDRIVERS.

ALWAYS use the screwdriver which most nearly fits in the slot in the head of the screw. A loose-fitting screwdriver burrs the edges of the slot and causes much difficulty when a screw has to be removed. Don't use screws out of proportion to the size of a job. Too large a screw is as big a mistake as one too small. When screwing into soft wood only a small starting hole is needed, though a much larger starting hole will be necessary in hard wood, such as the mahogany top of the operating table. When inserting a screw a little vaseline smeared on its thread will lighten the labour both of insertion and possible removal at some future date. If a screw jams in hard wood, it is useless to force it in further or you will find either half the head break off, or else it will break half way down the shank. A jammed screw should be removed, the hole enlarged and more grease applied before attempting to drive it home. A screw which refuses to turn for removal may sometimes be loosened by a sharp tap with hammer, or by a tightening twist before again trying to unscrew it.

SOLDERING BOLT.

When dealing with insulated or aerial wire, always use the bolt in preference to the blow lamp, as apart from the injury which excessive heat causes to the wire, it also tends to destroy the insulation. Cleanliness is the prime necessity of successful soldering. It is a good plan to keep a tin lid with a little solder and flux in it for use with the bolt. If the bolt be heated, cleaned, tinned, and dipped into this lid, sufficient solder will adhere to it to make a small joint, such as is required at ends of the primary and secondary of the magnetic detector.

SPANNERS.

Using a spanner which is too large results in a rounded nut which is both unsightly and troublesome. Should you not have a spanner small enough, try inserting the end of a screwdriver between one of the jaws and the nut. If a nut sticks it may sometimes be loosened by giving spanner a sharp jerk in the direction for tightening and then exerting a steady strain in the right direction. A steel nut which has rusted can frequently be loosened by judicious tapping with a hammer. Care must be taken, however, not to burr up the thread of the bolt. Paraffin oil is useful for freeing rusty nuts. Should a nut defy all efforts with a spanner and there is not time to coax it with oil, hold the cold chisel at one corner and knock it with the hammer in the direction for unscrewing. Sometimes it is necessary to cut off a nut, in which case it is advisable to saw down through it at one corner as close to the bolt as possible. This will generally permit of its being removed with a spanner which is always safer than cutting right through the nut with your cold chisel. Spanners should not be used as hammers or levers for opening cases.

Tommies.

When these are used, the screw should be coaxed, as a sudden strain will snap their hardened points.

Vice.

This tool should be firmly screwed down in some convenient position so as to be ready for immediate use. The top of tool box is handy. It should, of course, be removed and locked up when leaving the ship. Don't screw the vice on to operating table. If using the vice as an anvil, do not hit too hard, because, being made of cast steel it breaks very readily. "Clamps," which are protective linings for the steel jaws and are used to prevent smooth surfaces being scratched by the roughened grips, are generally made from strip lead, but in emergency strips of wood can be satisfactorily used for this purpose. Never grip any article in a vice tighter than is necessary to secure rigidity. File scratches and saw cuts on top of vice jaws are signs of an untidy and careless worker. Ebonite, such as a Bradfield tube, should be well wrapped round with a rag before being gripped in a vice, or it will chip.

General Remarks.

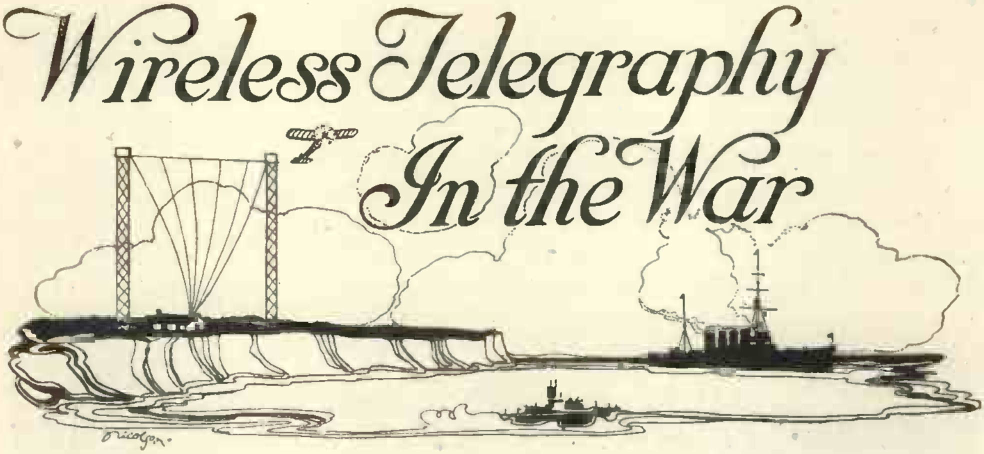
The custody of the tool box is an important matter, all tools being replaced in it immediately after use, for safe keeping. The lid must not be used as a substitute for a bench to work on. This is not its function, and, moreover, the wood is likely to split and break, if, for instance, hammering is done on it.

There are usually sufficient tools on board a ship to meet all ordinary requirements, though occasionally an unusual breakdown occurs which demands special appliances. These can generally be borrowed from the chief engineer.

Look after your tools carefully and they will prove to be of great use to you. Don't lend them indiscriminately. On the other hand, do not curtly refuse the loan of any of them. You may, as shown above, have occasion to borrow tools, and if you do lend a tool, remember you are responsible for it, and see that you get it back in good condition.

Any small tools which may have been kept handy in drawers, etc., for the sake of convenience during the voyage, should be returned to their proper places on arrival in port. A bad workman may blame his tools, but a good workman is severely handicapped without the tools requisite, which ought to be, but are not, available for work to be done; therefore be particularly careful to keep the tool box locked, especially when leaving the ship.

Wireless Telegraphy In the War



THE WIRELESS OF A BLACK REPUBLIC.

IN our issue of July, 1917, page 261, we referred to the "Purging of Africa" from German wireless influence, at that time furthered by the declaration of war against Germany on the part of Liberia. In the course of April last we received news of the shelling of the wireless station at Monrovia, the principal port of that Black Republic, by a German submarine. Seeing that, by the "north-about" route, the distance between Heligoland and Monrovia has been estimated at about 5,000 miles, we have here apparently to deal with a long-distance voyage on the part of a submarine, which reveals in a startling way the cruising powers of the later types of under-water craft.

This Negro Republic formed part of the "back to Africa" movement which was so active during the first part of the nineteenth century. Our illustrations on pages 154 and 155 show the French and German stations erected there. Both of them had a daylight range of about 300 miles and night range of about 600 miles, and both installations were dismantled at the outbreak of war. The former had, however, resumed operations; and the enemy therefore took the earliest opportunity to "strafe" it with his guns.

We have little information as to the effect of the Hun bombardment; whether his object was attained or whether merely wanton damage was done to the Liberian inhabitants. We notice, however, it has been maintained that the U-boat commander was not justified in directing an act of war against a totally unfortified town. In view of the fact that radiotelegraphic activities are in wartime frequently of considerably more importance than fortifications, we find ourselves inclined to take the view that this German attempt to destroy an enemy installation was no illegitimate task. There are so many undeniable instances of outrages against every sense of decency and moral obligation to be set down against the Germans and their Government, that it would seem a thousand pities to strain a point on so doubtful a matter as the one in question. Any "learned counsel" will tell you that it is perfectly possible to spoil the best of cases by over-statement.

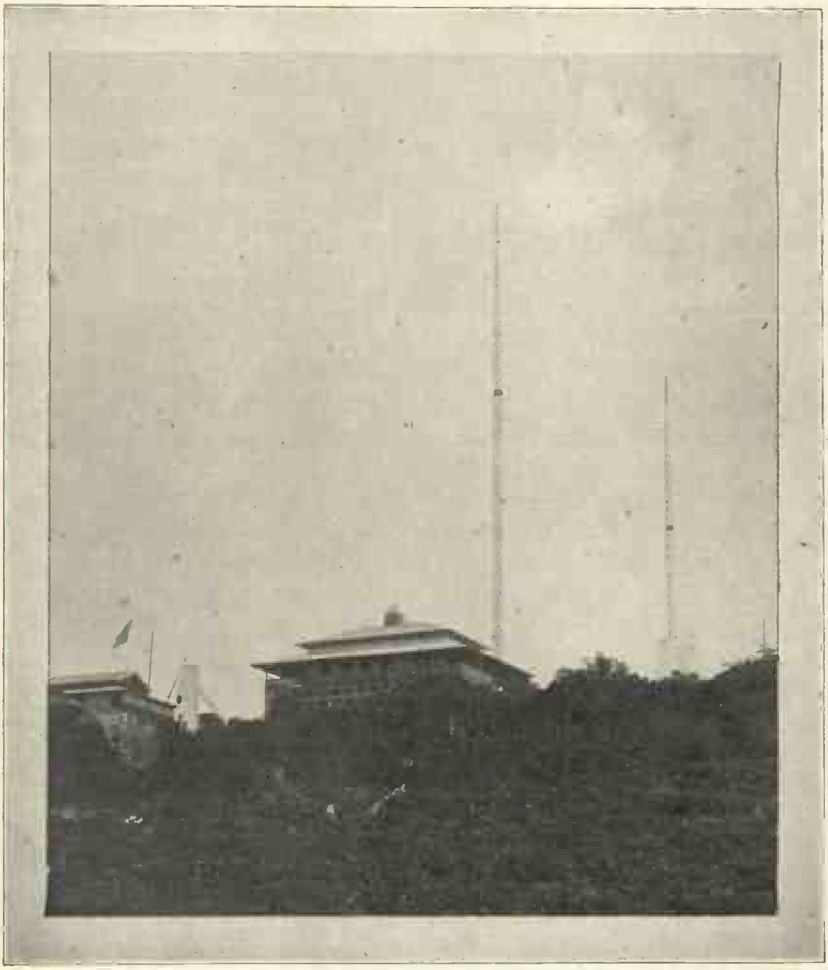
FRENCH WIRELESS STATION IN MONROVIA

Scientific Warfare.

How often we see in British reports of fighting, especially on the Western front, such phrases as " the enemy operations were favoured by a heavy fog " ; or " our " men struggled heroically against adverse weather conditions " ! Now, according to the Teutonic way of looking at things, such references are easily explained. The Huns and their hellish deeds receive the smile of approval from the deity whom they worship, and his aid is always available for a Hohenzollern, ruling by Right Divine as his vice-regent and ally !

But I suppose that we British may be pardoned for unwillingness to accept such an explanation. The careful collation of meteorological observations, reports and statistics has, over a considerable period in the past, enabled scientific men to foretell, with a fair amount of accuracy, the weather which is likely to affect definite areas at certain specified times. The introduction of wireless into world-wide use profoundly modified and extended this fore-knowledge ; and, in the *Wireless Year Book,* one of the annual features consists of an article enumerating the *International Time and Weather Signals* established by the various nations of the world in order (*inter alia*) to facilitate the compilation of such prognostications. Before the commencement of hostilities, weather forecasts, based largely on wireless reports from vessels crossing the Atlantic, used to be regularly issued by the British Meteorological Office. For the express purpose of withdrawing such facilities from enemy use, one of the earliest steps taken in this country was to suspend the issue of the forecasts. But it is not sufficient for any Government to prevent the

GERMAN WIRELESS STATION IN MONROVIA.



OUR VIEW SHOWS AN INSTALLATION ERECTED DURING PRE-WAR DAYS, BY OUR PRESENT FOES, IN THE CAPITAL CITY OF THE LIBERIAN REPUBLIC.

utilisation of information by the enemy, it is even more important to see that such means are taken full advantage of by their own leaders. The Allies, with their world-wide facilities, with their vast fleets constantly traversing the oceans, and with the multitude of wireless stations at their disposal, should be in a far better position than their adversaries for availing themselves of favourable phases of weather conditions, and timing their operations accordingly.

It is an open secret that the German Headquarters Staff proceed in a serious and businesslike way with regard to weather reports and the forecasts based upon them. We have seen evidence of this procedure, not merely on the battle front, but also in the case of Gotha and Zeppelin raids. It would be a matter well worthy the attention of some influential and patriotic Englishman to ascertain confidentially from the proper sources whether our own Weather Bureau works as scientifically as the enemy's, and whether the information they provide receives anything like the same attention on the part of *our* military leaders as does that furnished by the methodical Germans from Hindenburg, Ludendorff and company.

More Spy Wireless.

The treason trial of some German spies at Genoa, towards the end of March last, resulted in the condemnation to death by shooting of Kœnigsheim, Ampt, Martell and Haas *in contumaciam*, four subordinates receiving sentences of from ten to twenty years' hard labour. Interesting particulars came out in Court concerning the way in which our enemy, during the early stages of the war, forwarded wireless material to America for utilisation in spy and propaganda work. Radio-telegraphic apparatus was transmitted from Berlin to the care of the Genoese Electrical Power Company, and conveyed from Genoa to its final destinations. As a reward for his treasonable activities Ampt received a decoration of merit from the Imperial German Government.

The four condemned men mentioned above were genuine Germans, and the principal directors of the Genoa Electrical Company. They managed to escape from Italy before the latter country joined in the struggle, and it was only because they were for the moment beyond reach of the Italian Courts that they were condemned *in contumaciam*. The principal point of interest for ourselves lies in the transmission of wireless apparatus to German agents abroad, who were evidently considered to be in a position to utilise it in enemy interests. There can be little doubt that many a dramatic story in this connection remains yet to be revealed.

From the Italian point of view, however, the "wireless interest" is quite overshadowed by the fact that this Genoese Company, one of the important electrical corporations of the Peninsula, was bound hand and foot to Germany, and the organisation was used to the full against Italy. Owing to scarcity of coal, our ally depends very largely on electrical power for her industries. The tenure by Germans of a predominant interest in this Italian field of enterprise constituted a hidden menace to the vitals of the State that tolerated it. Deliverance from the effects of past pusillanimity is slow and tardy. National efforts all over the world will require to be continued with redoubled energy after the war, both to complete our effacement of the past and to provide against recurrence for the future.

A Pocket Dictionary of Wireless Telegraphy

Interesting New Publication for Students and Operators

WHAT is an "auto-jigger"? What is meant by "beat reception"? How are "continuous waves" produced? What is a "direction finder"? Such are a few of the questions arising each day in the minds of inquiring students. It is with the idea of answering these and hundreds of other such queries that the Wireless Press, Ltd., have produced the compact little volume* which lies before us as we write. Correctly described as a "Pocket" Dictionary—it fits into the waistcoat pocket with ease—the publication is yet so thorough in its treatment that no term of importance has been omitted. This is a really wonderful achievement considering the advanced stage which radiotelegraphy has now attained.

No more opportune moment than the present could have been found for its publication, seeing that an unprecedented number of men—both in the Services and outside—are now either operating or engaged in mastering the intricacies of this most fascinating of sciences. Any publication which may help to "speed-up" the training of a wireless operator in these anxious times is playing an important part in defeating the submarine menace, for without wireless telegraphy very many of our protective measures would be totally useless. The "Pocket" Dictionary is effective ammunition for helping to defeat the Hun!

The author points out in his preface that his aim has been to produce a "Students' Companion" as well as a dictionary, and for this reason many words have been included which, though not actually "wireless" words, are yet almost sure to be met with in pursuing the study of this subject. Under this heading we should place such terms as "Absciss," "Amplitude," "Booster," "Daniell Cell," and "Element." The inclusion of such words is undoubtedly wise, particularly in view of the fact that it is always difficult clearly to define the limits of such a subject as radiotelegraphy, which touches upon so large a number of other sciences.

Not only the beginner, but the advanced student, may profitably turn the pages of this handy book, the former finding definitions of simple terms and the latter such information as the chemical composition of the various crystals used for rectification. We specially commend the dictionary to journalists and authors. It will help them to avoid those multifarious pitfalls which beset the path of a general writer when dealing with technical or semi-technical subjects.

The publishers are to be congratulated on the excellent format of the volume, which, with its 160 odd pages bound in rexine, is compressed into small compass without any sacrifice of clearness in printing. The price, too, in these days of expensive production is remarkably low, and only the prospect of very extensive sales can make possible its publication at two shillings.

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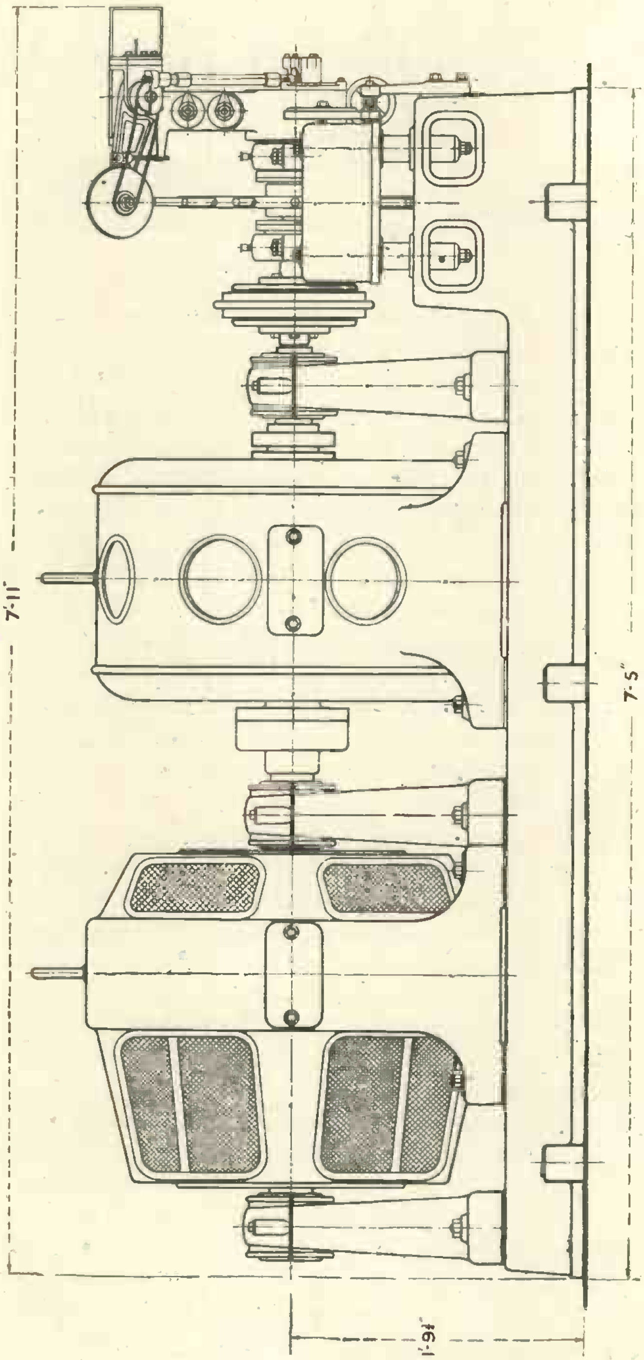
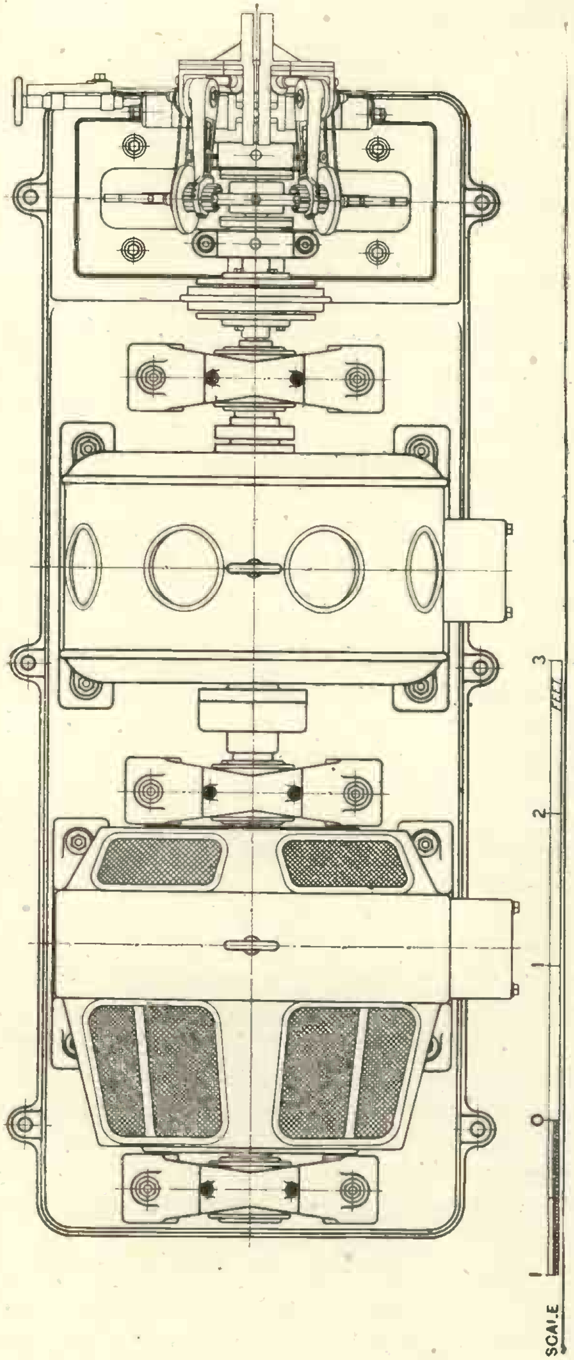
* *A Pocket Dictionary of Technical Terms Used in Wireless Telegraphy.* By Harold Ward. London: The Wireless Press, Ltd. Price 2s. net.



Motor Alternator Disc-



-Discharger Set 30 kw

The Blown-in Chamber

By PERIKON

THE superiors of Lieutenant McIntyre knew him for a good sapper, and to him they had assigned the task of constructing a fresh battle headquarters whence the staff of his division would control the next leap forward—due at dawn.

The site chosen for headquarters was a row of ruins which lay in the plain, three kilometres west of the objective—a ridge from which the billowing smother of smoke by day, and the flicker and dance of explosive by night, seemed never to lift nor to fade. For three days the guns had hammered it, had seemed to blot it out, had seemed to blow the ridge level with the rest of the dank dreary plain it rose from, yet above the smoke pall the flares and signal lights of the enemy still rose, bursting in clusters of green and red. He was holding, and would hold, till the infantry " went over."

McIntyre toiled with his men till the series of sandbagged shelters was completed; then, with his sergeant, he searched the ruins for a sleeping place. In the endmost ruin they stumbled on the blown-in dugout. The entrance to the shaftway faced the line. This, together with the build and dimensions, told McIntyre the place was of enemy construction. They descended, to find the dugout had been divided into two chambers. The outer was intact, but the entrance to the inner was blocked by a tortured mass of blackened earth and splintered timber. McIntyre wondered vaguely what sort of ghastly tableau lay hidden behind the screen of earth and wood sealing the entrance—what sort of grisly picture would meet his eye, could he pierce the ten-ton shroud of debris. He found himself speculating as to the cause of the explosion. Bombs, hand grenades—either these or a charge of some high explosive, detonated from the interior, he told himself. But hang the explosion—he was looking for a sleeping place, not making a report on the thing! The floor of the outer chamber would do. He was so dog-tired that he'd cheerfully have slept in three feet of freezing water. In pushes, when jobs *must* be done, one cannot expect one's usual spell of sleep, nor can one expect hot and regular meals. He'd sleep there till zero. Zero was timed for four the next morning. He'd manage just over three hours, and jolly grateful he'd be to manage even that. He was dead beat. He climbed inside his sleeping bag and lay down. The flicker of the guns capered on the square of timbered wall opposite the shaftway, in vivid sprays of violet green and crimson, half-lighting the place with a weird, uncanny fire, which fluttered and leapt, and lived and died, fitfully, spasmodically, now bright, now dim; and with it, the thunder and throb of the bombardment working up to drum-fire, for it wanted but three hours to zero—zero, the gaunt, dreary hour on the dawn when the blasted country, the barrage, and the mists of the valley, lie ahead—the hour of wild agony, the hour of great calm.

McIntyre tossed and turned. When would he sleep? Hang the guns and their infernal noise! He'd light a cigarette; perhaps it would better help him doze off.

Suddenly he noticed the ruins were being shelled and being shelled heavily. Still, that was only natural. They were searching for the battery of eighteen pounders he'd noticed camouflaged in front of the ruins. Funny though, they seemed to be concentrating scores of guns on the ground directly overhead. The dugout staggered and swayed, and jumped and lifted, as the shells smashed round it. The sickening reek of explosive wafted in and drifted round in choking eddies. Fragments of chalk and earth trickled through the chinks of the roof-boards in fitful little streams.

Suddenly McIntyre heard someone on the stairway. Someone was descending, seeking shelter doubtless. He turned toward the entrance, and in the leaping half-light he saw an infantryman. The left sleeve of the man's tunic had been cut away, and his arm was swathed in dirty sodden bandages. His bayonet was fixed, and he wore battle order.

He was covered in mud and filth. His face was wild and haggard. He was shouting—looking straight across the inner chamber at the opposite wall, and shouting. He paid no attention to McIntyre's enquiries and challenges, but continued to peer wildly across the dugout. "They're coming—coming!" Then he turned and disappeared hurriedly up the shaftway. McIntyre heard the creak of the man's equipment and the crunch of his boots gradually growing fainter as he mounted the steps.

McIntyre turned, and his eyes caught the opposite wall. Heavens! what had happened? The debris had vanished. He could see right into the inner chamber. He made to raise himself, to ask what had happened. He failed. Something pinned him where he lay. He seemed to be strapped there. His limbs were dead and numb. They refused to obey the messages of his brain. He struggled—struggled till his body was dripping, till his veins stood out on him, but it was of no avail. He was helpless—move, he couldn't. He shouted, shouted till a hoarseness gripped his throat, till his voice became a mere croak; but nobody heard.

The inner chamber was lit by two guttering candles. Below the candles lay a mass of queer, glittering instruments, and varnished cases, which shone and winked at a thousand points in the dim, jumping light. Two men were bending over the apparatus. On their heads some form of telephone was strapped. Telegraph stuff of some sort, evidently. The instruments began to hiss and splutter. McIntyre remembered. He'd seen a similar set before—a trench wireless station, that's what it was. Suddenly the shelling ceased. In its place came the rattle of rifles and machine guns *directly overhead.* Heavens! what on earth was wrong? Some terrible disaster must have overtaken his division. Then other sounds—the sharp, vicious bark of hand grenades, the snap of lead on brickwork—broke on his ears. Again he strained desperately to rise. Again he tried to fight down the Something which held him where he lay. Again he failed. From the ruins above came wild bursts of shouting, the crunch of boots, the thud of blows, groans, blasphemy, and cries, all mingling in a devilish hell-chorus. Then comparative quiet. Suddenly, a shuffling step on the stairway. Someone was descending—descending cautiously.

He glanced toward the inner chamber. Both men were feverishly packing their instruments. Suddenly there was a report, a vivid crimson flash, and one of the wireless men dropped; dropped in a sprawling heap, and lay strangely quiet and still. His comrade reached wildly for his rifle. "Halt! Halt!"—and with that a hulking figure in sea-grey strode swiftly across the outer chamber. McIntyre saw, by his facings and badges, that he was an enemy captain of infantry, and a Prussian. On his heels came his orderly in fighting kit. The wireless man had no option. He threw up his hands.

The German thrust him aside and glanced rapidly at the instruments. He turned, and spoke at length to the orderly, who saluted and withdrew. Five minutes later the servant returned with another officer whom McIntyre put down as a lieutenant of signals. The newcomer ran over the set in a casual and careless manner. McIntyre could see that parts of the apparatus puzzled him, and that he was loath to confess his ignorance before the Prussian and his wooden-faced servant. He turned to the captain. Evidently the set had been reported in working order, for the Prussian swung round to the operator. "You will send a brief message. We have here your cyphers. Good. Your machine is working. The lieutenant says it. The message will merely ask that intensive fire shall be directed on a certain map square. Yes, your pigdog infantry *are* there—do not jump. It is a great idea, this of mine. What your trash English news sheets should put as 'characteristic German thoroughness.' Here is the message. The station which receives it will know nothing, as it would be simple that you should be overlooked in our advance. Send it."

But the operator did not reply.

"Send it, or I shoot."

Still the man kept silent.

Then the Prussian changed his tactics.

"Come, send it; I myself will ensure that you are well treated."

Still no reply.

"I might even arrange that you should make escape. Come, send it."

"Right," suddenly broke out the operator. "I'll send it."

"Ah, I thought you would," murmured the German.

"Where," asked the operator, picking up the message form, "shall I send it?"

"To the headquarters of your heavy artillery. Be careful to send each letter correctly." And he read over the groups of the message.

"This—X3 N10 K19—is most important. That is the map position by your own maps."

"Very good."

A great disgust surged up in McIntyre. The man was a coward, a craven coward. If he'd had his revolver with him, instead of at headquarters, he'd have emptied the six chambers in the rotten cur. By sending the message he'd perhaps cause the annihilation of an entire brigade. Seemingly, that didn't matter. The man's concern was entirely for his own dirty skin. Well, he hoped the first British shell knocked the waster out. They hadn't much use, nor would the enemy have much use, for such a white-livered skunk.

"Very good," repeated the operator. "I'll send it." And he bent over the table toward a small varnished case—a small case which was clamped on the table alongside the largest and most important looking of the instruments. The lid flew open. And there, in a row, were five Mills grenades. The pins were connected to a common brass rod. Before the Prussian, or the signal officer, could stay him, the pins were out. There was a wild scream of fear from the captain of infantry, a hideous yell from the servant. The lieutenant flung himself on the floor. The operator did not move. He stood where he was. Next instant there was a thunderous roar, a blinding flash, and the inner chamber vanished in a whirling fog of flying earth and hurrying smoke.

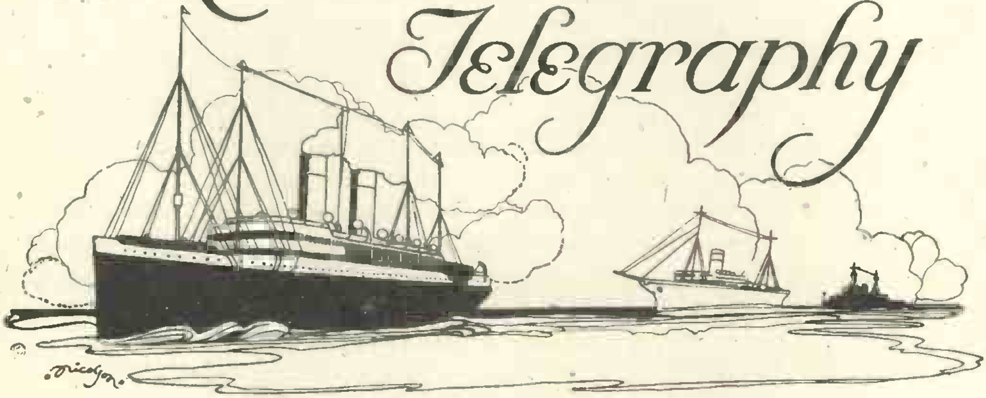
Something flew past McIntyre's head with a hiss, struck the wall, and stayed there, embedded in the wood. He lay stunned and deafened, blinded and dazed, by the concussion, by the flash of the thing. Gad! might he be forgiven his unjust thoughts. The operator was more than a hero. Would that he had half the man's grit, half his gallantry. A great remorse overwhelmed him, a great sadness. He'd been a rotter to think the poor lad a coward—might God forgive him. Suddenly, he told himself, it was getting lighter. The inky blackness of the place was giving way to greyness. Someone was again descending the shaftway. Someone was calling him. He sat up with a start. "Zero, sir," announced his man. Heavens! had he dreamt it then? Could it be? Yes, he'd dreamt it. And what a ghastly, vivid, convincing nightmare it had been! As he dressed, something protruding from the wall scratched the sleeve of his coat. He lit a match, and pulled at the object. It was a splinter of grenade shell, and, adhering to it, a scrap of dirty paper. On the paper was some faint pencilling. He could just make it out. The symbols were: X3 N10 K19—the identical combination he'd heard the Prussian repeat to the wireless man.

A week later, in rest billets, the Divisional Signal Officer made him certain. The place *had* been a wireless station, but it had been lost in an enemy counter-attack almost a month since—that was all "Signals" knew, but McIntyre knew more.

A Lifeboat Idea

In a recent issue of our contemporary, *The Motor Boat*, we notice a suggestion from a correspondent that after the war it may be possible to design and experiment with flying lifeboats, fitted with wireless, which could answer the SOS calls, proceed to the vessel in distress and "report progress." The writer adds that it might be even possible to build a boat strong enough to effect rescues. We sympathise immensely with the first part of the idea; but the second item of the programme rouses scepticism amongst those with some experience of storm rescues at sea.

Maritime Wireless Telegraphy



Synchronous Signalling at Sea.

Professor J. Joly, of Trinity College, Dublin, one of the Commissioners of Irish Lights, delivered in the earlier part of April the second of his lectures at the Royal Institution, London, on the recent developments and probable lines of progress in synchronous methods of signalling. The lecturer stated that such methods would add considerably to safety at sea, inasmuch as they neutralised the dangers arising from the failure of aerial fog signals.

The method is based on the use of signals propagated in different media, but timed to start at the same instant. The different rates of speed at which such communications travel would, he maintained, be useful to navigation, apart from the ensurance of reception guaranteed by the multiplication of the warnings. All wave-transmission, whether radiotelegraphic, optical, or oral, is liable to encounter "dead areas." The cause of this has never been fully explained, and whilst the precautions recommended by Professor Joly are unexceptionable, the explanation he suggested hardly appears adequate.

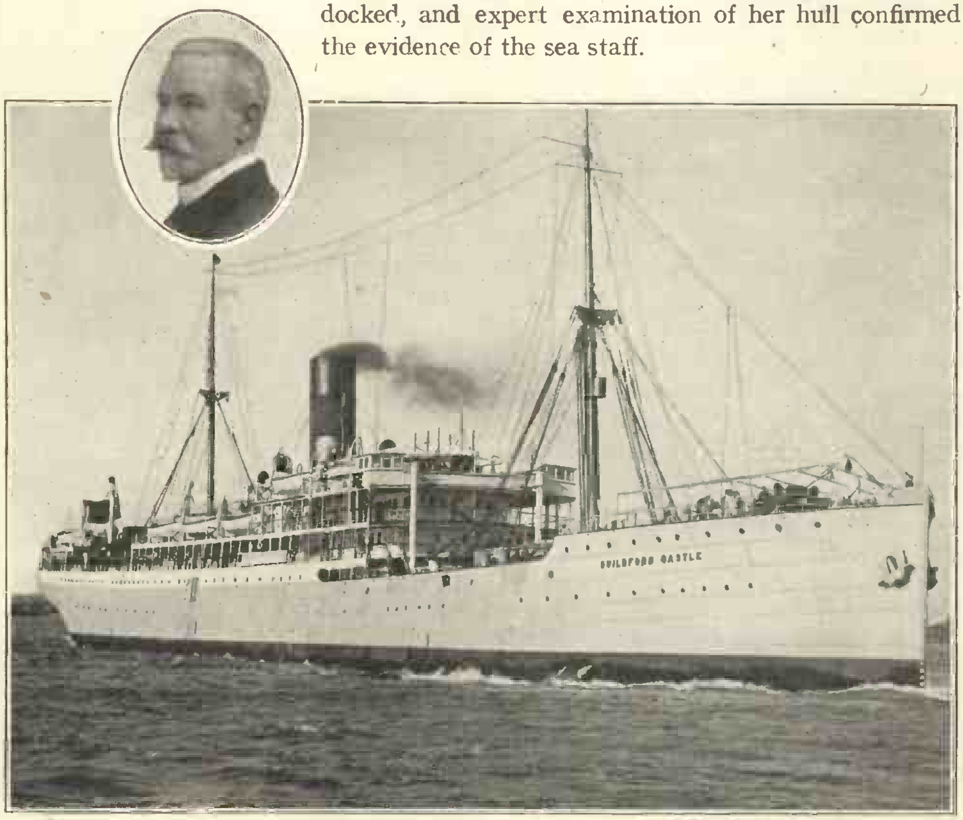
He paid a tribute to submarine signalling and wireless telegraphy that (unlike light transmission) neither were affected by weather conditions, and reminded his audience that the submarine bell stroke lagged behind the wireless waves by 1·2 seconds for each nautical mile traversed. Stated briefly, Professor Joly recommended the combination of submarine sound with wireless signalling.

The lecturer gave an interesting account of the employment of wireless telephony for warning ships at sea, taking as his illustration the installation of the Radiophone at Port Judith on the Western approach to Narragansett Bay. This station radiates its name over a considerable distance, and on vessels approaching the danger zone gives a second warning. He maintained that such a scheme of signalling, in conjunction with the wireless compass, would enable the bearing of the signals, as well as the name of the station, to be ascertained, but claimed that the actual distance could only be ascertained by synchronous signalling. The present position appears fully to justify the Professor's pronouncement that "This recent advance, whereby the

" mariner is addressed in plain language and guided on his way in darkness and in "storm, constitutes an extraordinary achievement, and captures the imagination " beyond any other example of applied science of our day."

Hospital Ships.

The attack on the British hospital ship *Guildford Castle*, on March 10th last, constitutes the latest of these particularly dastardly German outrages. There can be no doubt that the German Commander knew the character of the vessel. It was at 5.35 p.m. in clear weather, a Red Cross flag of the largest size was being flown; whilst, in anticipation of night, the navigation lights had been lit and the distinctive marks showing the character of the vessel were brightly illuminated. Moreover, the vessel was passing through an area where, according to the German pledge, such craft (the genuineness and exclusiveness of devotion to whose work of mercy is guaranteed by every imaginable International expedient) should be immune from attack. Two torpedoes appear to have been launched; the first was seen by the Master, Captain T. M. Lang, R.N.R., and a number of his subordinates to " pass close to the ship's "stern from port to starboard." The second struck the vessel abreast of the main mast, but fortunately did not explode. On arriving in port the vessel was dry-docked, and expert examination of her hull confirmed the evidence of the sea staff.



HOSPITAL SHIP "GUILDFORD CASTLE," WITH PORTRAIT OF CAPT. LANG, THE GALLANT COMMANDER (INSET)

It is impossible to exaggerate the value of wireless on such occasions, and we can assure readers that no achievement of this wonderful science is dearer to the heart of the great Italian inventor and those who have worked with him in its development than the saving of human life. Think of the moral effect alone upon the Captain and all on board produced by the knowledge that aid has been summoned and is near at hand. There were 438 wounded soldiers in transit for " Blighty," and had it become necessary to transfer so large a number of these helpless war victims from their sick beds to small boats, under the short notice and fearful disabilities involved by torpedoing without notice, the amount of suffering and loss of life would have been perfectly heartbreaking. Yet one of the leading German newspapers, the *Deutsche Tagezeitung*, brackets hospital ships with auxiliary cruisers, guard ships and transports, as shipping " which is particularly exposed to and " attacked by the U-boats of Germany."

THE MEDIÆVAL SPIRIT.

How essentially mediæval in mental attitude are the Germans of to-day! I daresay that some readers who found their ideals of the Middle Ages upon the romances which have come down to us, or upon the poems, like Tennyson's " Idylls of the " King," which are modelled thereupon, will exclaim at such a statement. 'Tis our *littérateurs* who are at fault!

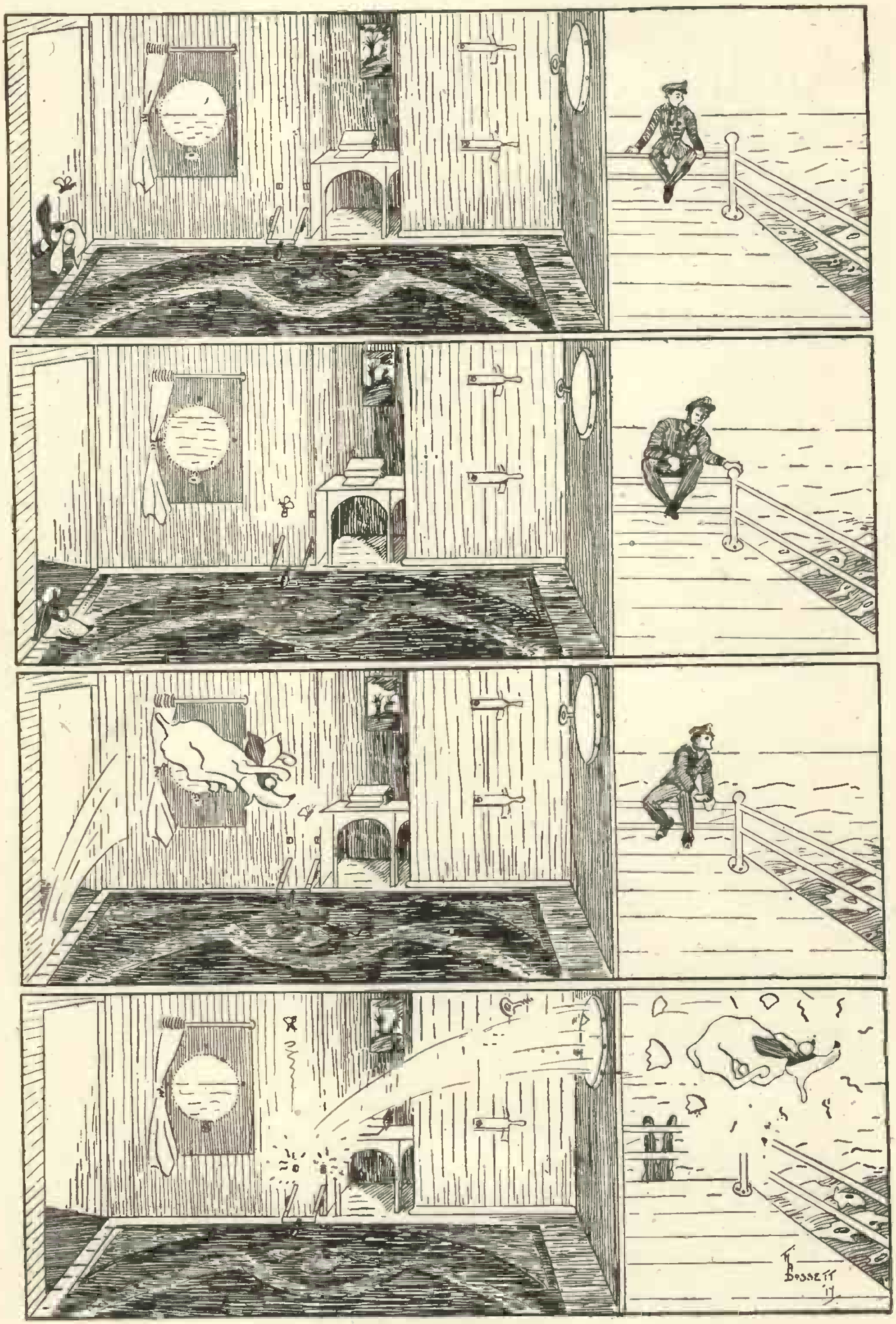
The average mediæval " knight and gentleman " was brutal, cruel, and unscrupulous; physically brave yet a bully, and contemptuously overbearing towards the proletariat. Chivalry constituted, not a natural outcome of the mediæval spirit, but a protest against it. We recommend those who take any interest in the matter to read the pages of Froissart and his compeers *critically*.

Of course the picture was not uniformly dark—no true picture ever is. Here and there flashes of chivalrous feeling appear, usually in connection with fighting. We will not labour the details of our generalisation with regard to the relationship between up-to-date Germany and genuine mediævalism—they are fairly obvious to any thinking investigator. But a case illustrating our latter reference found publicity in our daily contemporaries a short while ago, and is worth recording here. The commander of an United States destroyer now in European waters reports in the account of one of his voyages that:

> Nearly every night the commander of this destroyer receives by wireless a message which says:
>
> " My position is — degrees North and — West. Come and get me, I'm waiting " for you."
>
> The message is always signed " Hans Rose," and Rose is the name of the German who took a submarine into Newport (U.S.A.) two years ago.
>
> The American commander has, it is stated, several times rushed his vessel rapidly to the position indicated by the enemy; but " drawn blank."
>
> " The mysterious wireless message," says the gallant American, " still comes nearly " every night, no matter where the destroyer may be."

This is a " challenge to the lists " conceived in truly mediæval style, and would at first glance appear at variance with the spirit which makes these German submariners jeer at the sufferings they inflict on women and children. The inconsistency is apparent rather than real, and the explanation may be sought on the lines we have indicated above.

CARTOON OF THE MONTH



THE DOG WATCH.

An Interesting Legal Decision

The Marconi Wireless Telegraph Company of America v. Emil Simon

A DECISION of considerable importance has recently been promulgated in the action brought by the Marconi Wireless Telegraph Company of America against Emil J. Simon in the Supreme Court of the United States. Briefly stated, the facts of the case are as follows :

In August, 1915, the United States Navy Department accepted a bid by Emil J. Simon to construct twenty-five wireless telegraph transmitting sets. Before the contract, however, was formally completed the Marconi Wireless Telegraph Company of America filed its bill against Simon, seeking an injunction to prevent him from making or delivering the apparatus described in his bid, on the ground that his so doing would be an infringement of the rights secured by the Marconi patents. The matter was taken before the Courts, who refused the injunction on the grounds that by an Act of 1910 the United States possessed a general licence to use patent rights when necessary for its governmental purposes, and that Simon was therefore entitled to make and deliver the articles in question, which action on his part would not be an infringement. The Marconi Company appealed, and again were refused the injunction—the Court of Appeal confirming the decision of the Court below. The further appeal to the Supreme Court, however, resulted in a reversal of the decrees of both the Courts below, and established the principle that—in the United States at all events—the Government have not the power to authorise contractors to construct apparatus under the Marconi, or other patents, without the consent of the patentee. The extent of Simon's liability to the Marconi Company will depend upon the final decision of the Court on the question as to whether the infringement was direct or contributory. The chief point, of course, so far decided is that a contractor with the United States Government stands in the same position as any other infringer, and acquires no immunity because of the fact that he supplies apparatus to the Government.

To "Our" Marconi Operator

THE sentiment contained in the attached lines sent us by the father of a wireless operator will appeal pretty widely in these days of wartime peril at sea :

In your cabin on the deck of a ship far out at sea
You sit and just manipulate a little metal key.
Then the ether waves are started that will spread in circles wide
Till they reach another wireless man across the surging tide ;
If his instrument is tuned aright your message he will read
Just as surely as the written word that most of us would need.
And as you pace the deck at night, or sit " at ease " by day,
You may start a thought-wave when you will to the " Auld Folk " far away !
They will need no apparatus to receive what you would send,
For their hearts are just in tune with yours, and will be to the end !

Notes of the Month

Shell Shock Apparatus.

Mr. Ernest Elias Greville, a manufacturer of electrical medical apparatus, applied on April 25th last for a licence to take the patented sparkgap of a German wireless apparatus to fit in an instrument he was making for treating shell shock by electricity. The applicant explained to the court that he wanted a high-frequency current, and that the apparatus covered by the German patent gave him just what he desired with a silent working. The Controller of Patents granted the licence on the grounds that " the court existed to assist all useful adaptations " for manufacture, and if the patent specification was limited to wireless it might " be a nice question whether the patent covered use for anything else at all."

The patent in question was No. 6,424, accepted on November 25th, 1909, and constitutes one of the basic patents of the Telefunken wireless system.

The German apparatus secures the production of " rapid but slightly-damped " electrical oscillations," and there are many other methods giving similar results patented (*e.g.*) by Belgian, British and American citizens. Mr. Greville will have to pay to the Comptroller a royalty for the use of the enemy patent, and it is to be presumed that the applicant satisfied himself before making the application that the German device answers his desired purpose better than those fathered by Allied patentees, because it is obviously preferable that such fees should be paid to our own subjects or those of friendly countries, rather than held in trust for an enemy concern.

Chilian Time Signals.

We observe the recent announcement in *Lloyd's List* to the effect that wireless time signals are being sent out by the Hydrographic Office at Valparaiso, commencing at 8 h. 12 m. 13.7 s. Standard Time (corresponding to 12 h. 55 m. 00 s. G.M.T.) and continuing for five minutes. According to an Admiralty notice to mariners (No. 484 of 1918), during this period every tick of the chronometer is transmitted except the 29th second, the last ten seconds of each minute.

Enemy Wireless Companies.

For some time past *pourparlers* have been proceeding between the two German wireless concerns—The Telefunken and the High-Frequency Company—with a view to the conclusion of a working agreement, in order to further the future development of their undertakings. Up to the present we understand no final result has been reached, but the attempt to consummate such a project is significant of Teutonic forethought for the coming of peace.

Some Curves and Nomograms for Wireless Calculations (III.)

By P. BAILLIE, L.Sc.

NOTE.—*The first instalment of this article appeared in our April issue, p. 41 et seq.*

K (λ λ') = coupling coefficient of coils λ and λ' etc. . . . Factors termed R, S, T, U should then be got from nomogram (Fig. 14) in the following manner:

Join by a straight line values of corresponding diameters recorded on D and D' scales. Join the point where it meets C scale to value of K (as taken from curves, Fig. 2). Read the value of R or S, T, U on the R scale.

Then: $K = \frac{n_1 n'_1}{\sqrt{L L'}} \cdot [R+S-T-U]$ per cent. – n_1 and n'_1 turns/cm. – L and L' microhenrys.

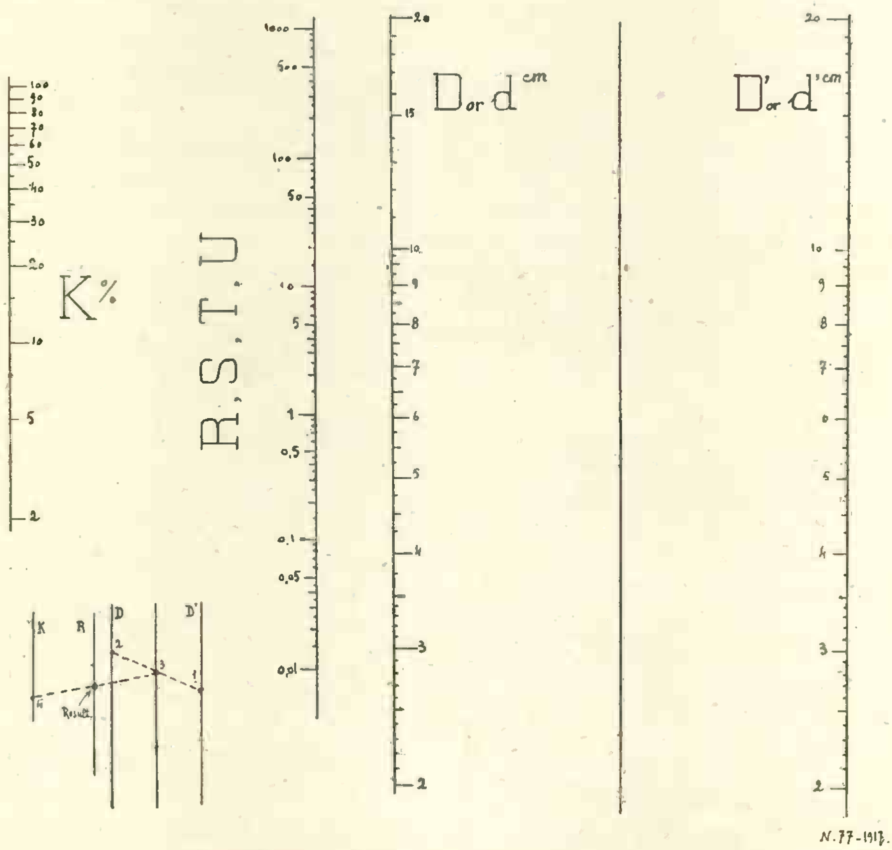


FIG. 14.

3. *Particular Cases.*—(*a*) When coils have the same dimensions (they may have different windings) $K=\frac{n_1\, n'_1}{\sqrt{L\, L'}}\ .\ [R+S-2\,T]$ per cent.

(*b*) When one of the coils is wound to the centre $K=\frac{n_1\, n'_1}{\sqrt{L\, L'}}\ .\ [R-U]$.

Turning now to the oscillating circuit, the power in this circuit is $P_{o.c.}=\frac{P}{\eta}$, η being the efficiency from oscillating circuit to antenna. When there is no data for η, it may be taken as $\eta=\frac{K^2}{K^2+\frac{2}{\pi}\,(\delta_1+\delta_2)}$ though no great accuracy is to be expected.

K = coupling coefficient.

δ_1 and δ_2 : decrements per semi-period of coupled circuits.

The two coupling waves $\lambda=\lambda_0\sqrt{1\pm K}$ may be quickly calculated from nomogram Fig. 15.

It is now a usual practice of making use of transformer primary resonance. Since it does not seem that calculations thus involved are very frequently spoken of in this country, a few details will be given. It is known * that primary current i and potential v are given by:

$$i=-\frac{E_0}{R}\,(1-e^{-\alpha t})\sin\Omega t \qquad \alpha=\frac{R}{2\,L}$$

$$v=E_0\,S\,(1-e^{-\alpha t})\cos\Omega t \qquad S=\frac{1}{R\,\Omega\, a^2\, c}=\text{overtension}$$

as pointed out, v should be a maximum when sparking occurs—that is to say, sparking should take place (Fig. 16) at 1 or at 2 or etc. . . . Sparking occurring after k reverses of potential (k = a whole number), the number of sparks per second will be $N=\frac{\Omega}{k\pi}$.

Ω = pulsation = $2\,\pi\times$ alternator frequency.

Hence sparking potential U is

$$U=(-1)^k\ .\ a\,E_0\,S\,(1-e^{-\frac{k\pi}{2s}}),$$

and primary potential $=E_0\,S\,(1-e^{-\frac{k\pi}{2s}})$.

Power at the spark gap is then $P_{o.c.}=\frac{1}{2}\,N\,c\,a^2\,E_0{}^2\,S^2\,(1-e^{-\frac{k\pi}{2s}})^2$.

Power taken from alternator is. $P_a=N\displaystyle\int_{t=0}^{t=\frac{k\pi}{\Omega}}\varepsilon\, i\ .\ dt$

ε = electro-motive force $=E_0\sin\Omega t$.

$$P_a=\frac{N\,E_0{}^2}{R}\int_0^{\frac{k\pi}{\Omega}}(1-e^{-\alpha t})\sin^2\Omega t\ .\ dt$$

* See THE WIRELESS WORLD, August 1917. The same notations will be used.

integrating and accounting for resonance condition $La^2 c\,\Omega^2 = 1$.

$$P_a = \frac{N E_o^2}{R}\left[\frac{k\pi}{2\Omega} - \frac{S}{\Omega}\left(1 - e^{-\frac{k\pi}{2}}\right)\right],$$

The efficiency ρ of feeding circuit is then

$$\rho = \frac{P_{o.c.}}{P_a} = \frac{S\left(1 - e^{-\frac{k\pi}{2S}}\right)^2}{k\pi - 2S\left(1 - e^{-\frac{k\pi}{2S}}\right)}$$

This is the case of a transformer without losses or magnetic leakage. The transformer efficiency, y, when there are losses and leakage has been considered by the author in the August 1917 issue of this magazine. The reader should refer to the quoted article for values of y. Total efficiency from alternator to spark gap $= \rho y$

Curves Fig. 17 give values of ρ in terms of S for different values of k. It should be noted that ρ is a maximum when $k = 1$; *i.e.*, when the spark note is

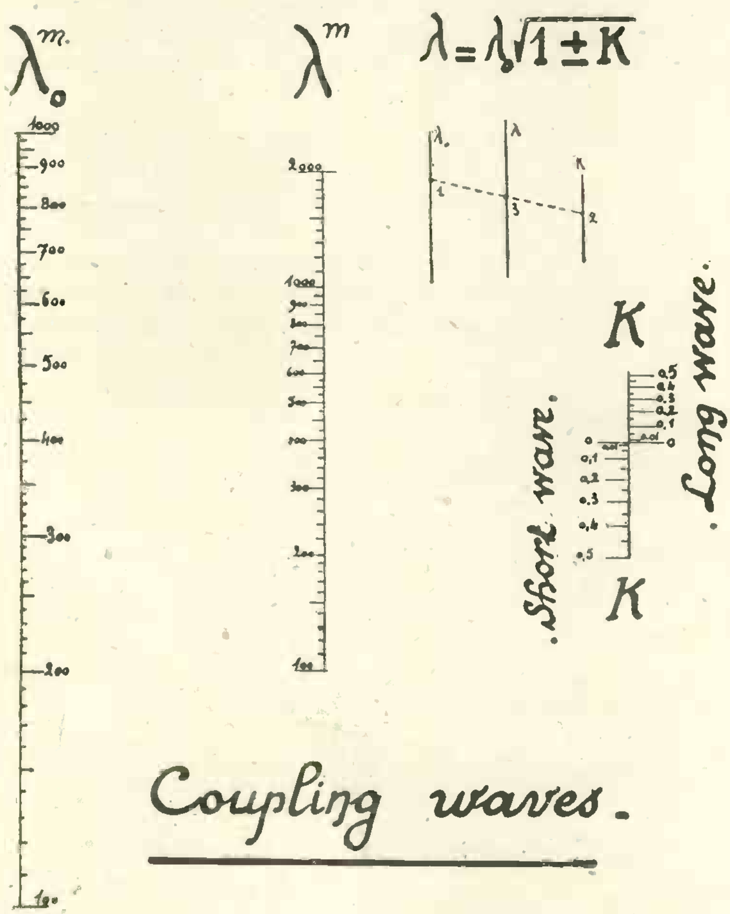


FIG. 15.

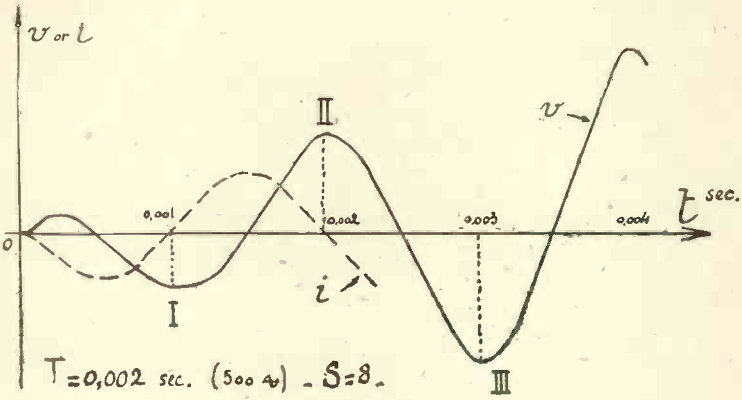


FIG. 16.

twice the alternator frequency as is the case with Marconi synchronous dischargers.

The power $P_{o.c.}$ at the spark-gap is imposed. The capacity c of the condenser is given by $c=\frac{2\,P_{o.c.}}{N\,U^2}$; U has to be assumed accounting for insulation and dielectric losses. The maximum of the electro-motive force of the alternator is then

$$E_o=\frac{U}{a\,S\left[1-e^{-\frac{k\,\pi}{2\,S}}\right]}.$$

The transformation ratio, a, and overtension, S, have to be chosen according to the preceding formula (for instance, S may be from 6 to 8). Or E_o and S may be assumed, and a thus be chosen such as giving a suitable value to U.

Moreover, the current in the oscillating circuit

$$I_{\text{R.M.S.}}=\frac{1{,}885\,.\,U_{\text{R.M.S.}}\text{ (volts)}}{\lambda\text{ (metres)}}\,.\,e^{-\frac{\delta}{2}}\,.\,c\text{ (mfds.)}\,\#\,\frac{1{,}885\,.\,U_{\text{R.M.S.}}\text{ (volts)}}{\lambda\left(1+\frac{\delta}{2}\right)}\,.\,c\text{ (mfds.)}$$

should not be so high as to damage the discharger. H.F. resistance of the connections may be calculated by ordinary formulæ or by a nomogram given in October 1916 issue of this publication.

The inductance of the oscillating circuit is given by Thomson formula :

$$\lambda\text{ (meters)}=1{,}885\ \sqrt{l\text{ (mhys.)}\quad c\text{ (mfds.)}}.^*$$

The resistance and total inductance of primary circuit are :

$$R=\frac{U^2}{2\,\pi\,k\,S\,a^2\,P_{o.c.}}\qquad L\,\Omega=R\,S.$$

R is the sum of alternator, circuit, and adjusting rheostat resistances. L is the sum of alternator and adjusting coil inductances, and of inductance $\frac{L'}{a^2}$ equivalent

* See The Wireless World, February 1917.

to secondary inductance L' (choking coils). The alternator has to be designed in order to give at a frequency $f = \frac{kN}{2} \sharp$ a R.M.S. electro-motive force

$$E_{R.M.S.} = \frac{U}{aS\sqrt{2}\left[1 - e^{-\frac{k\pi}{2S}}\right]}$$

and a current

$$I_{R.M.S.} \text{ (amp.)} = \sqrt{\frac{P_{o.c.} \text{ (watts)}}{R \text{ (ohms.)}}} \left(\frac{1}{\rho y} - 1\right)$$

Its power is

$$\frac{P_{o.c.} \sqrt{\left(\frac{1}{\rho y} - 1\right) \pi k S}}{aS\left[1 - e^{-\frac{k\pi}{2S}}\right]}$$

(P in $kw.$; Power in kilovolts-amperes)

Curves Fig. 18 give values of $S\left[1 - e^{-\frac{k\pi}{2S}}\right]$ which may be needed in previous calculations.

In designing the alternator and the transformer it should be kept in mind that the frequency is high compared with commercial alternating currents. The losses are then more considerable. When heavy losses cannot be allowed, particular attention should be paid to lamination and to transformer windings as already indicated when dealing with y.

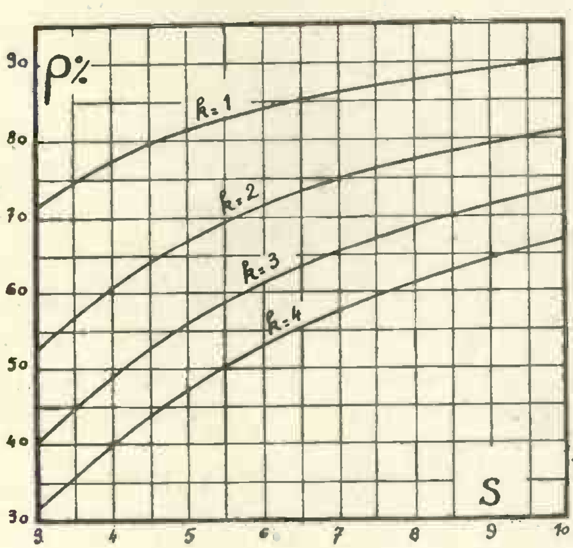


FIG. 17.

Since the primary resonance may accidentally not be obtained, it is good to give to the alternator a power somewhat larger than the calculated power.

The calculations involved by the design of the receiving part of a wireless station chiefly refer to inductance and capacity. The receiving antenna being given, means are to be provided for its tuning on all desired wave-lengths. The usual ways of inserting in the antenna circuit a condenser, an inductance, or both in parallel, have already been dealt with, as well as determination of "steps."*

* THE WIRELESS WORLD, February and September 1917.

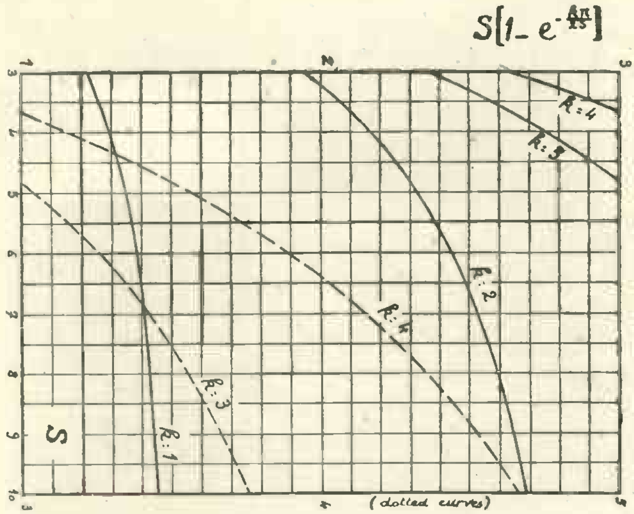


FIG. 18.

There is nothing new to be said about the design of the detector circuit, whether it be oscillating or aperiodic, directly coupled to the antenna circuit, or by means of a low resistance oscillating circuit. The capacity and inductance have only to be designed with regard to the nature of the detector (current or potential detector, etc. . . .) ; especially a large proportion of inductance has to be secured when three electrodes, valves, amplifiers, or detectors are to be used. Reference has already been made to the coupling of the circuits. The advantage of using flat spiral coils, especially of coils wound to the centre, or nearly so, should be pointed out, as the calculation of coupling coefficients is comparatively easy, and moreover such coils do not of themselves possess a large capacity. This applies to sending inductances as well as to receiving ones. Where compactness is required, flat coupled coils are very suitable ; curves (Fig. 13) are then useful.

For instance, it may be found that the receiver oscillating inductance, calculated by Lieut. Bertram Hoyle (Vol. V., page 265), may be composed of four flat coils 10 cm. in diameter, separated by 1 cm., and wound to the centre with $\frac{50}{100}$ of m/m wire ($n_1 = 18{\cdot}6$).

The steps may be :

50 mhys. : at 2·8 cm. from centre of first coil.
200 mhys. : at 4·4 cm. from centre of first coil.
555 mhys. : at 7·7 cm. from centre of second coil.
3,405 mhys. : at end of fourth coil.

This would form a block 10 cm. in diameter and 4 cm. thick. A cylinder of same diameter and inductance would have 14 cms. in length. This calculation required but half an hour ; this is a simpler matter than using the trial method of building a model.

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. H. A. Marshall, whose death took place in hospital at Newport News, U.S.A., the lives of the operators mentioned 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. Herbert Anthony Marshall, who died in hospital from illness at Newport News, U.S.A., on February 14th last, was born at Courett, Durham, January 10th, 1899, and educated at St. Cuthbert's College, Ushaw. He was trained at the North-Eastern Schools of Wireless Telegraphy, Newcastle-on-Tyne, and after gaining the P.M.G. Certificate, appointed to the Marconi Company's staff in July, 1917.

Born at Dumfermline, on April 24th, 1900, Mr. Robert Black Duffin was educated at Winchburgh Public School, and trained at the North British Wireless Schools, Ltd., Edinburgh. He received the P.M.G. Certificate, and was given an appointment by the Marconi Company last January.

Mr. Roland Walter Falconer was born at Arbroath, on February 4th, 1899, and went to the St. Paul's and to Dudhope School, Dundee. Commencing his career with Messrs. D. and J. Tullis, engineers, Clydebank, he subsequently attended the North British Wireless Schools, Ltd., Glasgow, and obtained the P.M.G. Certificate. Mr. Falconer's service with the Marconi Company started in December, 1916.

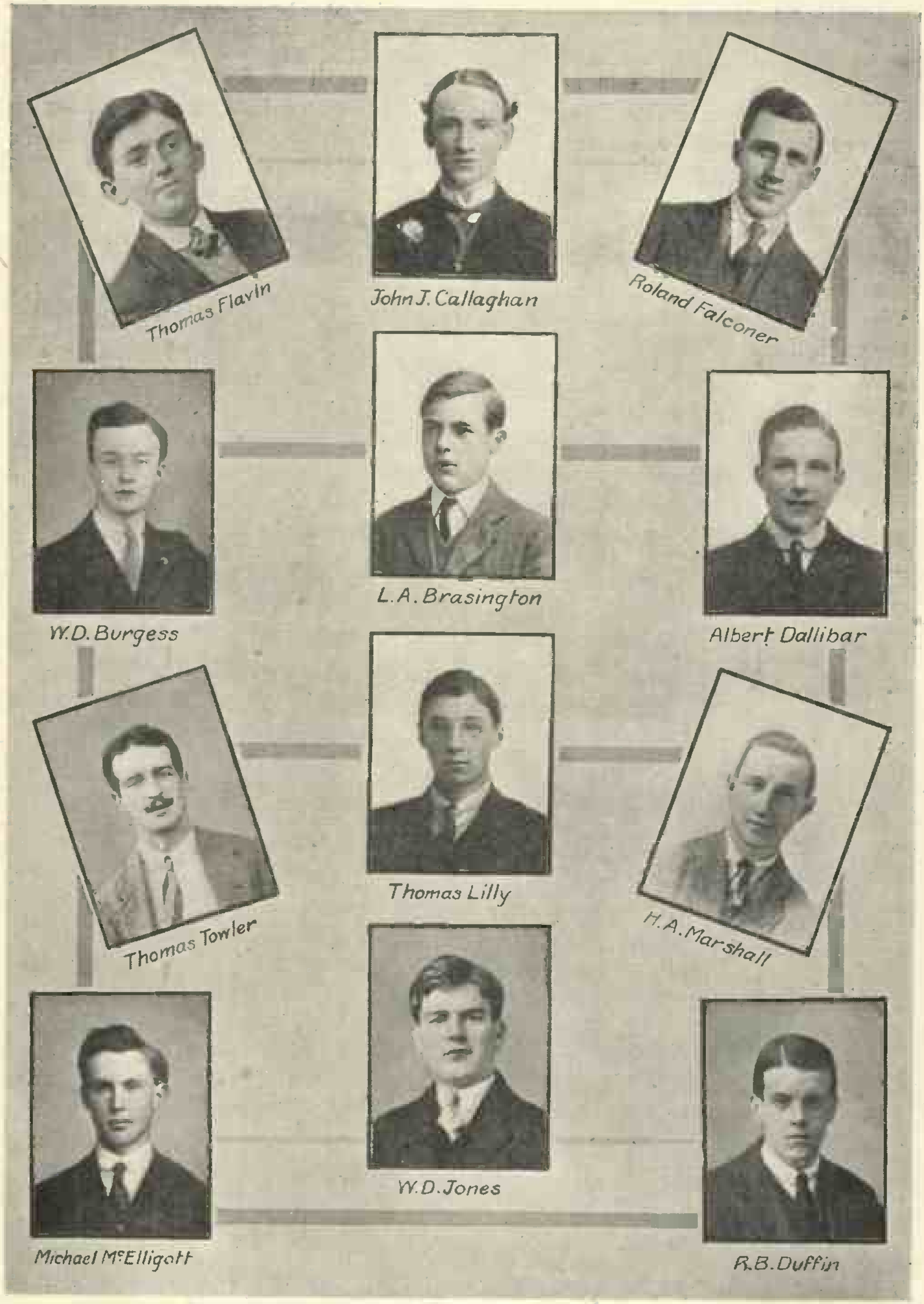
Of Irish birth, Mr. John Joseph Callaghan was twenty-four years old, and born at Knightstown, Co. Meath. He received his education at St. Finian's College, Mullingar, St. Kieran's College, Kilkenny, and at St. Joseph's Seminary, Leeds. His specialised training he received at the Atlantic Wireless College, Cahirciveen, where he gained the P.M.G. Certificate.

Mr. Callaghan was appointed to the Marconi Company's staff on October 22nd, 1916.

Mr. Michael McElligott was born at Lerrig, Co. Kerry, on August 18th, 1897. He was educated at Ardfert, and trained at the Atlantic Wireless College, Cahirciveen, where he qualified for the P.M.G. Certificate, and was placed on the staff of the Marconi Company on August 24th, 1915.

Woolwich was the birthplace of Mr. Albert Edward Dallibar seventeen years ago. After receiving his education at the Raines Foundation School, London (during which period he was awarded the Royal Life Saving Society's Certificate

ROLL OF HONOUR.



and badge), he was trained at Marconi House School. In January last, immediately after winning his P.M.G. Certificate, he joined the operating staff of the Marconi Company.

Mr. Thomas McKinnon Dilly, born at Arbroath on August 8th, 1901, was educated at Abbey Public School, Arbroath, and started his career by joining the staff of the co-operative society of that city. His wireless training was received at the North British Wireless Schools, Ltd., Dundee, and—on receipt of the P.M.G. Certificate in December, 1917—he proceeded to sea in the Marconi Company's service.

Mr. William David Jones was born on November 9th, 1897, at Dangendirne, Wales, and received his education at the Elementary School. After completing the curriculum there he entered the service of a coal mining company, subsequently leaving their employment to take up wireless as a career. Trained at the South Wales Wireless College, Ltd., Cardiff, Mr. Jones qualified for the P.M.G. Certificate, and entered the service of the Marconi Company on March 12th, 1916.

Born on September 18th, 1900, at Bibury, Gloucestershire, Mr. Leonard Alfred Brasington was educated at Cirencester Grammar School, and trained in wireless telegraphy at Marconi House School.

After obtaining the P.M.G. Certificate Mr. Brasington joined the Marconi Company's staff on January 13th of this year.

Formerly with Mr. Langhorne, draper, of Pontefract, Mr. Thomas Towler was born at Hunslet, Yorkshire, on May 6th, 1890, and educated at the Bewerley Street, Leeds, and Stourton Board Schools. He took a course of training at the North Eastern Schools of Wireless Telegraphy, Leeds, and received the P.M.G. Certificate.

Mr. Towler entered the Marconi service in June, 1915.

A Youghal man, Mr. Thomas Flavin was born at Pilmore on November 14th, 1898, and received his education from the Christian Brothers. He was a student at the Irish School of Telegraphy, Cork, and qualified for the P.M.G. Certificate, being placed on the sea-going staff of the Marconi Company on January 1st, 1917.

Mr. William Dunn Burgess was born on April 13th, 1898, at Montrose, and attended the North Links and the Townhead Supplementary Schools there. For a time he was employed by Messrs. J. Selby & Co., tailors, Montrose, after which he received a training in radiotelegraphy at the North British Wireless Schools, Ltd., Dundee. On gaining the P.M.G. Certificate, Mr. Burgess was placed on the Marconi operating staff on March 26th, 1916.

A Correction.

The late Mr. W. E. Pinder was trained at the City School of Wireless Telegraphy, Ltd., Manchester ; not, as erroneously stated in the May number, at Marconi House School.

Instructional Article

NEW SERIES (No. 3).

EDITORIAL NOTE.—Below we give the third 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.*

FORCE (*continued*).

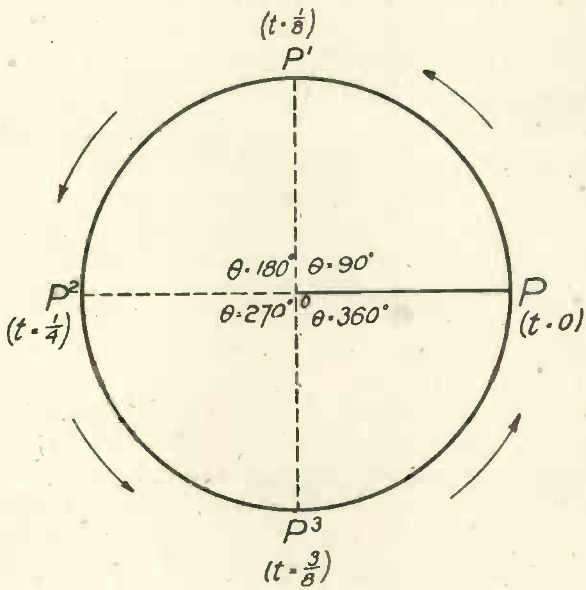
Angular Velocity.—Having dealt with velocity considered as the rate of displacement it is appropriate to explain at this point Angular Velocity, an important quantity with which the reader will often meet in his study of wireless telegraphy and related subjects. In reference to Fig. 12 let us assume that the point O is fixed and that the line OP revolves about it in a certain plane. In this case we will let the plane be that of the paper. If the line OP completes 120 revolutions every minute its Angular Velocity is 120 r.p.m. or 120/60 r.p.sec. Angular Velocity may or may not be uniform but we shall only refer to uniform Angular Velocity as the student is not likely to be concerned with cases of angular acceleration. Angular Velocity may be either clockwise or counter-clockwise in direction, the latter usually being considered as a positive direction and the former as a negative direction.

Another method of measuring Angular Velocity is to determine **the angle swept out in unit time.** If the line OP makes 120 r.p.m. this is equal to 2 r.p.sec. ; that is to say, it sweeps out an angle of 360° twice every second, an Angular Velocity of 720° per second. Moving at this velocity in a positive direction the line OP will have reached in one-eighth of a second the position OP^1 and will have *swept out* an angle of 90° ; this angle is the **Angular Displacement** for that particular instant. In one-fourth of a second the line OP will have reached the position OP^2, the angular displacement for that instant being 180° ; in three-eighths of a second it will have reached the position OP^3, the angular displacement being 270°, and in half a second it will have reached its starting position OP, having in that amount of time swept out 360°. Angular displacement is generally denoted by the Greek letter θ (Theta).

Instead of expressing Angular Velocity in revolutions per minute or degrees per second it is far more usual to state **the number of radians swept out in unit time** by the radius OP or its analogue. The student already knows that a **radian equals 57·3°** and that **the circle contains 2π radians.**

NOTE.—A radian (57·3°) *is the angle which is subtended at the centre of a circle by an* arc *of the circle equal in length to the radius of the circle*—i.e.,

$$\frac{\textit{Circumference}}{\textit{Radius}} = \frac{6{\cdot}2832}{(\textit{or } 2\pi)}, \textit{ and } \frac{360°}{6{\cdot}2832} = \frac{57{\cdot}3°}{(\textit{or } 1 \textit{ radian})}.$$



$\omega = 720°$ per sec.

FIG. 12.

If the rate of revolution is known, then to express Angular Velocity in Circular measure (radians per second) all we have to do is to multiply this rate (in seconds) by 2π.

EXAMPLE.—A wheel revolves at 600 *r.p.m. What is the Angular Velocity?*

$$600 \text{ r.p.m.} = \frac{600}{60} \text{ r.p.sec.} = 10 \text{ r.p.sec.}$$

Each of these revolutions equals 360°, and as each 360° equals 2π radians, $10 \times 2\pi =$ Angular Velocity in radians per second.

That is, $10 \times 6{\cdot}2832 = 62{\cdot}832$ radians per second.

In electrical engineering Angular Velocity is always understood to be expressed in radians unless otherwise specified, and is denoted by ω. If n = revs. p. sec., then $\omega = 2\pi\mathbf{n}$. The Angular Displacement at any instant, t, is given by the formula, $\theta = 2\pi\mathbf{n}\mathbf{t}$, where t is the time which has elapsed since the revolutions commenced—*i.e.*, since $t = 0$.

EXAMPLE.—A wheel revolves at an uniform velocity of 1,440 *revs. p.m. What will be the Angular Displacement a tenth of a second after it starts?*

Frequency, $n, = \frac{1{,}440}{60} = 24$ r.p.sec.

Angular Velocity, $\omega = 2\pi \underset{(n)}{24}$; and as this is the number of radians swept out per second the question is resolved into this: If 2π 24 radians are swept out in one second how many are swept out in $\frac{1}{10}$ second?

Obviously in $\frac{1}{10}$ second, $\theta = 2\pi \underset{(n)}{24} \times \underset{(t)}{\frac{1}{10}} = 2\pi \times 2{\cdot}4 = 15{\cdot}07968$ radians.

Hence θ in degrees $= 15{\cdot}07968 \times 57{\cdot}3 = 864°$.

Knowing the Angular Velocity it is easy to find the **Linear Speed** of the point P in Fig. 12 as it travels round the circumference. By mensuration, circumference equals $2\pi r$, so that if n be the frequency, the point P covers a distance equal to $2\pi rn$ every second. We have, however, already seen that $\omega = 2\pi n$, so that in the expression $2\pi rn$ we can cut out $2\pi n$ and write ω in its place. Thus the **linear speed** of the point P is ωr—that is, Angular Velocity multiplied by the length of the radius, and is usually expressed in feet per second. To find out how many feet P travels in a given time we must multiply ωr by t.

EXAMPLE.—A wheel 8 feet in diameter revolves at 120 r.p.m. What is the linear speed of a point on its rim ?

$$\omega = \underset{(2\pi)}{2\pi}\,\underset{(n)}{n} = 6{\cdot}2832 \times \frac{120}{60}$$

$$\text{Linear speed} = \omega r \text{ ft. per sec.}$$

$$= \underbrace{6{\cdot}2832 \times \frac{120}{60}}_{(\omega)} \times \underset{(r)}{4}$$

$$= 50{\cdot}26 \text{ ft. per sec.}$$

When we come to consider Harmonic Motion the reader will find that an instant appreciation of the relation between Angular Velocity and Angular Displacement and of the way in which they are calculated will be extremely useful to him. It is important to remember that ω stands for a certain *rate* dependent only upon n, to which it is directly proportional.

$$\omega \propto n, \text{ or, } \omega = kn, \ k \text{ being a constant—viz., } 2\pi.$$

For a given value of ω, θ is a quantity dependent upon the value of t at any given instant and varies directly as t. If we select two instants, say half a second and one second after the motion commences, it is clear that ω will be the same at both instants, whereas θ will be twice as great when $t=1$ as when $t=\frac{1}{2}$.

For a given value of ω, $\theta \propto t$, or, $\theta = kt$, k being a constant—viz., $\underbrace{2\pi n}_{(\omega)}$.

Acceleration.—Reference to Fig. 13 (which is Fig. 11 reproduced) shows that from A to p and from x to y the velocity of the train is increasing, whilst from z to B it is decreasing. **The rate at which velocity changes is called Acceleration.** When used in everyday speech the word acceleration generally signifies increase of velocity and one might be apt to think that in the case of a *decreasing* velocity there is the reverse of acceleration, whereas by the scientific meaning of the word there is true acceleration because the velocity is changing. Acceleration means the **rate of increase or decrease of velocity.**

EXAMPLE.—A body moving in a straight line has a velocity of 20 cms. per sec. This velocity changes and after ten seconds becomes 50 cms. per sec. What is the acceleration ?

In ten seconds velocity increases $(50-20)=30$, cms. per second.

Therefore in one second velocity increases $\frac{30}{10}=3$ cms. per second.

Thus in this example the velocity increases by 3 cms. per second *every second*: this rate is the acceleration, which is written 3 *cms. per second per second, or* 3 *cm./sec.*^{2} From the expression 3 cm./sec.^{2}

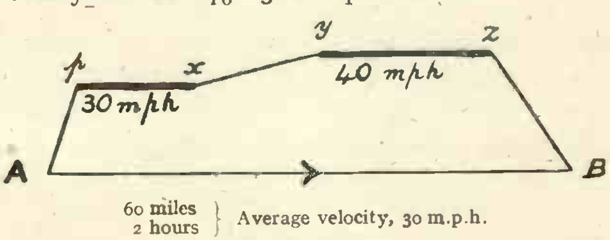


FIG. 13.

it is a simple matter to see that the *dimensions* of Acceleration are $\left[\frac{L}{T^2}\right]$ or $[LT^{-2}]$, because we divide a *velocity*, in this case 30 cms. per second, by *time*, in this case ten seconds, in order to find Acceleration. Now, the dimensions of velocity are $\left[\frac{L}{T}\right]$, and dividing this by $[T]$ we get $\left[\frac{L}{T}\right]\times\frac{1}{T}=\left[\frac{L}{T^2}\right]$ or $[LT^{-2}]$.

The C.G.S. unit of Acceleration is 1 cm./sec.^{2}.

NOTE.—The reader may need to be reminded that $\frac{L}{T^2}$ *can be written* LT^{-2}, *because a negative power is equal to the reciprocal of the corresponding positive power. Thus* $4^{-2}=\frac{1}{4^2}$, *and in general,* $x^{-n}=\frac{1}{x^n}$.

Acceleration, like Velocity, is a vector quantity. Fig. 14 represents an acceleration of 10 cm./sec.^{2} acting along the line *AB towards A*, the scale chosen being 1 in. = 10 cm./sec.^{2}. If the *sense* of this vector—*i.e., towards A*—be considered as positive, then the reverse sense would be negative. This distinction provides us with a means of representing acceleration as an increase or decrease of velocity, or, in a case where the magnitude of the velocity remains constant but its direction changes, of representing this change.

Scale: 1 in. = 10 cm./sec.^{2}.

FIG. 14.

In this connection it should be noted that as velocity is a vector quantity acceleration occurs if velocity changes in magnitude *or direction*. For example, the velocity of the flow of water through a pipe may be increased or decreased by increasing or decreasing the head of water; in either case the change in velocity is one of *magnitude*. If the water is allowed to flow along a part of the pipe containing a bend, then (1) Acceleration occurs at the bend, and is dependent upon the angle of the bend; (2) Acceleration occurs after the bend is passed, on account of the change in the *direction* of velocity. The student will find it advantageous to think out this and similar cases and to make a separate study of Vectors.

FORCE (*continued*).

It will be recalled that we defined force as the cause of the starting or stopping of uniform motion in a straight line. In the light of the foregoing explanation of Velocity and Acceleration the student will now see that to produce acceleration force has to come into play, because an acceleration is a change from uniformity (of motion in a straight line) to non-uniformity. Now, it is a matter of common experience that there is a close relationship between the *mass* (or *weight*) of a body, the force applied, and the resultant acceleration of the body; in order to move a 10 lb. weight a distance of a foot in one second, one has to exert a greater force on it than would be required to move a 1 lb. weight over the same distance in the same time. Also, the force necessary to move the 1 lb. weight one foot in one second is less than that required to move the same weight over a distance of one foot in half a second. To reduce these ideas of the relationship of force, mass and acceleration to a more scientific shape we must briefly consider the three fundamental laws of dynamics which were formulated by Newton.

Newton's First Law of Motion.—Every body continues in its state of rest or of uniform motion in a straight line unless compelled by forces to change that state. As it embodies the facts of experience this law scarcely needs amplification. In speaking of a "state of rest" we mean that the position of the body in relation to surrounding objects is unaltered. Actually there is no *absolute* rest in nature, for a seemingly still body is moving in space, sharing in common with the whole earth the dual motion of that planet, and at the same time its component particles are engaged in ceaseless complex movements at great speeds. So long as the x, y and z co-ordinates of a point (*see* p. 59, WIRELESS WORLD, March) remain the same the point is in a "state of rest." In the case of a body resting on the ground we may say that a point in it which is determined by its position relative to some point on the ground will maintain that position for ever unless force is applied to the body to a degree sufficient to overcome the inertia of the body and the resistance due to friction.

Newton's Second Law of Motion.—Rate of change of momentum is proportional to the applied force and takes place in the direction in which the force acts. If a ton weight and an ounce weight are taken together to a height and released simultaneously so that each falls freely they will reach the earth at the same time. If a piece of lead and a feather are put into a bell-jar which is then exhausted of air * it is found that the feather will fall from one end of the jar to the other as fast as will the piece of lead. In fact, all bodies at the same place fall freely with equal accelerations. Now, the force which produces the acceleration of a falling body may be said to be the *weight* of the body, which, it should be recollected, is proportional to the *mass* of the body so that if two bodies fall with equal accelerations it is not difficult to see that **the forces required must be proportional to the masses**—*i.e.*, $F \propto m$.

It can be proved experimentally that **the force which must be applied to a given mass is proportional to the acceleration required**—*i.e*,. $F \propto a$. Hence we can sum up the two laws by saying that the force required is jointly proportional to the mass and the acceleration and is measured by the product of these two quantities—*i.e.*, $F = ma$.

Let us take the case of a mass, m, at rest and suppose that a force, F, be applied to it, producing an acceleration, a, the velocity at the end of t seconds being v. It has been shown earlier in this article that Acceleration, a, is found by dividing Velocity by Time.

$$a = \frac{v}{t}.$$

So that if in the equation $F = ma$ we write $\frac{v}{t}$ instead of a we get

$$F = \frac{mv}{t}.$$

* In order to remove the factor of air resistance so that they can "fall freely."

The product mv is called the **momentum** of the body and may be regarded as the *quantity of motion*, a definition which is somewhat vague but which we will now try to make clearer. When the velocity is zero obviously the quantity of motion is zero but becomes mv after t seconds have elapsed ; hence, if in t seconds the body acquires a momentum of mv, the momentum acquired *per second* must be $\frac{mv}{t}$. It has above been proved that $F=\frac{mv}{t}$, and we can, therefore, say that the applied force is numerically equal to the rate of change of momentum. The applied force, the acceleration and the momentum are vectors quantities having the same direction and sense.

From the fact that momentum is equal to the product of mass and velocity the dimensions of momentum are easily found.

$$\text{Mass}\times\text{Velocity}=\left[\frac{ML}{T}\right]=\text{Momentum}=MLT^{-1}.$$

Newton's Third Law of Motion.—To every action there is an equal and opposite reaction. This law, as stated in these very general terms, is a little difficult to understand until one thinks about it in the light of a simple example, for at first there is a natural tendency to suppose it to mean that every physical action is undone, as it were, or nullified by an equal action opposite in effect or direction. If such were actually the case every system would be in either a state of equilibrium or of oscillation, which would mean that either no physical work could be done or that the sum total of available energy would remain constant, two conclusions which are opposed to facts. Clearly we must seek to explain the law on other lines.

The simplest case we can take is that of the mutual attraction between two bodies of unit mass, A and B. A attracts B with a certain force, but B at the same time attracts A with an equal force opposite in *sense*. The result is that A and B tend to move together with a force determined by the inverse square law.

Again, in the case of a man pulling a truck along level ground, the force which the truck exerts on him is equal and opposite to the force he exerts on the truck. Why, then, do both move? First of all it must be borne in mind that it is the *system*, comprising both man and truck, which moves; *none of the components of the system moves relatively to the other.* Also it should be noted that when two equal and opposite forces act on a body the latter, if at rest, remains in that condition, and if moving, continues to move without acceleration. In the system with which we are dealing the two internal forces balance each other and therefore do not affect the motion of that system. Now, the man experiences two forces, the backward pull of the truck and the forward forces arising from the action between his feet and the ground. If these forward forces are greater than the backward pull the man will move forward. As regards the truck, this is subjected to forward force exerted by the man and to the resistance of friction. If the force due to the man is greater than the retardation due to friction the truck will move forward. The *mutual action between the man and the* *truck* consists, as explained above, of equal and opposed forces, that due to the truck being exerted by virtue of its inertia. There are four agents—viz., two which may be considered as *external* forces: (1) The reaction of the ground on the man's feet; (2) the retarding forces of resistance; and two which may be regarded as *internal* forces: (1) The man's forward pull on the truck; (2) the truck's backward pull on the man. The internal forces balance each other, so that our example resolves itself into a contest between the external forces. If it is a good road it will be easy for the man to move the truck along; if it is a bad road—*i.e.*, much resistance—the man will be compelled to press very hard with his feet in order to produce the required acceleration. This is a matter of common experience for anyone who has pulled a truck over bad ground.

Units of Force.—From the equation $F=ma$ we arrive at the *dimensions* of force, by substitution. Acceleration, a, being $[LT^{-2}]$ we can write $[F]=[MLT^{-2}]$ $=$ Mass $\times$ Acceleration.

The absolute unit of force in any system is that which, if applied for *unit time*, will give a body of *unit mass* a velocity of *unit length per second*. Under the C.G.S. system the unit of force is called the **dyne** and is defined as that force which will impart to a mass of 1 gram an acceleration of 1 cm./sec.^{2}, or, in other words, that force which if applied for one second to a mass of 1 gram will give that mass a velocity of 1 cm. per second.

The **poundal** is known as the **British absolute unit of force**, and is that force which applied to a mass of 1 lb. will give it an acceleration of 1 ft./sec.^{2}.

The increase per second in the velocity of a body falling freely is, in England, 32·2 ft. per second, which is another way of saying that the uniform acceleration of a freely falling body is 32·2 ft./sec.^{2} or (C.G.S.) 981 cm./sec.^{2}. Thus a mass of 1 gram will fall with an acceleration of 981 cm./sec.^{2}. But a force of one dyne will impart to a mass of 1 gram an acceleration of 1 cm./sec.^{2}; *therefore a force equal to the weight of* 1 *gram equals* 981 *dynes*. Similarly, a force equal to a weight of 1 lb. equals 32·2 poundals.

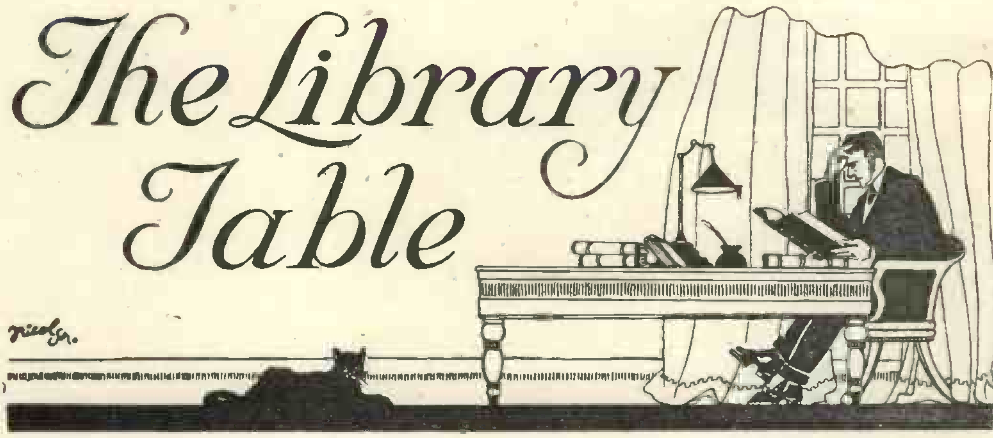
(*To be continued.*)

Share Market Report

LONDON, *May* 10*th*, 1918.

A QUIET tone has ruled in the Industrial Market during the past month. Notwithstanding the unfavourable conditions the shares of the Marconi group have shown a marked firmness, with considerable investment buying. The closing prices as we go to press are: Marconi Ordinary, £3 3s. 9d.; Marconi Preference, £2 12s. 6d.; American Marconi, £1 3s. 3d.; Spanish and General Trust, 9s.; Canadian Marconi, 10s.; Marconi International Marine, £2 8s. 9d.

The Library Table



SUBJECT INDEX TO THE PERIODICALS, 1916—*DATED APRIL,* 1918.

Published by the *Athenæum* at the request of the Council of the Library Association.

The section of this valuable series which has just come into our hands deals with " Science and Technology, including Hygiene and Sport." The section dealing with historical, political, and economic sciences appeared in November last year, and was reviewed in our January issue. Our former remark with regard to the indebtedness of the reading public to the work thus carried out by the *Athenæum* applies equally to the present Index. Wireless men who take their subject seriously will need no more than a notification that the volume in question is now available ; they will find the present issue contains some references to a number of interesting papers which appeared in various British and American periodical publications during 1916.

THE STUDENTS' SERIES OF TEST CARDS (*Series III.*). *A BOOK OF MODEL ANSWERS* (*Series III.*). *London : The Wireless Press, Limited.* 1*s.* 6*d. net each.*

It is now several years since Parts I. and II. of the valuable series of Questions. and Answers first appeared on the market, and their ever-increasing popularity forms an eloquent testimonial of their value to the student. With the publication of Part II. of the *Elementary Principles of Wireless Telegraphy* a demand arose for further series of Questions and Answers, and in response thereto the Wireless Press, Ltd., has produced the set now before us. The same high standard of excellence has been maintained, and the student who conscientiously works through the questions will detect and remedy his weak points quite as surely as if he were verbally cross-examined by some expert teacher.

The book of Answers contains no less than 110 pages, and by virtue of its full treatment constitutes a complete text-book in itself, which may be profitably studied by all interested in the subject, whatever their degree of advancement. To the student preparing for the P.M.G. examination these cards and answers are absolutely indispensable.

In these days of strenuous endeavour, when all of us are attempting to fit ourselves for some work of immediate practical utility, such aids to self-training cannot be too highly valued or too largely multiplied. We doubt whether anything can ever hope completely to take the place of oral tuition, however intelligent the student and however excellent the teaching medium; but such a combination as the wireless books of Bangay, Parts I. and II., with the test cards designed to serve as their complement, immensely lighten the task of any teacher of radiotelegraphy, and in so doing increase the number of students with whom he can deal.

"THE PRACTICAL ENGINEER" ELECTRICAL POCKET BOOK AND DIARY, 1918. *London: The Technical Publishing Co., Ltd. Price* 1*s. and* 1*s.* 6*d. net (difference only in the binding).*

We have once again to welcome the appearance of this handy pocket book, now in its nineteenth year of issue. The 1918 edition contains all the old and valued features as well as several new sections, prominent among the latter being the new wiring rules of the Institution of Electrical Engineers and a selection of the new rules for electrical machinery of the British Engineering Standards Committee. Wireless telegraphy is well handled in Section xxxiii.

Several misprints of a rather irritating nature mar what is otherwise an excellent publication, and we look forward to seeing them corrected in a future edition. The following cases in point have come under our own notice. On page 49 we find the surprising statement, under "Ohm's Law," that $C = \frac{E}{I}$ where I = current, E difference of potential and R resistance on page 84 there is an illustration of a "Witton" *Oil* Starter; and on page 329 a reference to *ten* discharge curves which obviously should be *four*.

After all, however, these are small blemishes, and easily remedied in subsequent issues. We have no hesitation in recommending the volume to all who require a handy pocket companion to help them in their electrical work.

SEA, LAND AND AIR, a new Australasian magazine. Published by the "Wireless Press" of Sydney, N.S.W. Price 9d.

The distinctive emblem adopted by our Australasian cousins consists of a kangaroo with the motto "Advance Australia." 'Tis a significant symbol with applications extending into many fields of activity. Amongst them is wireless, which, after many tribulations in early days,* is going ahead, kangaroo-like, "by leaps and bounds."

The latest antipodean radiotelegraphic enterprise consists of the production of a new magazine entitled *Sea, Land and Air.* The new-born journal sets before itself the task of dealing with the works and wonders of the Australian Navy and

* See our article entitled "The Progress of Wireless in Australasia," printed in THE WIRELESS WORLD for August, 1916.

Mercantile Marine; the exploits ashore of the virile manhood and aspiring adolescents of the Commonwealth and New Zealand, as well as with the spirit of adventure which finds a fitting arena in the vast spaces of air. Wireless telegraphy, indispensable in all three media, forms the connecting link of the triad.

We have here a programme ambitious indeed, but one which the first number—just in our hands—gives good promise of fulfilling.

The "Sea" section of this new venture is adequately dealt with in a number of articles. We find one of "Centurion's" brilliant submarine-hunting sketches, an article by Mr. Archibald Hurd on "Intelligence in Naval Warfare," and a stirring narrative from an American wireless man of his adventures at sea. Mr. O. M. Bagot contributes an *exposé* of the "Maritime Peril" from Germany which Australia escaped through the advent of war, and which with the re-establishment of peace may once again threaten her unless her rulers and her people beware; whilst the issue reprints Mr. Alfred Noyes's dramatic sketch of submarine warfare at sea entitled "The Wireless Drama." This latter article, and the series of adventures of an American wireless operator, detailed under the title of "All in a Day's Work," by Clarence Cisin, constitute two of the most thrilling accounts extant of the "wonderful experiences which have become almost commonplace amongst the officers and men of the Mercantile Marine."

The "Land" side of the magazine finds itself represented by Mr. Hilaire Belloc's parallelism contrasting the "Russian and French Revolutions," by "Women's Work on the Land and Elsewhere," and by a graphically pictured account of campaigning from a correspondent in Palestine. An interesting item in this narrative of military happenings in the Holy Land consists of the account given concerning a captured German aeroplane pilot, who boasted to his captors of the wonderful surprise which the Germans had in store upon this front. There can be little doubt that General Allenby's campaign of attack "took the wind out of the sails" of an enemy offensive.

The "Air" part of the programme is carried out, so far as this number is concerned, by Mr. Fisk's illuminating article on "Steering Zeppelins by Wireless," a complete and noteworthy exposition of the methods adopted by enemy airships, and by twin articles on "My First Flight," by Lieut. Scarr, R.F.C., and "My Last Flight," by Lieut. A. W. Nowle, both special contributions to the new journal. Mr. Fisk's dissertation upon enemy airships' methods of finding their way is not only the work of an expert radiotelegraphist, but also of one who has enjoyed exceptional opportunities for investigating the subject upon which he writes. Amongst other cognate experiences, he enjoyed the unique privilege of listening to the wireless signals exchanged between a fleet of Zeppelins and their base, whilst the enemy craft were in the act of crossing the North Sea *en route* for one of their latest raids upon London.

A number of miscellaneous items like "Questions and Answers," "News and Notes," "Directions for Making a Flying Model Aeroplane," etc., round off a maiden issue of the highest promise. We congratulate our new contemporary and look forward with confidence to its appreciation by those for whose benefit it has been initiated.

Personal Notes

Obituary.

We learn with regret of the death of Flight-Lieutenant C. H. Murray Chapman. Royal Naval Air Service, who was accidentally killed while flying on February 23rd, At the outbreak of war Mr. Chapman, who had a knowledge of wireless telegraphy, offered his services to the Royal Navy, and was appointed wireless operator on H.M.S. *Revenge*, taking part in the action off the Belgian coast in October, 1914. Later, he was minesweeping in the North Sea. In June, 1915, he obtained a commission in the R.N.A.S., and qualified for his certificate four weeks later.

We regret to announce the death in East Africa, from malaria fever, of Sergeant C. Atkinson, R.E., a wireless operator. Before the war he was on the telegraphic staff of the Midland Railway Company at Derby.

We also mourn the death at sea of Mr. F. R. Walker, a wireless operator in the service of the Navy.

The *Electrician* announces the sad news that Lance-Corporal S. Davies, R.E., senior partner of a Cardiff firm of builders and an instructor in wireless telegraphy in the R.E., has died of pneumonia.

Official notification has been received by Mr. and Mrs. J. W. Calton, cf 75, Portland Street, Southport, to whom we tender our sympathy, that their son, Frederick John Calton, wireless telegraphist, was among the crew of one of H.M. ships which was lost in a storm off the coast of Scotland on January 12th. Mr. Calton was 19 years of age and joined the Navy in December, 1914, seeing considerable service on destroyers.

Promotions.

Captain G. Powell, assistant commandant of the wireless school at Farnborough, has been promoted to the rank of major. This officer was formerly employed at a post office in Wales.

Mr. W. G. Vickers, formerly superintendent of the messengers at the Fenchurch Street office, Marconi's Wireless Telegraph Company, Limited, has now received a commission. Lieut. Vickers was stationed at Dar-es-Salaam.

Awards.

We learn with pleasure from a Supplement of the *London Gazette* that W.T.O. 1st Class Walter F. Whitehead, R.N.R., has had conferred upon him by His Majesty the King of Italy a bronze medal for military valour.

Corporal Harold D. Tipler, wireless operator, R.F.C., has been awarded the Military Medal for bravery in the field on January 1st, 1918. We offer him our congratulations.

On board H.M.S. *Eagle* at Liverpool, recently, Captain Sims presented the D.S.M. to the father of a boy telegraphist named Henshall for services in connection with a hostile submarine; the lad was afterwards killed in another action.

Two Members of the Belgian Company's Staff.

We regret to have to record the death of two members of the staff of the Société Anonyme Internationale de Télégraphie sans Fil.

Acting Inspector Réné B. de Brucq, who died at Lisbon, of typhoid fever, was a native of Brussels. Transferred for duty with the Belgian Government wireless service shortly before the war began, he found himself at Antwerp during the German assault on that city. At the end of 1915 he resumed duty with the Société, and received an appointment as their acting inspector at Lisbon in 1917. During the revolutionary disturbances there he had the misfortune to be wounded by a bomb. M. de Brucq, who was 30 years of age, leaves a widow and son three years old.

M. R. B. DE BRUCQ.

Operator Alvara da Silva, who was 24 years of age, laid down his life in the execution of duty. The Portuguese steamer on which he served was lost by enemy action in December last; and although we have no information regarding the timely arrival of assistance to the stricken ship, we know that the distress signals from her were received by both ship and shore stations in the vicinity. M. da Silva had for thirteen months been attached to the wireless service.

M. A. DA SILVA.

An Operator's Gallant Deed.

The crew of the Portuguese s.s. *Insulano*, which was wrecked last December at the mouth of the river Gironde, owe their lives to the perseverance, under great difficulty, of Telegraphist M. Carolina da Silva, who, although his cabin was badly smashed and repeatedly swamped by heavy seas, remained sending out the SOS signal until the last moment. Jumping into the sea, he was picked up by one of the ship's boats and eventually taken on board a French minesweeper. The *Insulano* became a total loss, but all hands were saved, a "happy ending" due to the gallantry of M. da Silva.

M. C. DA SILVA.

Company Notes

The Amalgamated Wireless (Australasia), Ltd.

THE above Company held their ninth half-yearly meeting at Wireless House, Sydney, N.S.W., on February 28th last. Sir Thomas Hughes, M.L.C., Chairman of Directors, in moving the adoption of the Report and Balance Sheet, announced the payment of interim dividend at the rate of 5 per cent. per annum. He pointed out that the Reserve Fund had increased from £2,700 in June, 1917, to over £23,000. He held out little hope that revenue from public radiograms would show any improvement until after the conclusion of peace ; but the closing of this important source of revenue has been more than neutralised by the extension in the Company's manufacturing and general trading during the past twelve months. This expansion is expected to continue in view of further extensions made to the Company's factory and the installation of additional time-saving machinery.

The Chairman also announced the establishment of a branch of the "Wireless Press, Ltd." in Australia ; the main object being to conduct certain news services with the aid of wireless telegraphy, and to issue publications dealing with wireless and allied subjects. *The new organisation has already started operations by issuing a monthly magazine entitled "Sea, Land and Air," of which a review will be found on page* 187 *of the present issue.*

Sir Thomas Hughes paid a well-deserved compliment to the efforts of Mr. E. T. Fisk, the Managing Director, and to the gallantry displayed by a number of members of the Company's staff.

The meeting cordially endorsed the views of the Chairman, and passed the adoption of the Report and Balance Sheet. We print below the text of the above-mentioned Report.

DIRECTORS' REPORT.

PERIOD COVERED.—Your Directors have pleasure in submitting herewith the Balance Sheet and Profit and Loss Account for the six months ending December 31st, 1917.

NET PROFITS.—The net profits of the business during the half-year, added to the balance brought forward from last account, after providing for expenses of management, and adding the usual proportionate amounts to the Depreciation and Marine Insurance Reserve, and providing for all other expenses, amount to £4,074 0s. 5d.

DIVIDEND.—Out of the above amount, which is available for distribution, your Directors recommend payment of an interim dividend at the rate of 5 per cent. per annum, absorbing £3,500, and carrying forward a balance of £574 0s. 5d. to the next account.

BUSINESS OPERATIONS.—Your Directors regret to state that an important section of the Company's operations, public radio telegrams, from which in pre-war days a continuously growing revenue was derived, remains inoperative, owing to the very necessary restrictions imposed by the authorities responsible for the protection of all shipping. Acting in conjunction with those authorities, the Company has spared no effort to enforce the necessary restrictions, without considering the financial loss which it suffers therefrom.

Apart from the foregoing, your Directors are pleased to report that in every other direction the Company's operations are being successfully extended. Until recently your Directors have been able to report the progress of the ship operating department by giving the number of vessels using your service; but, as stated in our last report, we are advised not to publish those numbers during the war. Your Directors, however, are pleased to be able to record a further increase in the number, and anticipation of continued growth.

During the period under review your factory has been fully occupied with work of a highly important nature, and in view of the demand still being made for its products further extensions are being carried out. A large number of complete wireless telegraph stations have been manufactured during the past twelve months, and the factory is still particularly engaged in that class of work.

INVESTMENTS.—Your Directors have been able to invest a substantial sum in the Commonwealth War Loan without interfering with the Company's operations.

SHARE ISSUE.—During the half-year a number of the Company's shares were offered at auction by the Public Trustee, under the War Precautions Regulations. Your Directors, believing that it would be to the advantage of the Company that they should control the holding of such shares, acquired the whole of the shares on behalf of approved intending shareholders. At the time of the closing of the half-year's accounts the transfer of the shares to such purchasers by the Public Trustee had not been completed, but this has since been done, and the Company has been reimbursed all expenditure on this account.

DIRECTORATE.—During the half-year Mr. J. H. Forrest retired from the Board of Directors, and Sir Thomas Hughes became a Member of the Board by invitation. By the unanimous vote of the Directors Sir Thomas Hughes has also been elected Chairman of the Board. Captain T. Langley Webb, a Director of Huddart Parker, Ltd., has also joined the Board by invitation. In accordance with Article No. 83 these gentlemen retire, and due notice having been given they offer themselves for re-election at the General Meeting.

Wireless Congratulations

Senatore Marconi Radiotelegraphically Expresses the National Sentiment of Italy.

THE Fatherland of Marconi commemorated with great enthusiasm the anniversary of the entry into the war of the U.S.A. This occasion furnished an opportunity for expression of friendly feeling, which was eagerly seized by all the nationstaking part in this modern crusade.

A huge assemblage gathered at the world-famous Colosseum, where speeches were delivered by the United States Ambassador, by the Mayor of Rome, and by Signor Berenini. The King of Italy despatched a telegram directly from himself to President Wilson; whilst Senatore Marconi, over his own signature, transmitted a summary of the proceedings addressed to the U.S.A. President, most appropriately utilising wireless for the purpose. The terms of the message run as follows:—

> "The people of Rome have assembled to-day at the Colosseum to celebrate the "anniversary of the entry into the war of the United States. On this auspicious "occasion the signal honour is granted to me of being the intermediary for forwarding "this message, which is being transmitted through the free ways of space, expressing "to you the sentiments of sincere friendship and close solidarity which unite the "Italian people with those of the United States, together with our deepest admiration "for your initiative, which is inspired by the same principles which made Rome "great and which will maintain our faith in the triumph of right and civilisation."

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.*

W. D. (Beeston).—(1) and (2) The distance that it is possible to transmit and receive with a Marconi 1½ kw. installation depends upon several factors. Within certain limits we may say that the larger the aerial the greater the distance that it is possible to transmit and receive, so that it is usual for a large ship to be able to send and receive over greater distances than a smaller vessel similarly equipped. Again the degree of sensitiveness of the receiver is an important factor, some of the modern amplifying sets enabling reception to take place over vastly increased distances. Generally speaking, on an average ship with the receivers usually installed, good readable signals are received in practically all conditions over a distance of 200 miles for a ½ kw. set, and 300 or more for a 1½ kw. set. In tropical and southern waters, greatly increased distances are frequently worked at night when conditions are "freakish." A number of cases have occurred where a ship with a 1½ kw. set has been able to communicate over a distance of 2,000 miles at night. (3) K.W. is an abbreviation of kilowatt. If you are not clear on the subject of power measurement in electricity you should study *The Elementary Principles of Wireless Telegraphy*, by R. D. Bangay. (4) It is not necessary to obtain a telephone headpiece in order to test your hearing, and in any case you would not be allowed to purchase any component parts of wireless apparatus at the present time. If you wish to practise telegraphy at home a key and loud buzzer is quite good enough for the purpose.

VALVES.—(1) No. (2) We cannot say definitely whether it will be possible to obtain all of the books mentioned, but if you wished to obtain them and were prepared to pay the price the Wireless Press, Ltd., would do their best for you. They could all be seen at the British Museum Library. (3) All British patents can be consulted free of charge at the Patents Office in London, or copies of any individual patents obtained at a small cost from the same place. If you have an opportunity of visiting the Patents Office Library, which is open daily without charge, you should certainly do so. You can then turn up any particular patent in which you are interested and see exactly what is claimed by the inventor.

SERGEANT J. D. (Belgian Army).—(1) Damping in this case is the dying down of amplitude in a train of waves and in a train of damped waves each successive wave is of smaller amplitude than the preceding one. In a train of continuous waves all are of the same amplitude. (2) Damped waves are usually produced by means of ordinary spark-discharge wireless apparatus and continuous waves by high frequency alternators, oscillation valves, arc transmitters or specially designed spark apparatus of the Marconi system. (3) Continuous waves can be received on ordinary damped wave receivers provided certain modifications are introduced. A description of these modifications cannot be given here through lack of space, but they are dealt with in Part II. of *The Elementary Principles of Wireless Telegraphy*, by R. D. Bangay, price 2s. 6d., postage 3d.

A. B. (Carlisle).—The whole question of examination and prizes for scouts is suspended until after the war. At the present time no syllabus is issued for such examinations.

E. G. B. (Birmingham).—(1) This question must be settled by the Company's doctor. (2) An applicant for employment on the marine operating staff of the Marconi Company must pass that Company's doctor after his application has been received and before he can be finally accepted. It is essential that he should pass the Company's own medical representative, who alone is fully conversant with the requirements. This also answers Question 3. There is no reason why you should not visit your own doctor before taking the course and obtain from him an opinion as to whether you are physically fit in all respects. If you were not, of course it would be useless to proceed further with your course, but if you were you would still have to pass the Company's own doctor before acceptance.

IGNORANT (Durban).—There is no reason why the foil obtained from cigarette packets should not act equally as well as the tin foil, and we can only suggest that some of the connections are faulty or else that the condenser is too small for the purpose for which it was put. Why not try increasing its size? You state that the tabs are separate pieces, which raises in our mind a doubt as to whether you have made good electrical connection between the tabs and sheets. A further point concerns the speed at which the interruptions take place. In some very high speed mercury interrupters a condenser is practically useless, but if your break is of the ordinary low speed type this difficulty should not be found.

V. S. (Corscombe).—(1) The requirements of the service vary so much from time to time that we can only suggest that you apply to the nearest naval recruiting office for particulars. If you have obtained your P.M.G. Certificate at any Wireless Training College this would probably facilitate your entry, although as far as the R.N.V.R. is concerned youths are frequently accepted and trained by the authorities themselves. (2) The fact that a man is a wireless operator does not in itself qualify him for the rank of warrant officer. There are a number of wireless ratings in the Navy, the lowest being boy telegraphist. Some are "bluejackets," others petty officers, and still others warrant officers, while certain men engaged exclusively on wireless duties hold commissions from second lieutenant upwards.

SERGEANT A. B. (B.E.F.).—The wavelength of an aeroplane aerial is very roughly 3·25 times its length. This should enable you to arrive at the information you require.

R. B. L. (Scotland).—A youth attending a properly equipped and well conducted wireless school, and starting with no previous knowledge of the subject, should obtain his First Class Certificate in from six to nine months. It is impossible to state how long it would take to qualify by means of a combined correspondence and practical course. We have on several occasions in these columns asked readers to let us have their experiences with regard to the correspondence courses and the length of time taken by them to complete their studies, but so far no one has provided us with this information. We take this opportunity of repeating the query, as the information so gained would be very useful to our readers.

G. D. (Wexford).—(1) A telegraphist with a good knowledge of the needle instrument would be able to learn telegraphy as used in wireless much more rapidly than anyone with no knowledge whatever of telegraphy, but in the case of a student who is not already acquainted with the needle instrument we would not advise him to practise with it as a means of learning Morse for wireless. (2) No. (3) As we have stated on numerous occasions previously, we have no idea of what the requirements of the Marconi Company may be after cessation of hostilities, but it should be remembered that merchant ships fitted with wireless telegraphy during the war will without doubt retain their installations after the war. We cannot conceive that any shipowner once having experienced the uses of wireless would ever dismantle it from his ship. (4) On this matter we can only refer you to the school in question for particulars. A great deal depends upon your present knowledge of the subjects in which you would be examined.

THIS MAGAZINE CAN BE SENT FREE TO OUR TROOPS ABROAD BY LEAVING IT AT A POST OFFICE.

MARCONI UNIFORM, 60s.; Bridge Coat, 70s.; suit tall operator. Also 24 in. Gladstone bag, 35s. All new condition.—Call or write, 9 Hartfield Crescent, Wimbledon.

WANTED.—No. 3 WIRELESS WORLD and Index to Volume I. Will pay good price. Also back numbers *The Electrical Experimentor*.—Box 100, WIRELESS WORLD, Marconi House, Strand, W.C.2.

OPERATORS' WHITE SUITS in perfect condition, height 5 ft. 8½ in. Coats, 4s.; trousers, 3s.; shorts, 1s. 6d. Camp bedstead, 10s. 6d.; topee, 2s. 6d.—ROMILLY, 70 Burdett Avenue, Westcliff-on Sea.

APARTMENTS, special terms to Marconi Students *only*, 15 minutes by tube to "The Strand," good table, excellent references, 16/6 per week inclusive.—MRS. BARRY YORKE, 22 Hogarth Road, Earl's Court, London, S.W.5.

THE YEAR-BOOK OF WIRELESS TELEGRAPHY & TELEPHONY.—We have had the opportunity of securing a few copies of earlier issues and can offer them as follows—
1915 edition, 4/- post free United Kingdom; 5/- Abroad.
1916 edition, 4/- United Kingdom; 5/- Abroad, post free.
THE WIRELESS PRESS, LTD., Marconi House, Strand, London, W.C.2.

SPECIMEN COPIES. — We shall be pleased to send entirely free of charge a few specimen copies of THE WIRELESS WORLD to the friend of any reader likely to be interested in the magazine.—Send a postcard to Sales Manager, THE WIRELESS WORLD, Marconi House, W.C.2.

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THE NAVAL OFFICER & THE 'LITTLE GREY BOOKS.'

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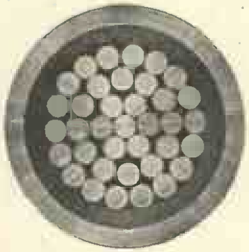

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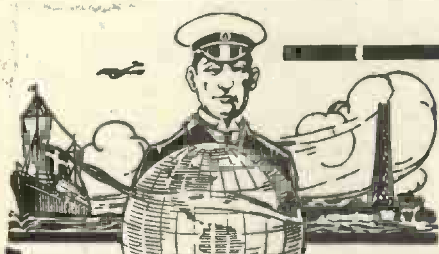

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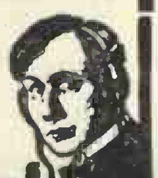

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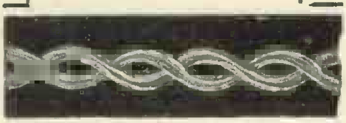

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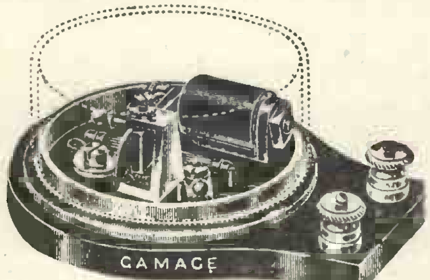

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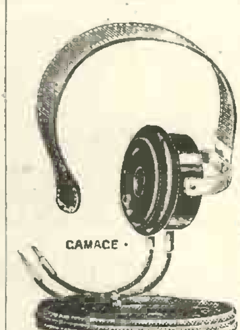

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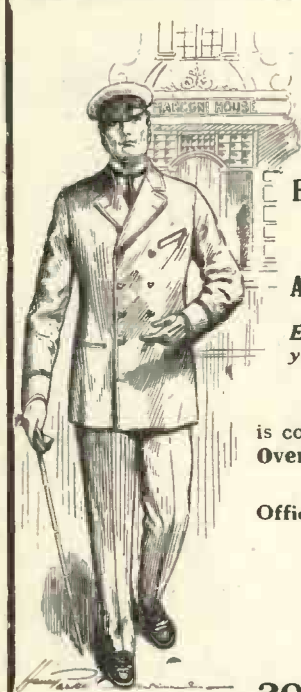

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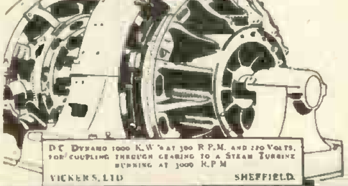

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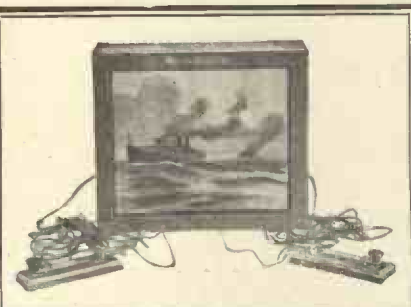

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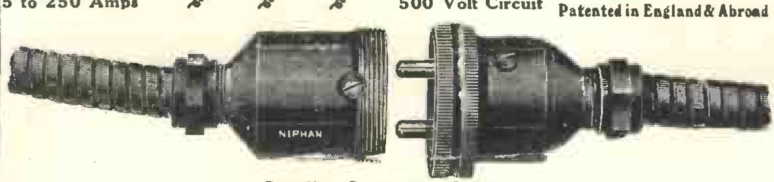

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