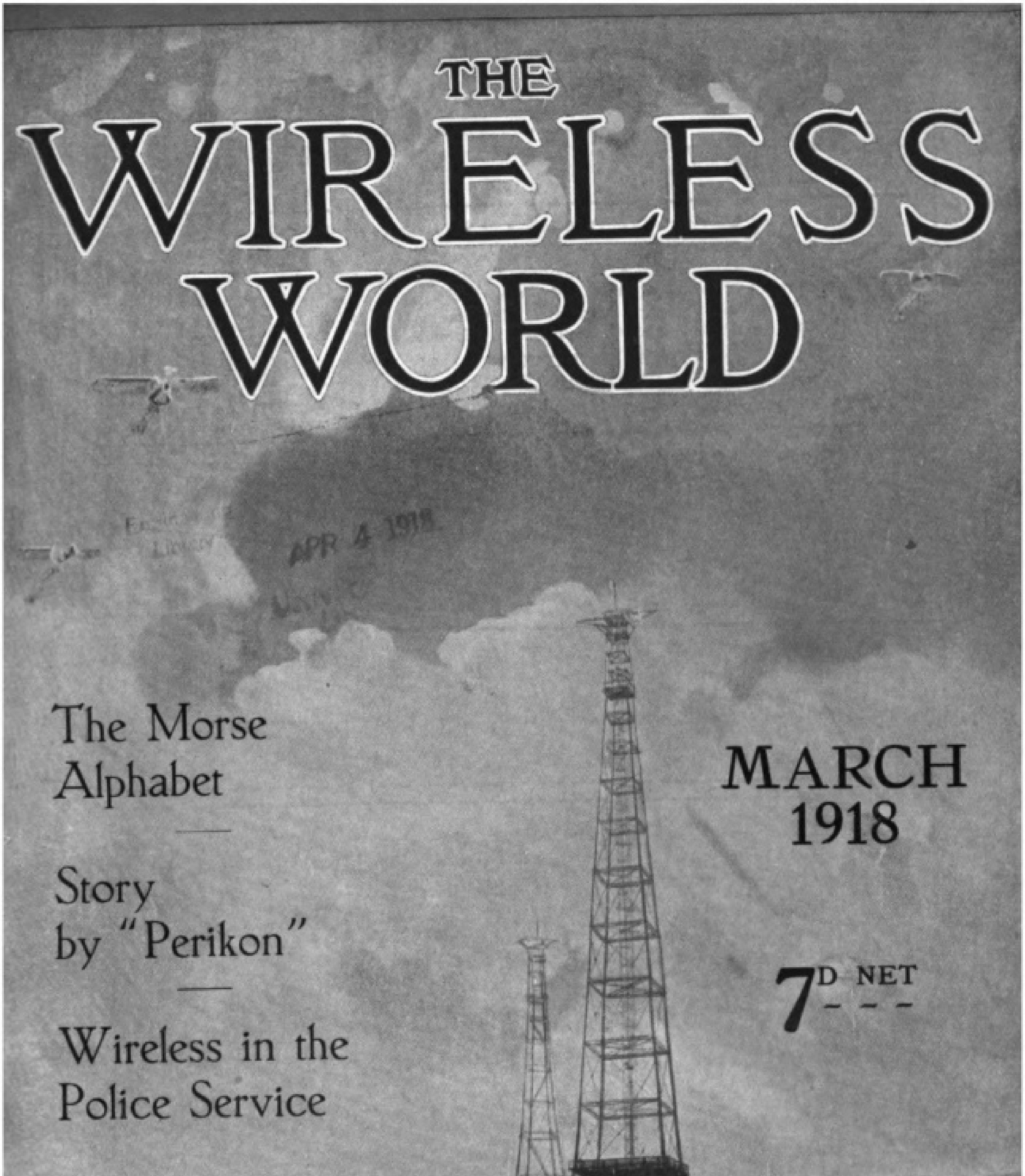
THE
WIRELESS
WORLD
APR 4 1918
The Morse Alphabet
Story by "Perikon"
Wireless in the Police Service
MARCH 1918
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The
WIRELESS WORLD

Volume V. No. 60. MARCH, 1918

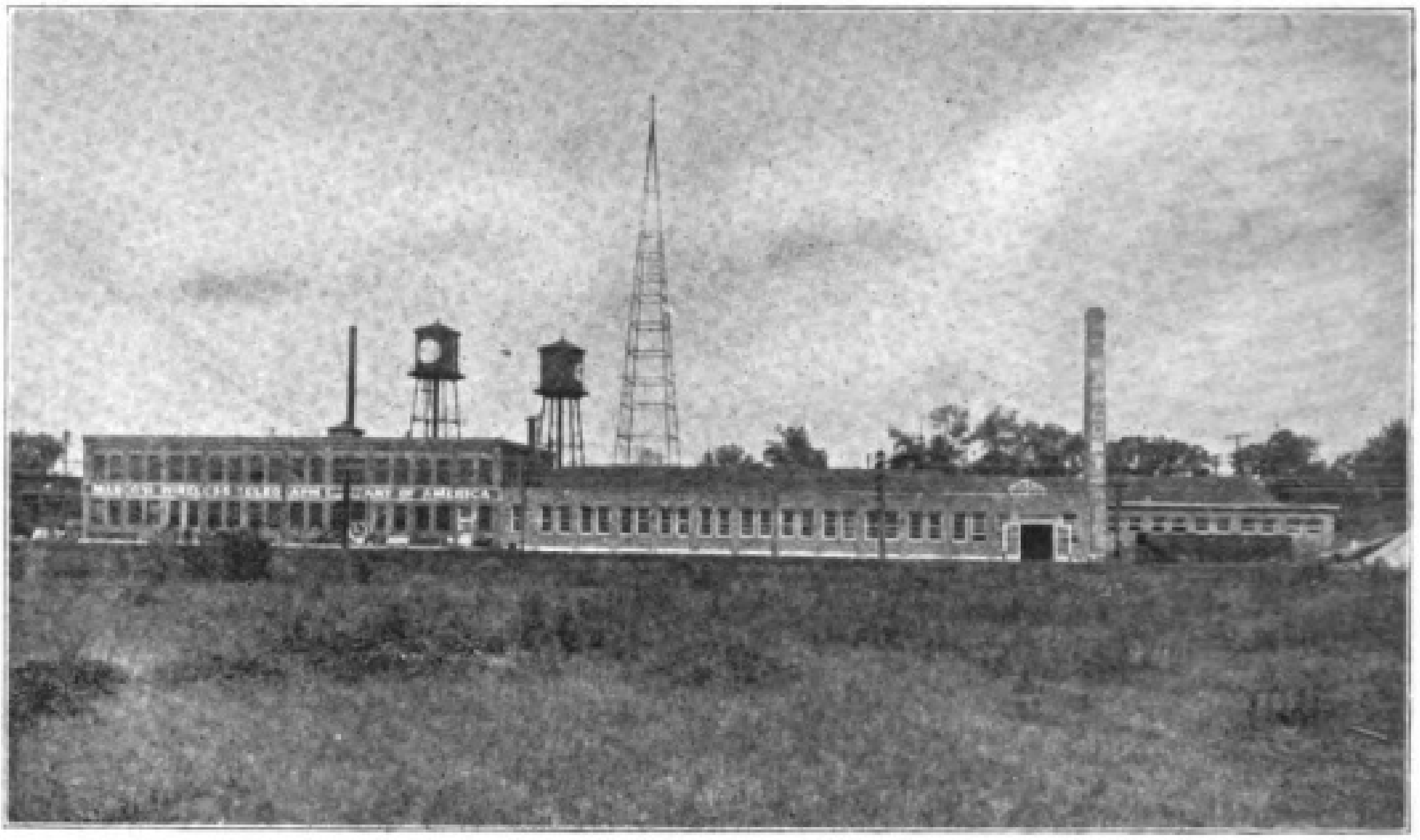
War-Time Progress in the United States

The New Marconi Works at Aldene, New Jersey

ONE of the most marvellous features of this war has been the reorganisation of industry to fit in with the new conditions which have arisen. The marvellous work of the Ministry of Munitions in this country, in organising the engineering talent of the United Kingdom for the production of shells and munitions of war, is known and appreciated by everyone, and it is only to be hoped that the return to peace conditions will be carried out as expeditiously.

Long before their entry into the world conflict, the United States had organised a campaign of preparedness, profiting greatly by the experience of Great Britain in these matters, and compiling vast quantities of statistics with but one end in view—the rapid production of munitions in case of necessity. This work was so well done, that, from the first day of their participation in the war, our Western ally was able to go ahead on the right lines.

In view of the enormous importance of wireless telegraphy, when the war came, the United States Government took from the Marconi Wireless Telegraph Company of America all available sets of apparatus, and called for the rapid production of a thousand or so more. The company's plant at Aldene, New Jersey,



A GENERAL VIEW OF THE WORKS.

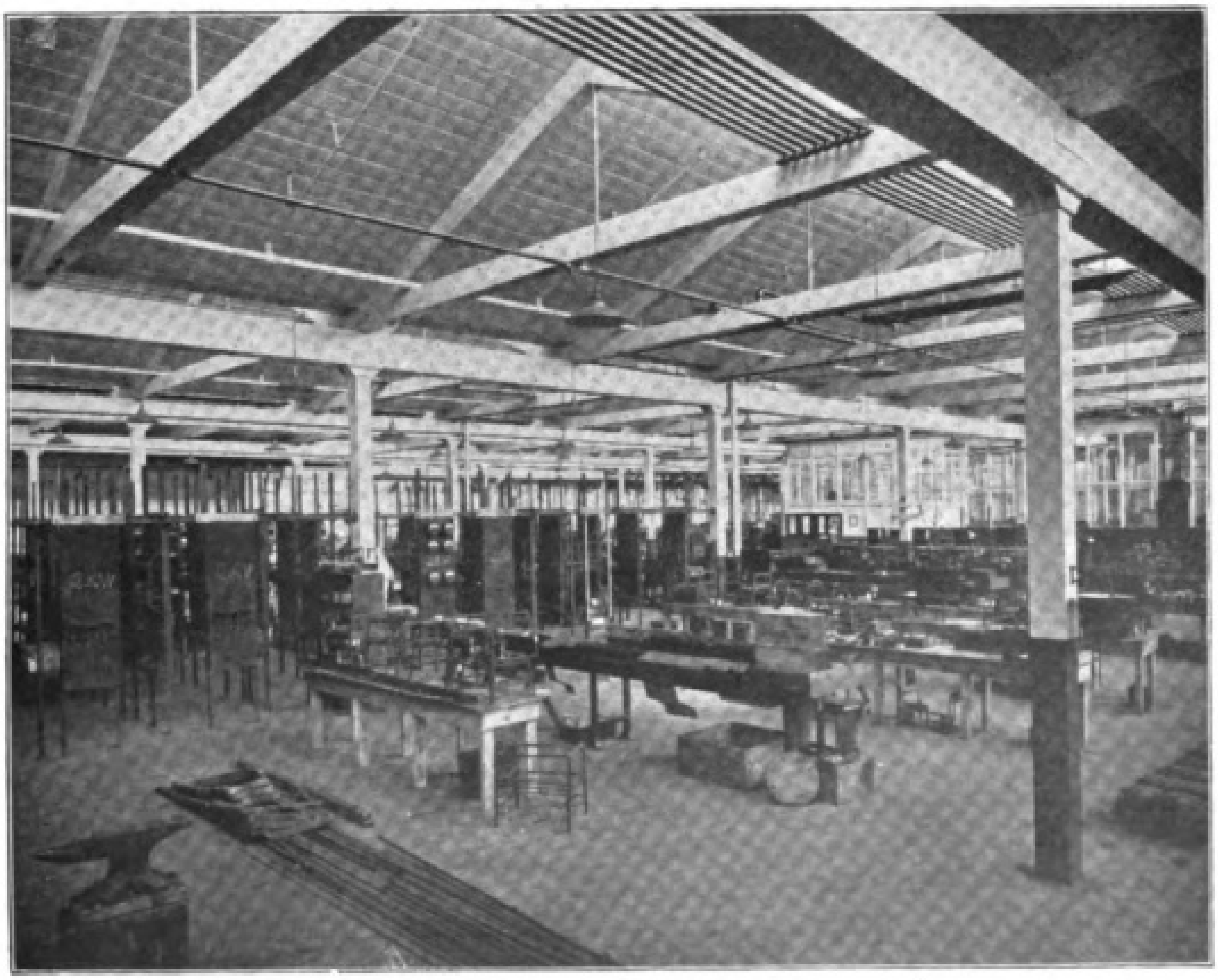
while well equipped for normal orders, was quite inadequate for such a great demand. It would have been impossible to have arisen to this great national need had not the company called to its aid the wizard of efficiency. There was no time to be lost. The work of additions to the factory; the perfection of new machines, new jigs and new models; the training of mechanics to a new and highly specialised calling—all had to be carried on at once, and so, from May 1st last, there started a building of large and important extensions to the factory, a task which was completed in record time, with the result that the works has been turning out apparatus on a large scale for some months.

To the uninitiated the first scenes would appear to be of the greatest disorder. Cartloads of bricks, piles of wood, great mounds of cement bags, all appeared overnight. Carpenters, masons, mechanics, engineers, and electricians arrived from all parts like so many tourists on an overnight train. On May 1st the old works were surrounded by neat lawns and well-laid out gardens; next day the landscape was so disordered—hundreds of workmen feverishly cutting up the ground and digging for foundations—that a soldier from the front might have thought that he was back again in the bombarded regions of France. Day and night men worked on, foundations being laid and brick walls reared on them with the utmost speed. The new buildings were to cover 40,000 feet more of ground space, and as the work progressed they were seen to be well-lighted structures resembling a series of studios rather than industrial works, for long ago it was found that good lighting means high efficiency, and efficiency was the goal at which all were aiming.

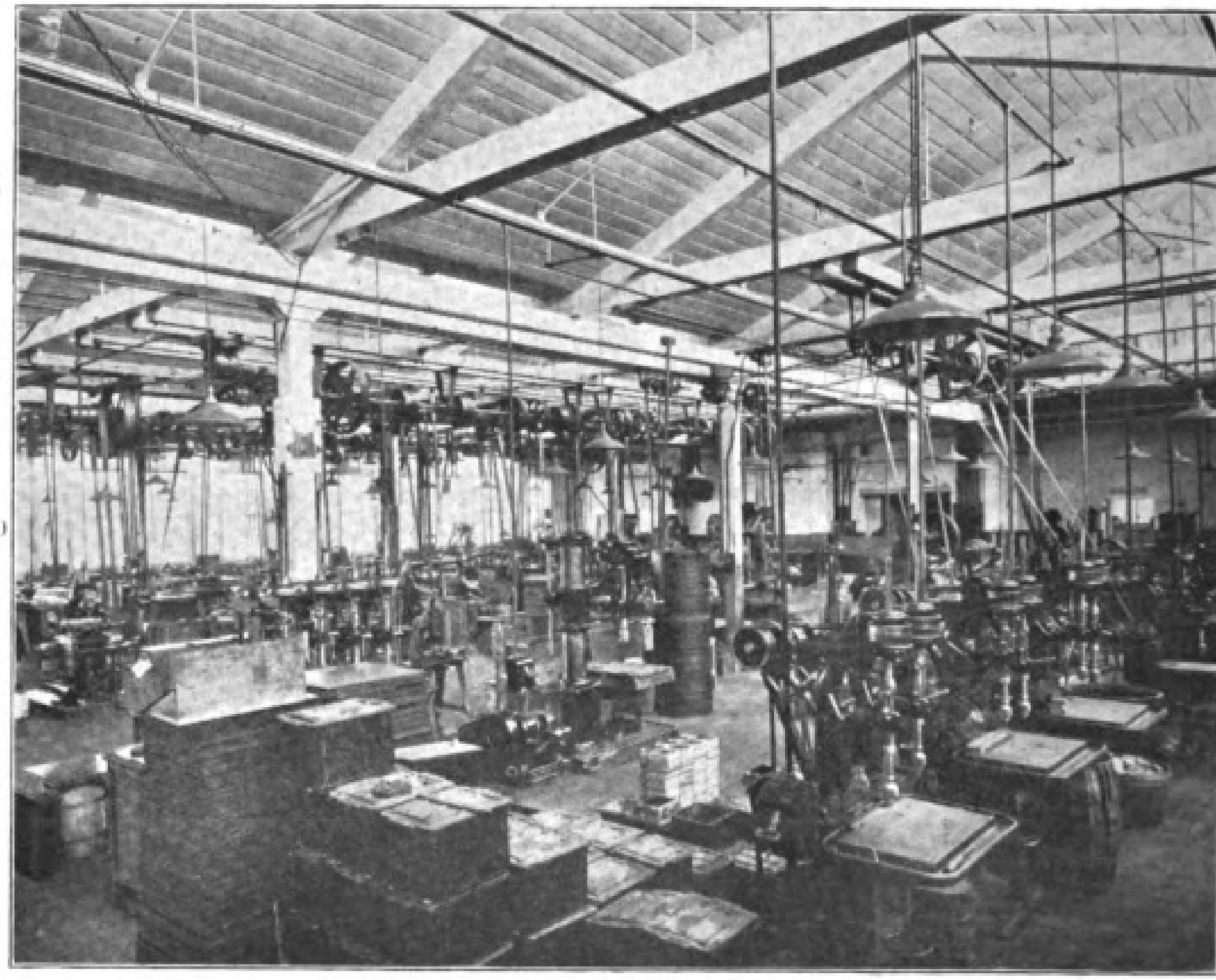
As the work progressed, new machinery was fitted in place with a speed which appalled some of the older lathe hands. These men, recruited from all parts of the country, were startled to see a group of carpenters nailing down a floor as though they were mad, rather than respectable craftsmen, and to see another frenzied crew slide a lathe upon the freshly planed surface, while others were rigging up belts; but these soon absorbed the spirit of rush. More than 700 men, working in two shifts, are now engaged. Some were once making gauges and callipers; others were adept in fashioning motor cars or sewing machines; others again were accustomed to brass work for the manipulation of ebonite. All of them, however, soon adapted themselves to the highly specialised work.

The Marconi engineers were faced with many problems in making the hundreds of sets ordered by the Government. The Federal authorities wanted apparatus adapted to wave-lengths different from those used on ordinary commercial apparatus, and this fact alone meant that many of the designs, and consequently the tools, had to be altered, as sets were required for aeroplanes, for destroyers, for submarines, for battleships and for colliers; all of which had to have their own patents before a single one could be turned out from the works. It is greatly to their credit that skilled workmen, brought to the new factory from all parts and all tasks, were able to progress with their work—while carpenters were sawing alongside, masons rattling their trowels in the next unit, and roofers hammering and stamping overhead, as though trying to show that each and every one of them was the most industrious in erecting the wireless works.

Of all the thousands of parts, large and small, which go to the making up of



ONE OF THE ASSEMBLING SHOPS.



A DRILLING SHOP.

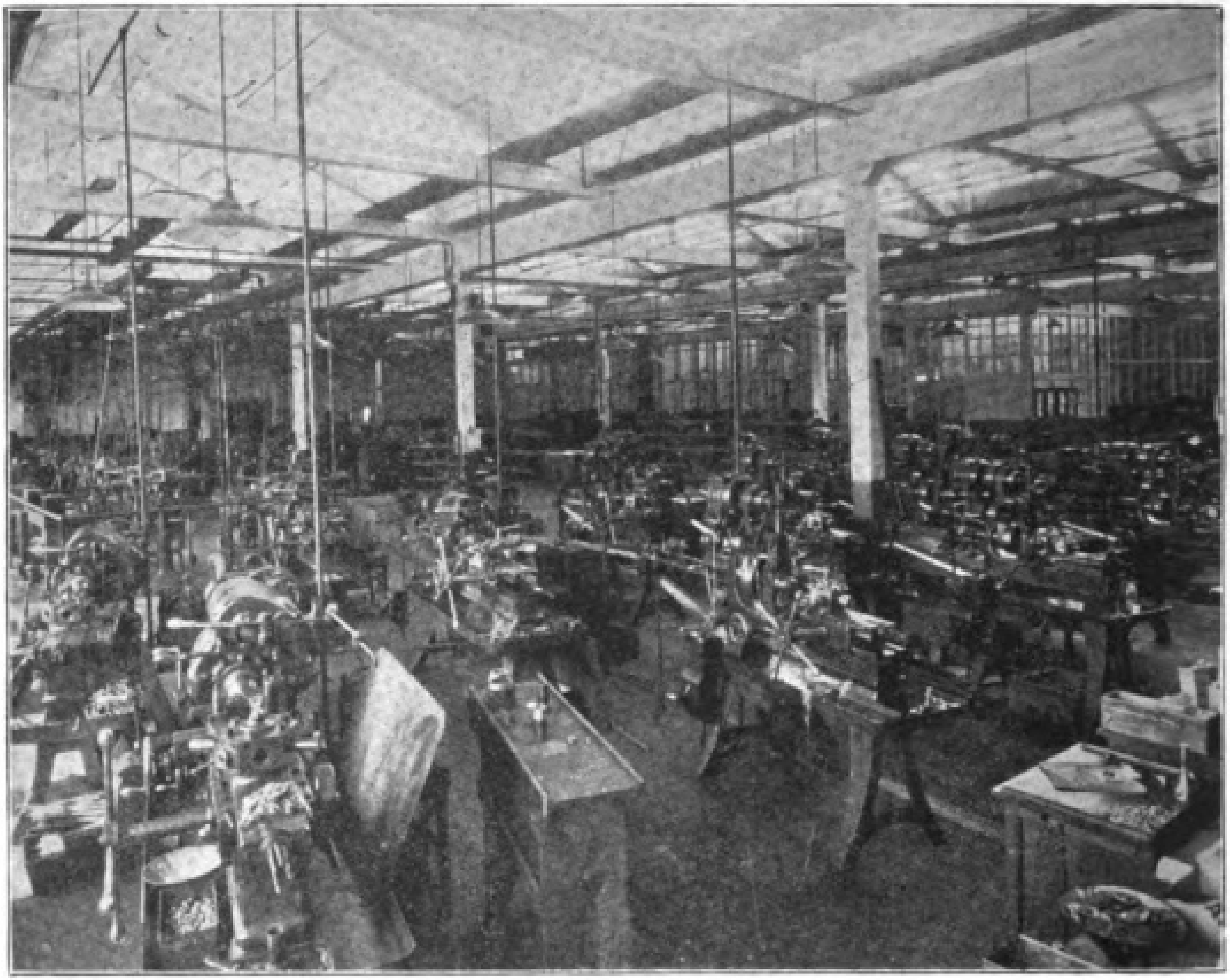
wireless sets, scarcely any can be bought in the open market. Screws and nuts, bolts, copper, aluminium, iron, steel and wire, which enter into the composition, are all made according to Government standard, and the process of standardisation itself was one which might have taken months had there been time to wait.

The plans in the making of a wireless set are numerous and intricate. Practically everything which goes in at the receiving end of the great plant is raw material. This makes its way through many operations into a delicately adjusted instrument, which does marvellous work in communicating by ether waves. All the raw material looks very much alike at the start, and one cannot tell whether it will emerge as a dainty aeroplane set, or some of the giant transmitters able to ring their signals across the Atlantic with but little effort. Operations of manufacture are legion, and by the time a set of apparatus emerges at the discharging end, the models and materials have passed through the hands of many hundreds of toilers, working day and night, and almost around the clock.

Some of the types of wireless sets which are being developed at the Aldene works are, to the visitor, unlike anything which has ever been fashioned before. That is evident in the dextrous manipulation of strange tools which are everywhere seen in the plant, and in the array of square jigs which are being carried out along rows of benches and lathes. Here we see a skilled mechanic mounting steel nickel bars into the frame for a new type of aeroplane set. There we see others preparing the frames for apparatus to be used on the submarine, destroyer, or the battleship. Side by side with the small sets may be seen a black panelled contrivance which before long will be talking from the wireless cabin of a Dreadnought. In order to manufacture all this apparatus, it was necessary to convert many of the standard machines to unaccustomed uses; the turning out of copper plates on the lathes, for instance, where iron castings or such materials were machined, is a very difficult job, but the difficulties have been overcome satisfactorily. As an example of the organisation, we may say that there are sixteen machines, end to end, on which are being turned the continuously threaded screws used in some of the more delicate tuners. Turret lathes, here and there, are performing their ingenious tasks so deftly, that they seem even to ignore the guidance of the skilful hands which drive them. Everywhere are bundles of rods, of brass sheets, of aluminium, and copper foil, emerging from machines as parts of the instruments which are to take such an important part in the great world warfare. Wonderful as is the mechanical ingenuity displayed, there is nothing automatic in the way in which the able mechanics go about their toil as the processes grow, step by step, more complicated. The same amount of enthusiasm is shown by girls and women, who are winding the miles of fine wire for the inductances of the various tuning devices. Side by side, we can see old and young women serving in the factory, while their husbands and sons, maybe, are enlisted in the fighting services of the country.

A WOMAN WAR-WORKER.

The extension of the manufacture of wireless sets has brought into play all manner of factory efficiency methods. This applies especially to the great stock rooms, wherein hundreds of separate compartments are piled up with the different sections of the various sets; motor generators, transformers, starters, gap switches, aerial ammeters, rheostats, and so on, are waiting in their stations ready to be fitted in place by the assemblers so actively engaged on their task. Owing to the highly developed system in the assembling, the widely



A TURNING SHOP.

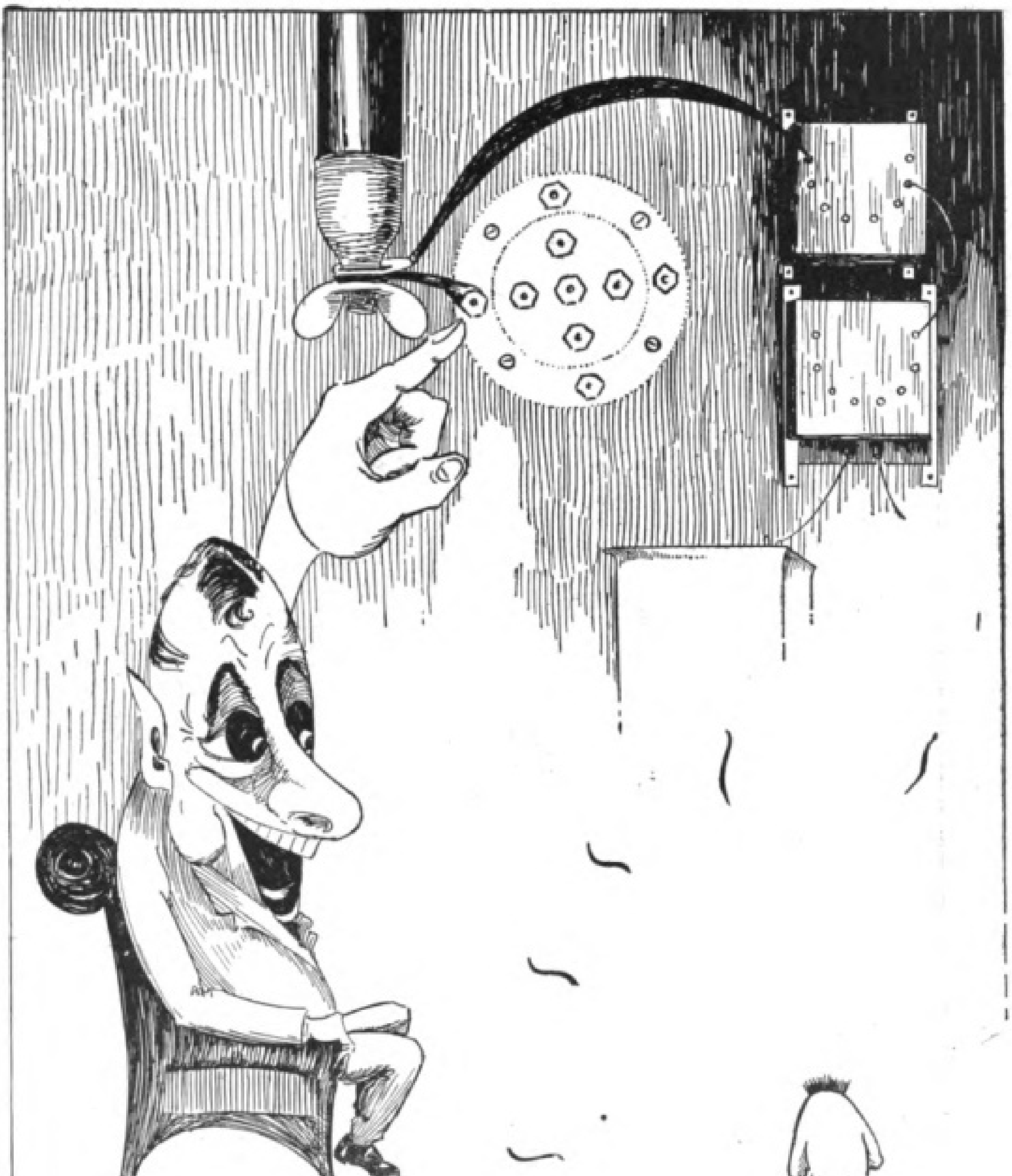
separated sections are joined with a rapidity which is startling to the uninitiated. As soon as the sets are completed they are transported to the testing rooms, where, under conditions approximately the same as are found in practice, they are tried out and thoroughly tested.

Not the least important part of the whole works is the drawing office, situated in a remodelled part of the factory which was the old building. Here we find keen young Americans from the schools of technology, and the drafting rooms of other great manufacturing plants. Among them is one who, only a few months ago, was a wireless operator, but by intensive study has fitted himself for one of the best positions in the employ of the company.

Commodious quarters for the men, and well-appointed rest rooms for women and girls, are, of course, provided in common with the best American practice, so that the staff is thoroughly well provided for.

Our illustrations give a good idea of the appearance and organisation of this new factory. In the first picture will be seen a general view of the works, the two-storied building, occupying about a third of the picture on the left, being the original factory. The other pictures to a large extent explain themselves.

EXAMINATION TRIALS



"Caught." An Earth Arrest.

PERSONALITIES IN THE WIRELESS WORLD

MR. CHARLES JACKSON PANNILL

PROFITING by the experience of her European Ally, the United States lost no time on her entry into the great conflict in exercising careful control of all wireless work, both amateur and commercial. This month we are able to give our readers a portrait and biographical particulars of Mr. Charles Jackson Pannill, Assistant to the Director of Naval Communications and the official in charge of the Commercial Radio Service. Mr. Pannill was born in Petersburg, Va., on May 13th, 1879. At 19 years of age he entered the United States Navy during the Spanish-American War, and was made Chief Telegraphist of the United States Coast Signal Service. In 1902 he entered the service of Professor Reginald A. Fessenden, at Old Point, and conducted experiments in radio communication across Hampton Roads. In the following year Mr. Pannill installed the first overland communication by wireless between New York and Philadelphia, and also installed the first radio outfit on a United States battleship. Later, he took part in the experiments conducted between stations of the General Electric Company at Lynn, Schenectady, and also between Brant Rock, Mass., and Machrihanish, in Scotland. Operators will be interested to hear that Mr. Pannill is the proud possessor of Commercial First Grade Licence No. 1.

In 1909 he entered the services of the United Wireless Telegraph Company as Division Superintendent, installing shore radio stations on the Great Lakes, and later taking charge of the division South of New York. When the Marconi Wireless Telegraph Company of America took over the United Wireless Telegraph Company, Mr. Pannill was made Superintendent of the Southern Division. In 1914 he re-entered the service of the United States Government as expert Radio Aid, being attached to the Naval Radio Service at Arlington. In April of last year he was promoted to the position he now holds.

Mr. Pannill is a member of the Washington Society of Engineers, a member of the Geographical Society, and the possessor of a Fellowship in the Institute of Radio Engineers.

The Valve as an Amplifier

By "D. J." (J. SCOTT TAGGART)

III.

In the two previous articles we showed how a valve may be used to amplify low-frequency current variations and also how it may be employed as a magnifier of high-frequency oscillations.

So far we have discussed low and high-frequency amplification separately. As a matter of fact, however, a single valve frequently carries out both functions at the same time, especially when used as a detector, which means to say that, in addition to low-frequency rectified pulses, a valve may produce in its sheath circuit high-frequency oscillations.

In Fig. 14 we see a typical example of a valve being used, at one and the same time, as an amplifier of high and low-frequency currents (or currents of radio and audio frequency as they are sometimes called when speaking of them in this connection). High-frequency varying potentials on the grid set up magnified oscillations in the sheath oscillatory circuit. These are then rectified by a crystal detector, the resultant pulses passing through the high-resistance primary of a step-up transformer which is connected so that induced pulses of even greater voltage are made to influence the grid of the valve. The pulses are therefore magnified in the sheath circuit of the valve where they operate a pair of high-resistance telephones, which are shunted by a small fixed condenser and, together with the high-tension battery, afford an easy path for the high-frequency oscillations which are taking place simultaneously in the sheath circuit.

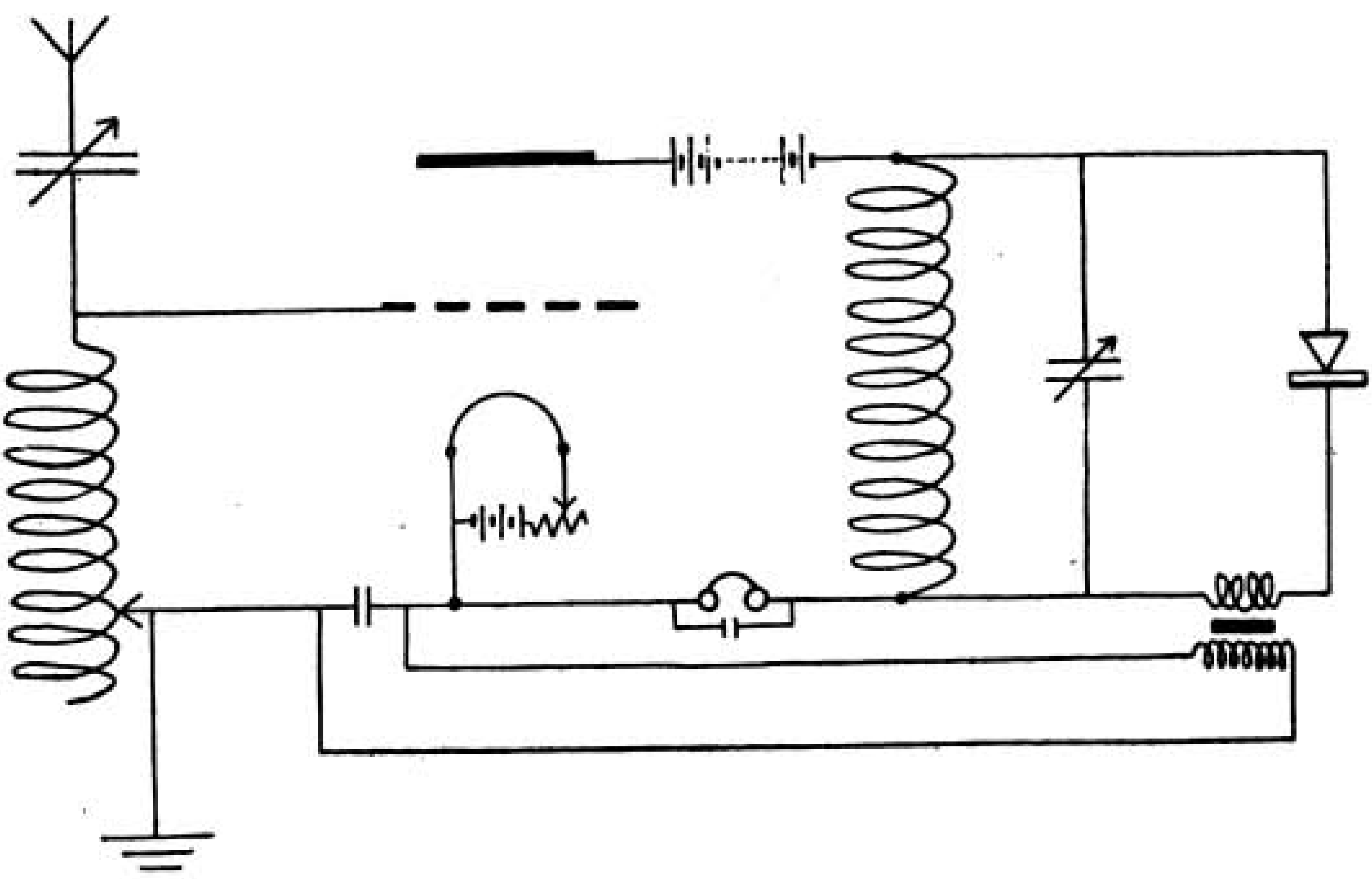


FIG. 14.

We now come to a third form of amplifying obtained by means of a valve, generally termed reaction-amplification.

This form of amplification is particularly useful for the reception of weak signals, since by its means we are able to strengthen the original oscillations in the aerial circuit or closed circuit of the receiver. Most detectors used in wireless have characteristic curves with blunt rectifying bends. This, of course, means that small variations of potential across the detector due to weak signals will produce practically no rectification effects. It is therefore desirable to make each oscillation of the incoming wave-train of as great an amplitude as possible. This is accomplished to a large extent by the reaction method of amplifying.

Let us consider again the case where we used the valve purely as an amplifier of received oscillations. An example of this was shown in Fig. 8. By utilising the amplifying properties of the valve we can produce in a sheath oscillatory circuit oscillations of the same frequency but of greater amplitude. Moreover, these amplified oscillations are exactly in time with the original ones.

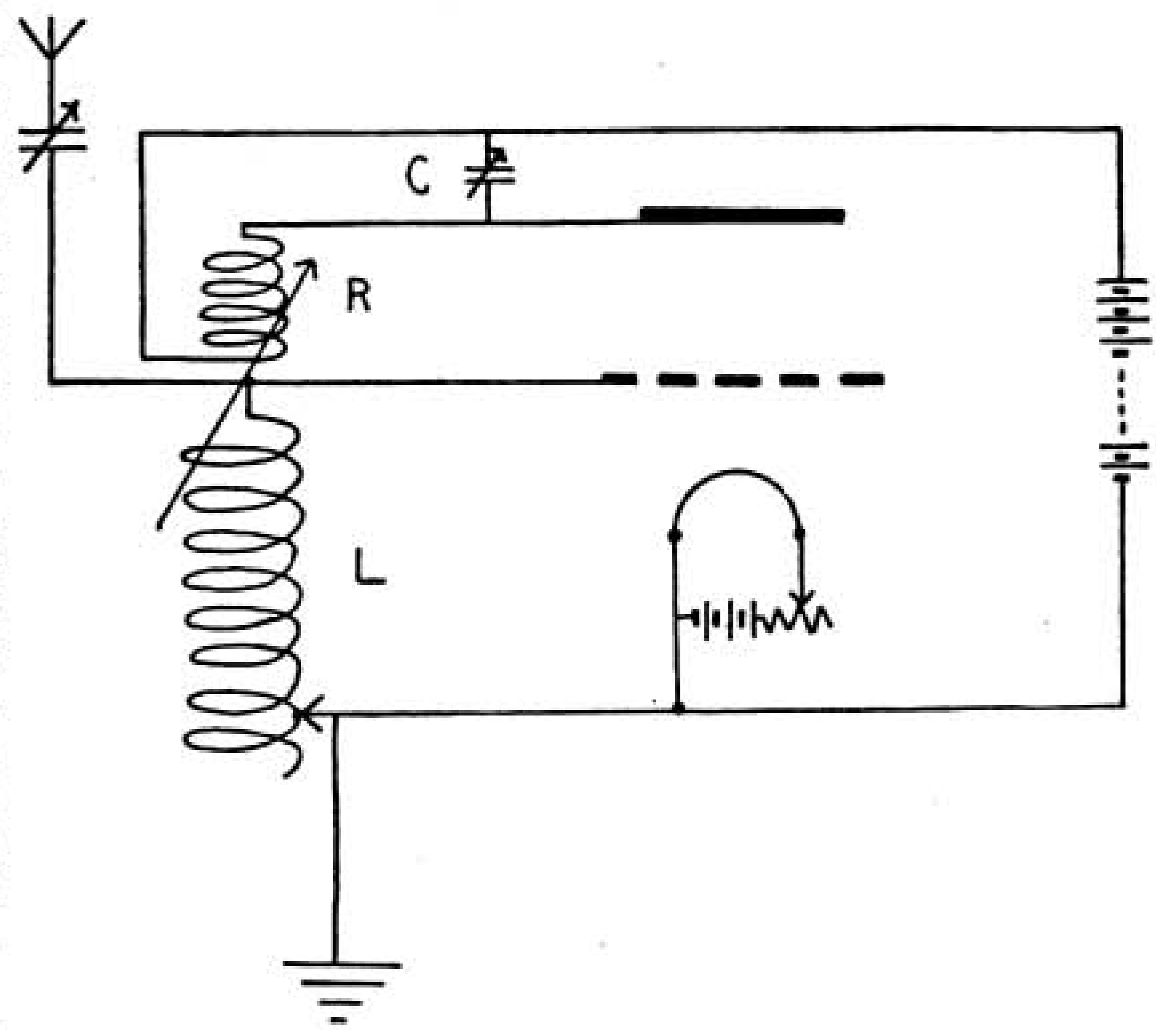


FIG. 15.

We can now use the sheath circuit oscillations, which represent energy from the high-tension battery, to induce back into the aerial circuit. One method of doing this is shown in Fig. 15. The coil *R* is the inductance coil of the sheath oscillatory circuit and is coupled to the aerial tuning inductance *L*. This coil *R* is generally termed a reactance or reaction coil, and its relative position to the coil *L* is variable. The frequency of the sheath circuit is shown variable by means of the condenser *C*. Frequently, however, when no detector circuit is connected to it the sheath oscillatory circuit is made aperiodic and consists simply of a fixed inductance.

Let us see now what takes place when a train of waves set up oscillations in the aerial circuit. Varying E.M.F.'s are produced across the inductance *L*, which, by altering the relative potential of grid and filament, set up stronger oscillations in *R*. Since this coil *R* is coupled to the coil *L*, the magnetic field produced by the currents in *R* will also embrace the coil *L* to an extent depending upon the coupling between the coils. Oscillations will therefore be superimposed on the original oscillations and, being in phase with the latter, will greatly strengthen them. If the coupling be loose between the coils *R* and *L* the superimposed E.M.F.'s will be small and very little extra magnification will be obtained. If, however, we tighten the coupling the oscillations in R will greatly strengthen those in *L*, which, in turn, through the amplifying action of the valve, will produce still stronger oscillations in *R*. The process repeats itself, and the weak original signals become strong enough to affect a detector and give good results in the telephones.

Another way of looking at this phenomenon is to regard reaction-amplifying as a means of lessening the damping of received oscillations. A wave-train sets up in an aerial circuit oscillations somewhat similar to those shown on the top line of Fig. 16. The oscillations, on account of magnetic losses, resistance, etc., die down comparatively quickly, and a long interval of time elapses before the next train of waves sets up a similar group of oscillations. In the figure the two consecutive groups are shown much closer together than if the diagram were drawn to scale. The time taken for the oscillations to die down is taken to be about $\frac{1}{50,000}$ sec., assuming the wave-length to be 600 metres and 10 the number of complete oscillations in each group. We can also take the interval of time between each group as being $\frac{1}{500}$ sec., the actual time depending upon the spark frequency of the sending station. From this we see that the time occupied by the group of oscillations to die down is $\frac{1}{50}$ of the time which elapses between each group. It would be possible, therefore, to keep the oscillations swinging for a very much longer time before dying out, while still keeping each group absolutely distinct. If this can be accomplished it is clear that far more energy will be available, when the group is rectified, for giving an audible signal in the telephones.

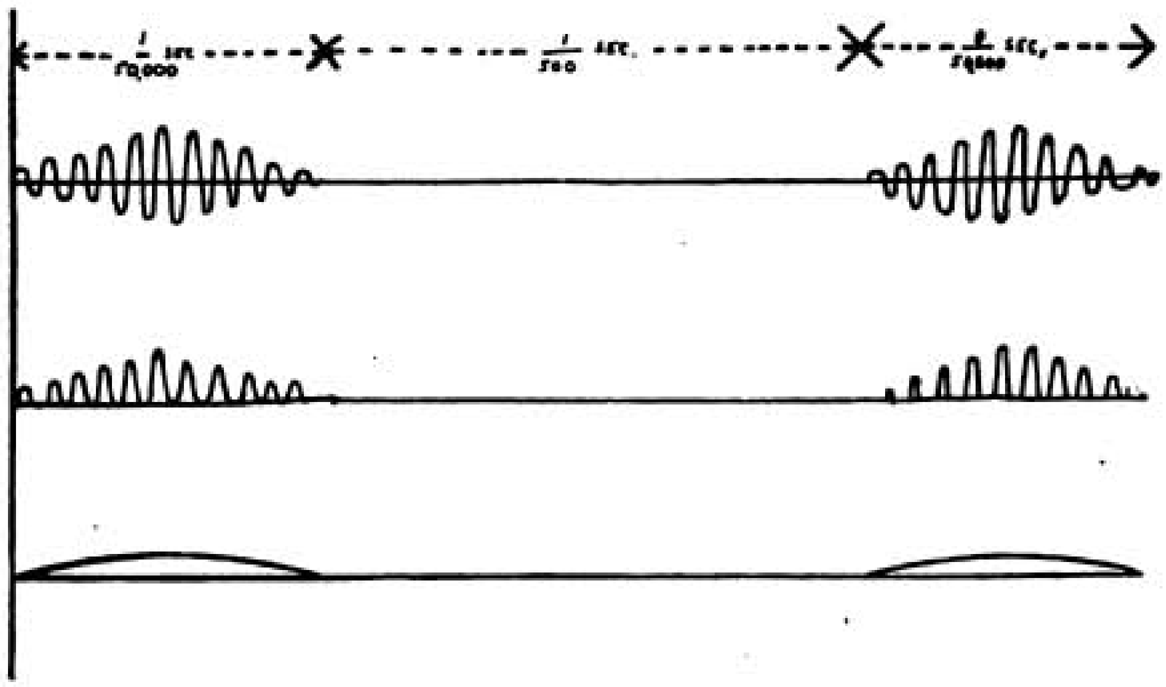


FIG. 16.

With the advent of the three-electrode valve, Franklin suggested its use as a means of prolonging this oscillating period of a group of oscillations, and its use for this purpose, described here as reaction-amplifying, is one of the great steps in the improvement of wireless reception which the valve has enabled us to take.

Let us suppose the coupling between the coils *R* and *L* is zero; oscillations in *L* produce similar oscillations in *R*, and, since each group dies out comparatively quickly in the aerial circuit, the same will be the case in the sheath circuit. Now let us set the coupling fairly loose: the change of current in the sheath circuit at every half-oscillation will give the oscillations in the aerial circuit a slight fillip in the right direction at exactly the right moment, and so keep the system oscillating for a considerably long period. The fillips, however, are not strong enough to maintain the oscillations, so that as a result they die out before the next wave-train comes along and repeats the process. Fig. 17 illustrates this, and, like Fig. 16, also shows theoretically the rectified oscillations and the effect of the low frequency pulses on the telephone diaphragm.

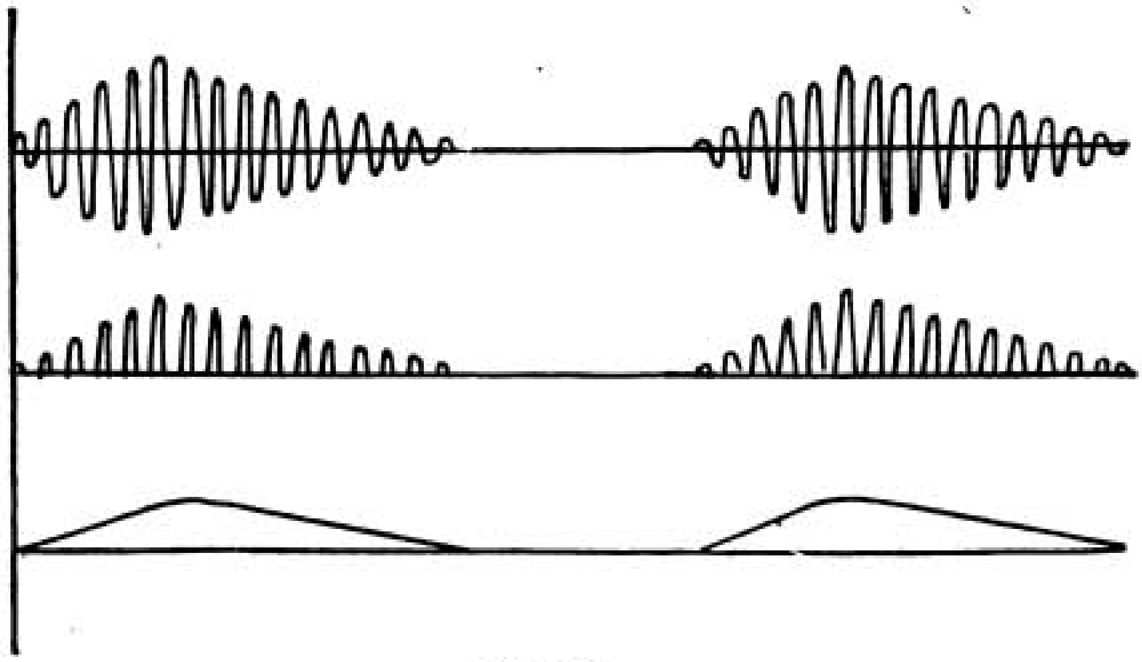


FIG. 17.

To understand reaction effects we can use the old analogy of a pendulum. The swinging pendulum represents the oscillations in the aerial circuit which, normally, would soon stop. By giving the pendulum a slight assisting tap at the end of each swing, and if we arrange to make the tap we give weaker every time, the pendulum will swing for a much longer period, but will finally stop. In the circuit we are discussing, the periodical and regular increase and decrease of sheath circuit current correspond to the taps we give the pendulum. Just as the taps are produced by outside energy, so are the signals strengthened by local energy in the form of current from the high-tension battery.

As we tighten the coupling between *R* and *L* the damping of the oscillations becomes less and less, until finally the fillips are strong enough to keep the circuits oscillating continuously without any decrement of the oscillations. The groups are no longer distinct, and, even if the sending station were to stop sending, the circuits would continue to oscillate and support the oscillations in each other.

In practice we gradually tighten the coupling between the reaction coil and the grid circuit coil, so that the valve just fails to oscillate of its own accord. When this condition is obtained the helping action of the valve is only brought into force when actual signals arrive and each group of oscillations has time to subside before the next one is set up.

Having set up oscillations in the coil *R* which are stronger and less damped than the original ones, our next object is to rectify them. This we can do by means of a crystal detector, as shown in Fig. 18. This circuit, although arranged differently, is exactly the same in principle as Fig. 15, with a crystal detector as rectifier. If we connected a detector circuit across the coil *L* much better results would be obtained than if no reaction effects were employed; we connect the detector circuit, however, across the coil *R* because the oscillations in that coil, having been amplified, are always stronger than those in *L*.

If desired, a separate valve adjusted to its rectifying point may be used as a detector.

A much simpler method, and one which gives good results, is to use the valve as detector and reaction-amplifier combined. This can be accomplished by including a pair of 'phones in the sheath circuit of the valve. By trying the effect of a grid condenser and varying the filament current and high-tension voltage good signals can always be obtained. Suitable connections are shown in Fig. 19. As usual, a small condenser is connected across the 'phones as a path for the oscillations. Care should be taken with regard to the reaction coil *R*, so that the oscillations in it do not *oppose* those in *L*.

It is interesting to notice the effect of gradually tightening the coupling of the reaction coil in a circuit such as that shown in Fig. 18. When the coupling is loose the signals heard are comparatively weak but clear. As we tighten the coupling the signals gradually become louder and louder, but also begin to lose their distinctive note. Just before the valve begins to oscillate the signals are strong but somewhat hoarse. As we tighten the coupling a click is generally heard which indicates that the valve is oscillating of its own accord. Signals are still heard, but the principle of their reception is entirely different and causes all signals to be very hoarse whatever their original spark-frequency. If the coupling is tightened still further a shrieking noise is frequently heard, due to the establishment of two sets

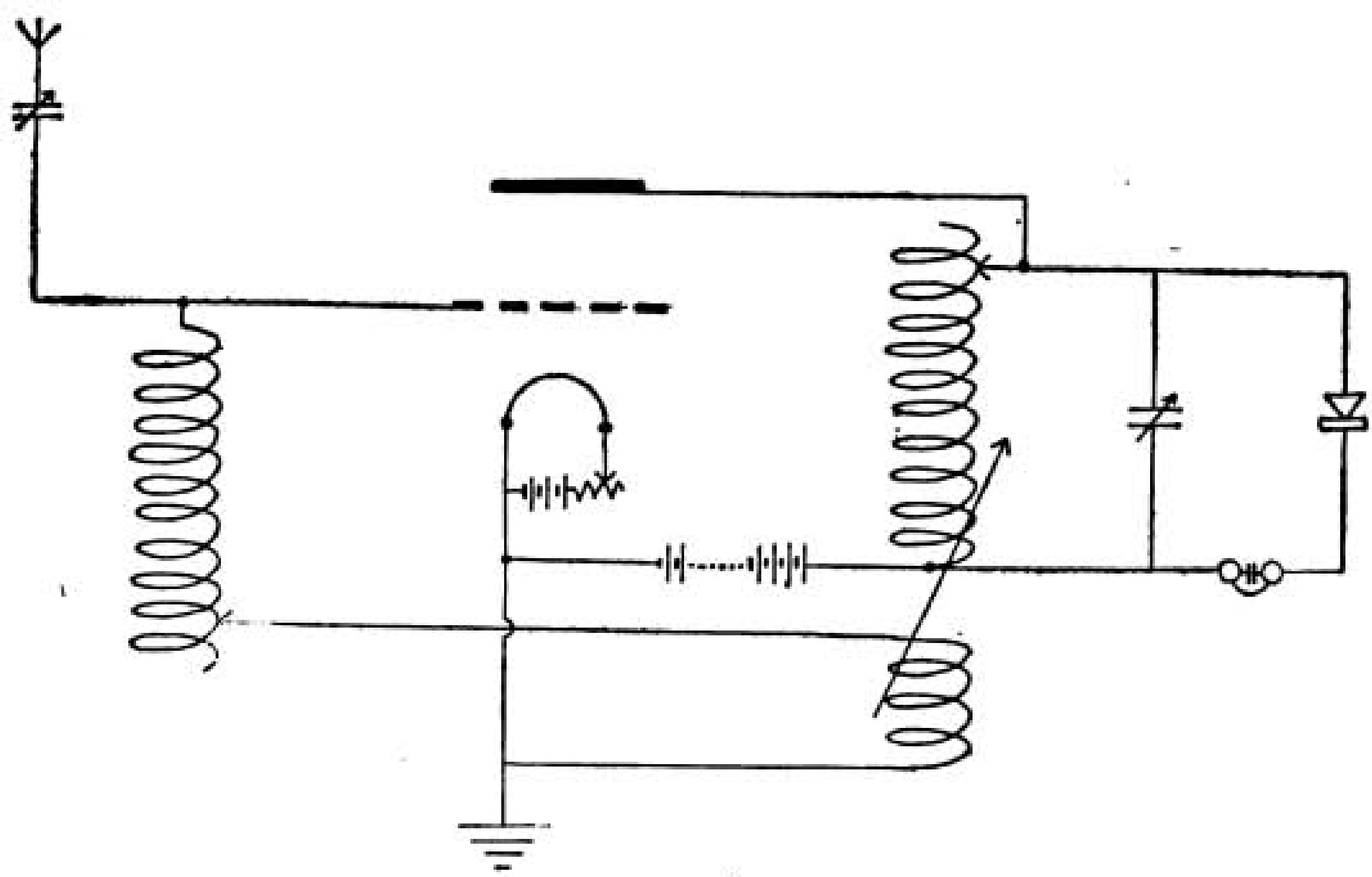


FIG. 18.

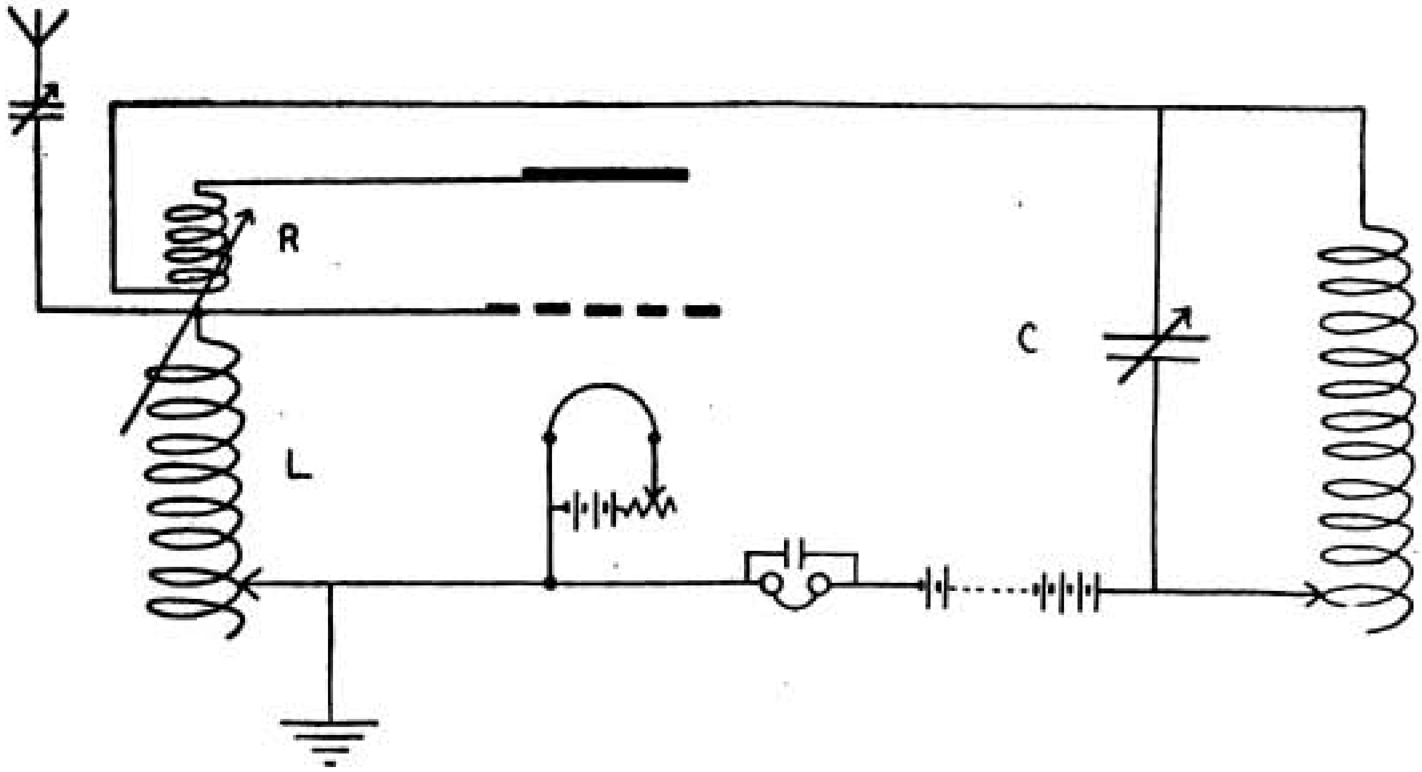


FIG. 19.

of continuous oscillations in the valve circuits which interfere and produce audible beats. Incoming signals will combine with these beats and produce loud signals, which, however, are drowned by the continuous howling of the valve.

Without varying the medium coupling of the reaction coil, we are also able to affect the tendency the valve has to oscillate by increasing or decreasing the filament current or high-tension voltage applied to the valve. An increase of either will often make a valve pass through the stages previous to continuous oscillations until it commences to oscillate of its own accord.

It is frequently desirable to know whether such a circuit is oscillating of its own accord or not. A suitable test is to bring an oscillating wavemeter, the design of which was discussed by the writer in the October and December issues, within range of your circuit. On turning the condenser of the wavemeter so as to " cut through " the wave-length of the receiving circuit a distinct chirp will be heard in the telephones of the receiver if the valve of the latter is oscillating.

We have now considered the valve in three of its capacities. An attempt has been made to show these three functions separately as much as possible, and also to show *typical* methods of combining these functions. Working on the principles illustrated here an infinite number of circuits have been and may be devised. On account of the present desirability of secrecy the writer is limited to circuits and principles already well known. These, however, are sufficient to serve as an elementary basis for a fuller conception of the use of valves in this particular direction.

Experimental results and the objects aimed at decide largely the type of circuit which is to prove most suitable. For example, if we have loud signals already, we have no need to employ any form of amplification. We could endeavour instead to eliminate interference, and if in the process we cut down the strength of our signals this can be made up by low-frequency amplification. If, on the other hand, we want to produce very loud signals for, say, demonstration purposes or for operating recording instruments we can use low-frequency amplifying apparatus, although it must be remembered that interference, etc., is amplified at the same time. High-frequency amplification has fewer disadvantages in many ways, though needing more careful adjustment of circuits. A circuit of the type shown in Fig. 12 is especially useful on account of its selectivity. If on an ordinary circuit signals of an interfering station were a quarter the strength of the real signals, the use of a circuit similar to the one shown in Fig. 12 would bring the strength of the interfering signals down to one-sixteenth that of the desired signals. The ratio of strengths is the square of the previous ratio; hence the particular selectivity of this method.

For very faint signals reaction amplification is most suitable. Signals which cannot be heard on an ordinary circuit in spite of attempts at low-frequency amplification can frequently be heard if reaction-amplifying is adopted. Afterwards, if desired, low-frequency amplification may be used to magnify these signals when obtained.

Except in special cases it is undesirable to make a single valve carry out too many functions at once, partly because of the increased difficulty of adjustment and design and partly because the best conditions for the different functions are not always the same, as in the case of rectification and amplification.

Throughout these articles methods have been shown of rectifying either by means of some form of crystal detector or by means of a valve. The former is perhaps the more sensitive, but the latter is the more reliable, and any loss of signal strength can always be made up by some form of amplification.

Another principle adopted has been that of showing valves in series rather than in cascade. This has been done for the sake of simplicity, though in actual practice the circuits are arranged as far as possible to allow for the use of one lighting accumulator and one high-tension battery.

Although any combination may be tried, for weak signals it is perhaps best first to strengthen the original oscillations by high-frequency amplification, combined, if desired, with reaction-amplifying; this may then be followed by valve rectification, followed in turn by low-frequency amplification. Whatever combinations may be decided upon, they can be based on the types illustrated, keeping in mind the general principles involved.

A Keen Young Applicant

Among the hundreds of applications for free training received by the Marconi Company many amusing letters are received. A recent communication read as follows:

"Dear Sir,—I would like to learn wirelessing out at sea and to save my flag from being put in the gutter by the Germans. Send me a letter by Saturday night, please.—Yours faithfully . . ."

Digest of Wireless Literature

Discharges Between Unlike Metals.

In a paper by D. L. Rich, in the *Physical Review*, some interesting particulars were given regarding oscillatory spark discharges between unlike metals. Many photographs of the oscillatory spark discharge between electrodes mechanically alike and chemically different were taken, in an attempt to determine whether or not the material of the electrodes has any influence on the initiation of the discharge. Electrodes of copper, iron, zinc, and bismuth were used, also both alternating currents and intermittent direct currents were employed in producing the required potential differences. The photographs were taken on a film wrapped round a wheel 40 cm. in diameter, which was driven at 2,000 revolutions per minute, and the lens moving across the film caused the record of the discharges to trace out a continuous spiral of about 20 complete controls. This spark gap was under continuous observation for over half a second at a time, showing the groups of spark trains in over 60 consecutive half cycles, in a single line photograph over 25 metres long. The relative number of spark trains per half cycle and the relative number of sparks per train indicated that the Cu + Fe − Discharge takes place more readily than the Cu − Fe + Discharge. When the electrodes were alike, symmetrical discharges were always found. When the electrodes were of two unlike metals, decided rectification effects were afterwards produced, being very pronounced when copper was one of the electrodes and most prominent when iron was the electrode. In other words, the material of the electrodes is not a negligible factor in the initiation of the discharge. If the discharge is electronic the electrons are emitted from iron more easily than from bismuth or zinc, and much more easily than from copper ; from bismuth more easily than from zinc, and from zinc more easily than from copper, so that the four metals can be arranged in a rectification series Fe, Bi, Zn, Cu. The rectification effects seem marked and consistent throughout, whatever shape the electrodes might have. All the experiments were in air and at ordinary atmospheric pressure (Science Abstracts).

Wireless on Railways.

At the meeting of the Institute of Radio Engineers held in New York on December 5th, Dr. F. H. Millener, Research Engineer, Union Pacific Railroad, Omaha, Neb., delivered a paper on Radiotelegraphy and Telephony between movable bodies on and over land, in which he gave a résumé of the research work undertaken by him for the Union Pacific Railway during the period of 1906 to 1916 inclusive. The purpose of the investigation was to find a method of signalling the cab of a locomotive or communicating with a train without interfering in any manner with the right-of-way or placing any obstruction upon it. For purposes of experiment an electric storage battery truck made by the Westinghouse Manufacturing Company and equipped with an aerial was utilised. The first great difficulty experienced was the securing of a good earth connection. In the early experiments the coherer was used, but the telephone and detector were afterwards substituted. In the first experiments a 60-cycle closed core transformer, a rotary spark gap, and a tin-foil condenser were used. It was found from these tests that it was possible to hear the high-pitched note of the stations above the strays. Dr. Millener gave a detailed account, with illustrations of the construction of the aerials. In railroad working, he said, it is absolutely necessary to have the aerials close and compact, and there is no doubt that the flat-topped antenna is the most practical for everyday use. It was found that placing the masts parallel with and close to the tracks was of great assistance in working east or west, and in transmitting over the mountains the rails seemed to assist transmission. For short wavelengths the spark method was found to carry farthest with the least amount of energy, and for long wavelengths the arc method. The radio laboratory car was constructed from a coach originally used as a dining saloon, the aerial containing thirty-one wires. At one end of the car was provided a telescopic mast, which could be erected if it was desired to use the car as a telegraph office to transmit over greater distances than was possible with the antenna on the car. In receiving signals, fair success is attained at the present time by using a powerful amplifying relay which is really a powerful telephone transmitter with associated circuits of special design.

Dr. Millener's paper was discussed by Dr. A. N. Goldsmith, David Sarnoff and J. L. Hogan, Junr. Mr. Sarnoff summarised the experiences of railroad wireless on the Lackawanna Railway.

Storage Batteries for Three-Electrode Valves.

Dr. Miller Rees Hutchison, in a paper recently delivered before the Institute of Radio Engineers, describes a new form of storage battery for use with electron relays. It is a well-known fact, said the author, that the " wing " circuit of an electron relay must be energised by a source of electrical energy entirely free from pulsation of electromotive force. Notwithstanding the splendid work which has been done in " ironing out " the commutator ripples by dynamo-electric machines, there are frequent periods when, owing to any one of a number of causes, non-periodic pulsations result which seriously affect the operations of the relay. It is for this reason that batteries both primary and secondary have been satisfactory sources of electrical energy for the " wing " circuit.

Until recently batteries of miniature dry cells have been employed and have proved to be fairly satisfactory when absolutely new ones can be readily obtained from the factories, but such cells have a comparatively short period of usefulness, produce a " frying " sound in the receiver when polarisation of the elements occurs, and are relatively expensive because of the necessity of frequent substitution by new ones. These disadvantages are pronounced on shipboard, where the dampness makes the life of such a battery particularly short and uncertain, where the unreliability of any piece of apparatus is emphasised, and where a reserve stock of dry cells cannot be depended upon because of their rapid deterioration at sea. With long cruises this uncertainty is of considerable moment.

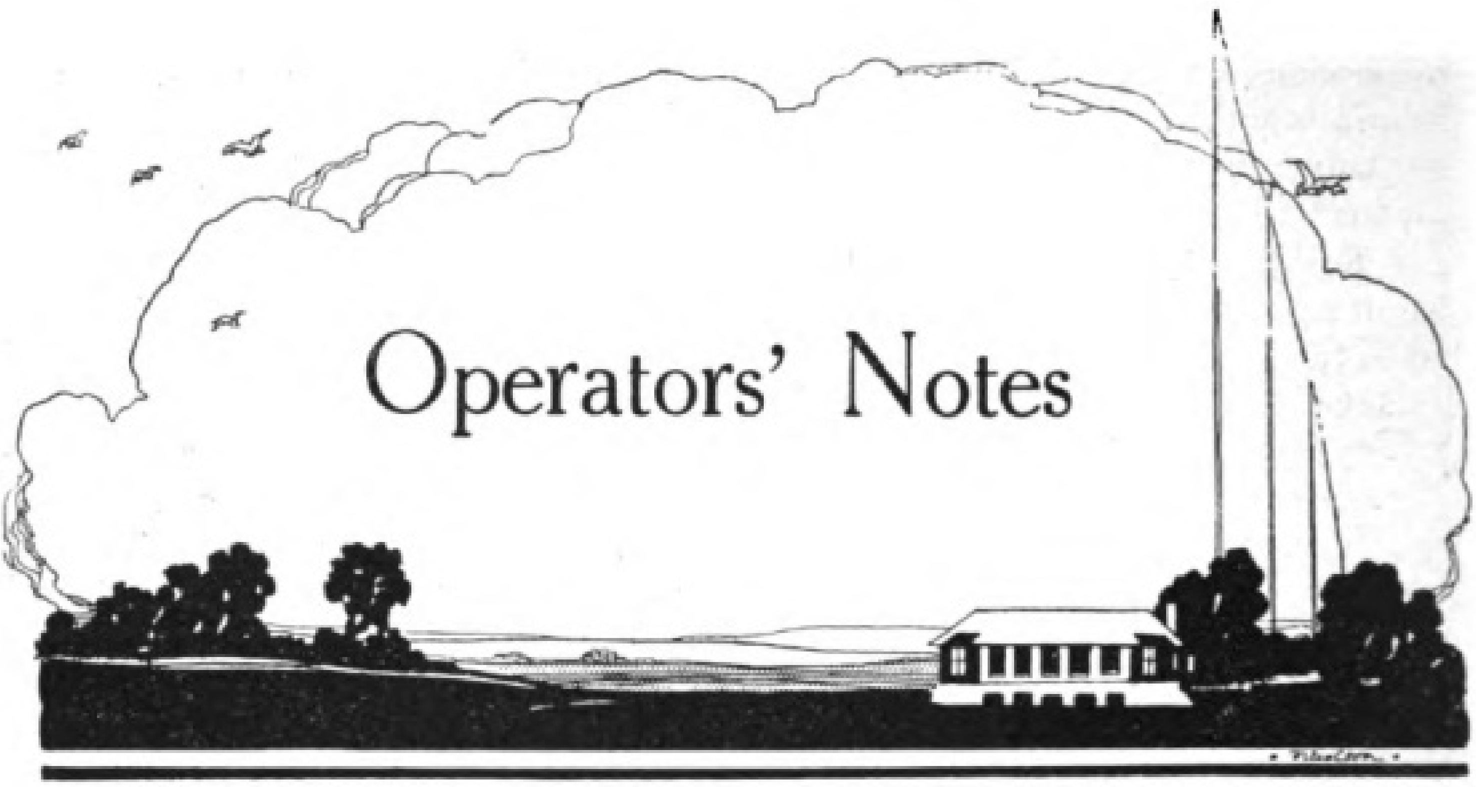
About a year ago radio engineers and those upon whom devolves the responsibility of maintaining radio apparatus at remote land stations and on board ships cast about for a more dependable and more economical battery for this service. Dr. Hutchison's attention was first called to this demand by Professor Alfred Goldsmith, who, having used storage batteries in the radiotelegraphic and telephonic laboratories of the College of the City of New York, was familiar with their robustness and dependability. A special storage cell was thereupon developed, and several batteries of these cells were sent to Professor Goldsmith for an extensive series of tests. After due time, and a few minor changes commercially, a valuable battery appeared incorporated with a standard size storage battery for heating the filament. Both have proved highly satisfactory in practical service and have been adopted as the standard for electron relay service by at least one Government.

A battery of any kind for use in radio work must, above all things, be dependable, even when subjected to the greatest of all abuse—neglect. Of course, when under the eye of a trained battery expert, almost any kind of a storage battery will give good service if the demand upon it is such as does not necessitate robustness ; but small units, widely scattered and in the hands of many who may be entirely unskilled in storage battery practice, seldom receive more attention than an occasional charge (which may be a prolonged overcharge at excessively high rates) and the replenishment of the solution with distilled water from time to time. In very small cells the total liquid content is not sufficient to fill the smallest hydrometer ; therefore the specific gravity of such a cell cannot well be ascertained. It is, therefore, requisite that a type of battery which requires no hydrometer readings should be used, and that such a battery should also incorporate the virtue of not being injured by oft-repeated overcharging, or by standing idle for protracted periods in a charged, semi-charged, or in some cases totally discharged condition.

The battery described in the paper is of the Edison type, particulars of which have already been given in this magazine. In view of the fact that very small current is required from the cells they can be made very compact. In normal conditions the time of charge is five hours, but in an emergency the normal charging rate can be greatly exceeded without injuring the cell. The low discharge rate in the wing circuit enables a battery to run from several hundred to several thousand hours continuously on one charge, depending upon the characteristics of the relay bulb.

Long-Distance Wireless Reception in Australia

THE *Scientific Australian* reports that in a recent lecture Commander Cresswell, R.A.N., stated that wireless messages from Nauen, near Berlin, were regularly received in Australia. The messages were received at Sydney or Perth, according to the time. The signals travel better at night.



On Joining Your Ship.

Signing on.—The Board of Trade authorities require every person making the voyage who is not a passenger to sign the ship's articles. You cannot sail unless you do this. The signing on is done on a certain day at a certain place, the time and place varying according to when the ship sails and the particular line to which she belongs. The necessary information in these respects will either be supplied to you at your own headquarters, or you will be sent down to the ship to find it out. If you are sent to the ship, the chief officer is the right person to ask for the details you require. Failing the chief officer, ask the purser; failing the purser or his assistant, ask any officer in charge at the time.

Remember, that for signing on you must be punctual, and you must have your P.M.G. certificate with you.

If you visit your ship before sailing day, make sure you find out the day and the hour when she is due to leave. Also be certain that your cabin contains all the necessary stationery and spare parts; once you are at sea it will be too late to requisition.

Sailing Day.—Get on board in good time. If you do not know where the key of your cabin is kept, ask the chief officer, who, by the way, generally keeps it himself. Change into your uniform at once and present your letter of introduction to the captain if he is aboard and disengaged. Very often at this time he is busy with dock or Board of Trade officials, or with his owners. If such is the case, keep your letter till later. It will sometimes be necessary to keep it until the ship has sailed and the captain has left the bridge. In a later article will be considered the relations of the wireless operator with the other people on board, but at this stage it is necessary to advise the beginner, and more especially the youthful beginner, to employ the utmost courtesy and tact in his dealings with his captain (as also, of course, with everybody else), remembering that that person is not only in command, but that his authority partakes of the nature of an autocracy over a floating kingdom. So that, in introducing yourself, endeavour to create a good impression right from the beginning. In general, when dealing with the captain, especially on the bridge or in his cabin, you cannot do wrong if you say briefly what you need to say and then retire ; this does not imply that you are to be abrupt to the point of rudeness. In all things try to make your captain your careful study, remembering, however, that you have also a duty to your employer.

Resisting any temptation to lounge about the decks, you should at once see about preparing your station for service. On some ships the aerial has to be lowered when the cargo is worked and sometimes it is not replaced until the vessel has sailed. Whether or no, if your aerial has been lowered, ask the chief officer *if it is convenient* for it to be hoisted into position. He will have it done as soon as possible. Go " topside " and see that your aerial is properly stayed, insulated and connected to the " Bradfield." Then run over your installation, taking care that the connections are correct and tight, the spark-gap of the right width, the brushes of the converter in position and your emergency set in good trim. Test your receiving circuit by tuning in actual signals. Then arrange ready to hand such stationery as you will need for immediate work. Do not wait till you are offered a message before you begin to look for message forms and envelopes. You may have traffic to handle before the ship has been moving half an hour.

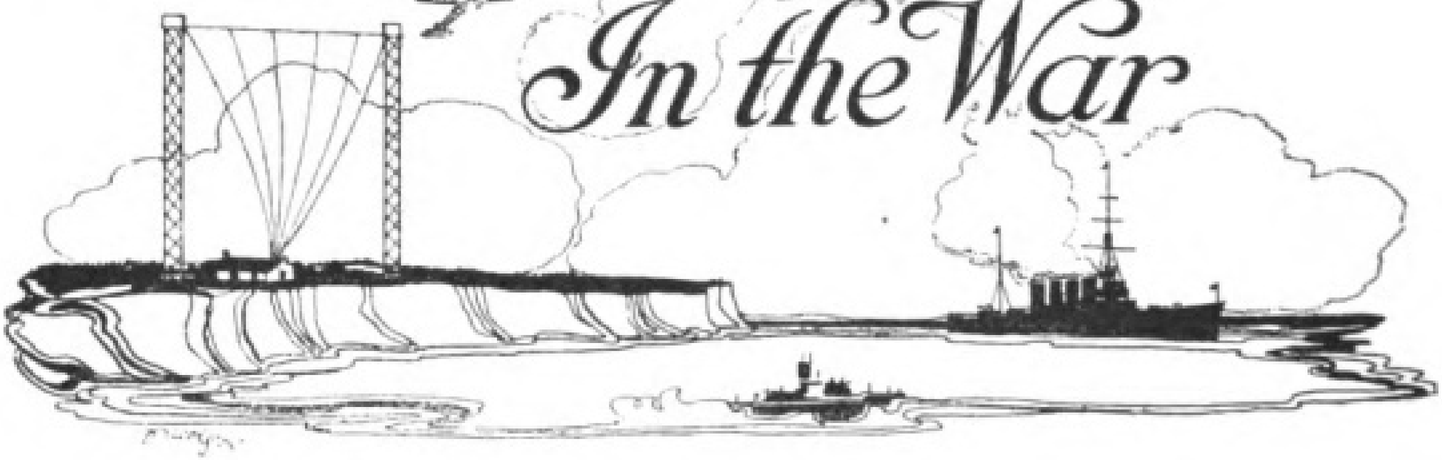
On most ships a general muster is held shortly before sailing. It is your business to find out when this takes place, on which deck, etc. Be punctual. If a definite place in the muster is not assigned to you take up a position amongst the officers, but recollect that even if you rejoice in the courtesy-title of junior officer, you are indeed a junior and will not, therefore, attempt to insinuate yourself between the chief officer and the first officer.

Muster over, it is a good plan to find out the hours for meals, and where you are to sit in the saloon. The best way is to go to the chief steward and ask him to tell or show you where your place is. You are advised to do these things *personally* on joining a new ship, in order to let yourself be known to the various departmental chiefs. Mind that you let yourself be known as an unassuming and unobtrusive person. Bombast may be all very well for the bo'sun, but sits badly on a wireless operator. There are other reasons why you should personally attend to these matters relevant to your own convenience. One is because you can secure greater satisfaction yourself than can a steward messenger. Another reason is that although your steward is intended to serve you, that is no excuse for not using your own legs. You must be considerate to stewards if you want respect and good service from them.

Aboard some ships the officers have their own bathroom and lavatory. The bath is used for the morning dip according to a fairly strict time-schedule. The captain, for instance, uses it at such and such a time, followed by the second officer, after whom comes the first officer, and so on. You must find out when the bathroom is vacant, fix your own bath time and stick to it. On the other hand, if there is no particular bathroom set apart for officers, you had better ascertain which bath you can use.

During the voyage you will have business to transact with the purser. Ask him to fix a regular day and hour for this, to suit his own convenience.

Wireless Telegraphy In the War



To Jerusalem under Difficulties.

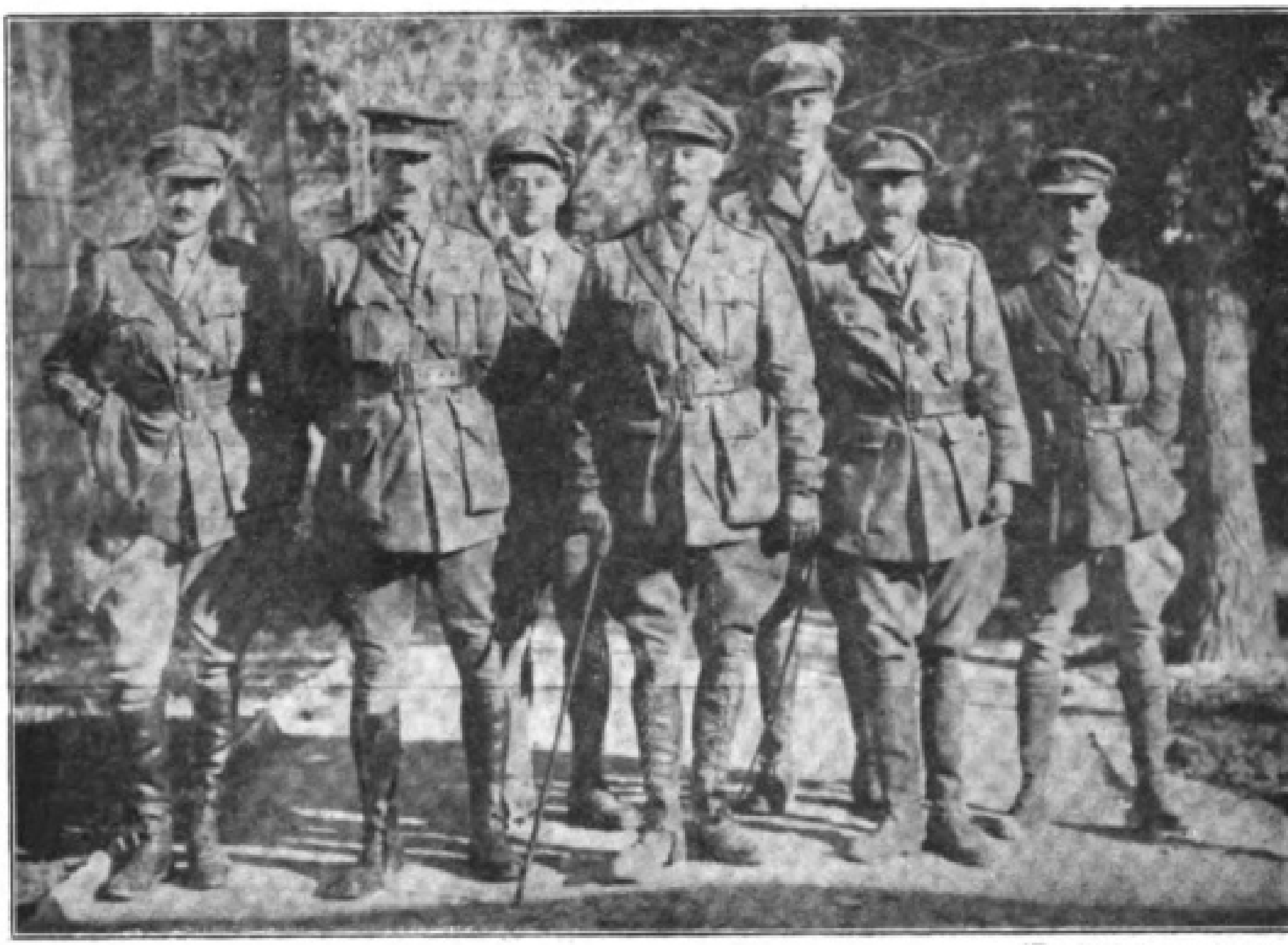
When in mid-December there was flashed around the world the glorious news of the fall of Jerusalem few stopped to picture for themselves the exceptional difficulties offered by the campaign. Compared of course with what was being done on the Western front its magnitude was of quite secondary importance, but the authorities undoubtedly exceeded all reasonable modesty in waiting several weeks before making known our soldiers' wonderful mastery of the strategic situation and the complete success which had attended our treatment of problems rich in exceptional difficulties.

Who would have imagined, for instance, until General Allenby's despatch provided the information, that 30,000 pack camels were required early in the advance for supplying with food, water and ammunition but *one portion* of the Eastern force operating towards Beersheba? The campaign is a triumph for engineers, and although we are not specifically informed of the use of "wireless," such use is practically certain, for amongst the preliminary operations intended to keep the Turks in doubt as to the real point of attack was a bombardment of Gaza by naval forces, British and French, under Rear-Admiral Jackson, and we all know by now that the "wireless" instruments on British battleships are not allowed to tarnish. Much very useful reconnaissance was performed by aeroplanes, and here again it is not impossible that "wireless" had a part. The Germans have asked the world to believe that the Palestinian campaign was an unimportant side-show of no real importance to the "matter in hand." Had the Germans captured 100 guns, more than 20,000,000 cartridges, a quarter of a million shells, besides an incidental 12,000 prisoners in an action so far from home, and across seas infested by enemy submarines, the Kaiser's publicity department would have worked overtime.

"Floandi" Wireless Log Helps Red Cross Fund.

We trust that the Imperial War Exhibition, which was opened at Burlington House, Piccadilly, early in January and has been drawing thousands whose interests are divided between the Red Cross Society and the many novel departures in the science and art of modern war, will not be disbanded until the great provincial centres have been visited. Amongst the relics of the maritime operations, legitimate and decidedly otherwise, are two exhibits of peculiar interest to wireless men.

The first is that of the water-sodden log of Douglas Morris, the young wireless operator of the drifter *Floandi*. Morris, it will be remembered, was actually writing up his log when an Austrian shell sent him to eternity. The pencil-mark across the riddled page tells its own tragic story and provides perpetual evidence of the devotion of a brave man to duty in face of certain death.



[*Topical Press Agency*.

GENERAL ALLENBY AND HIS STAFF IN JERUSALEM.

The other exhibit, equally stimulating to the imagination, is a German submarine buoy bearing the message, " Here is sunk U.C. 42. Please telegraph at once to submarine headquarters, Kiel." By telegraph of course the German means " wireless," for it is obvious that the unhappy victim of British vigilance would prefer some more expeditious method for making known to the authorities his truly " submarine " position than a telegraph message from Kiel harbour to Headquarters on the return of the finder of the tell-tale.

ANOTHER PLACE WHERE WIRELESS COUNTS.

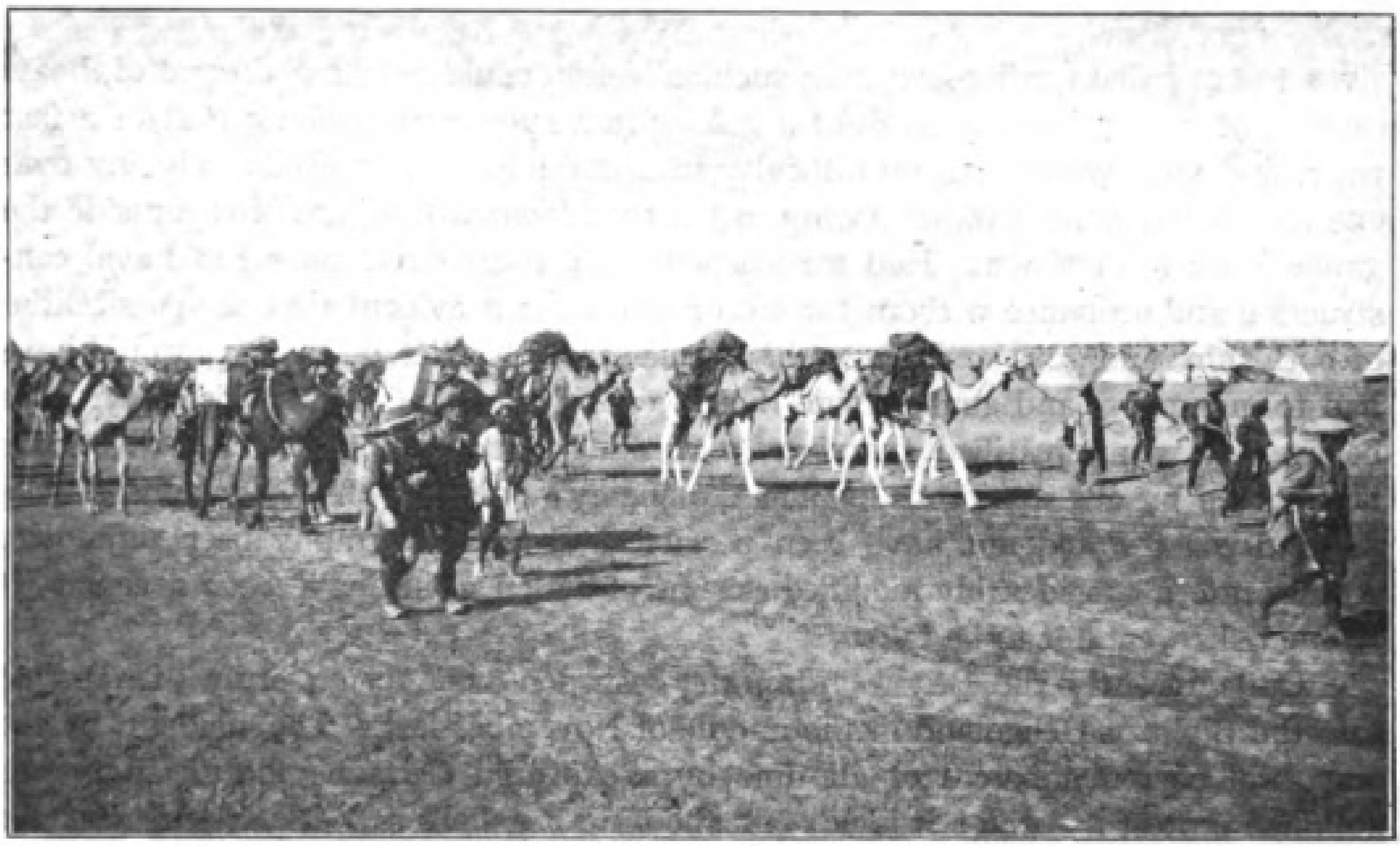
Our readers must have noted with gratification the official acknowledgment of their special utility, conveyed in so practical a manner through the new scale of pay and allowances for officers and warrant officers in the Observers Branch of the Royal Naval Air Service. The schedule allots to Observer Sub-Lieutenants and officers of higher rank the pay of their corresponding rank in the Royal Navy, and in addition ***eight shillings*** per day, payable continuously to those who are qualified in ***wireless telegraphy***, as against five shillings per day extra for those who are not so qualified. A proportionately higher rate of pay is also allotted to warrant officers qualified in "wireless." Those so qualified are to receive, in addition to the usual pay of their rank, four shillings per day as against three shillings per day for non-qualified men—a rare instance of a wireless development which is at the same moment "in the air" and an accomplished fact.

SECRECY AN ANTI-U-BOAT WEAPON.

Outside their own immediate duties there is naturally nothing of greater interest to wireless men at the moment than the progress of the anti-submarine campaign. We all therefore received with satisfaction the recent reassurance by the First Lord of the Admiralty, Sir Eric Geddes, that "the submarine is held"—in other words, that the methods now in vogue for U-boat destruction are ridding the seas of these pests apparently as fast as the German shipyards can construct new ones. No less gratifying, too, is Admiral Sir John Jellicoe's expression of belief that by August the submarine menace will not merely be held but mastered. Sir John need not question our ability to hold out until the autumn. The First Lord also spoke with confidence on another point of considerable importance—the effect which the British policy of secrecy is having on the moral of the German submarine crews. Sir Eric Geddes tells us that the average U-boat is no way equal in efficiency to the U-boat of twelve months ago, the difference being due in some measure to

[Topical Press Agency.

DJEMAL PASHA, TURKISH COMMANDER, AT HIS HEADQUARTERS IN PALESTINE. GERMAN NAVAL OR AIR OFFICERS ARE IN ATTENDANCE.



[*Photopress*.

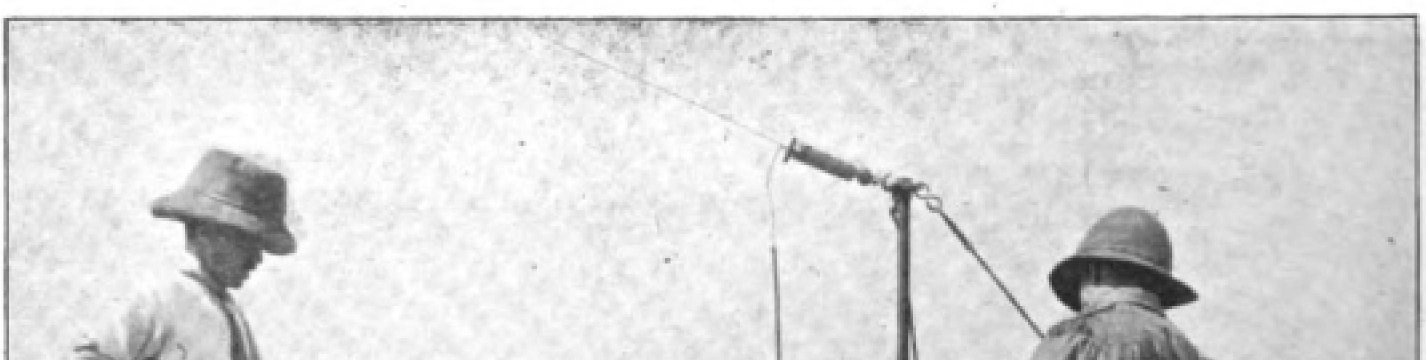
A CAMEL TRAIN CROSSING THE DESERT.

the wearing effect of suspense. Crew after crew sets out, and no more is heard of them. Not only is their fate uncertain, but, what is more trying from a naval point of view, there is no evidence of the type of trap into which they may have fallen. Whilst we have a hearty distaste for unnecessary secrecy (believing it to be a breeding ground of distrust) we are convinced the Admiralty's policy in this direction is the right one. Nothing wears like anxiety, and the fact that the German temperament is particularly susceptible in this direction is indicated by the various methods which they apply in their endeavour to create anxiety amongst the Allies. Hence the loud talk through the winter months of coming offensives and the oft-repeated threats of new varieties of "frightfulness." The ruthless submarine campaign was instituted, we are told, only after the possibilities and risks had been examined by a group of Germany's leading commercial men. One of these, Dr. Paul Reusch, of Oberhausen, a Royal Prussian Councillor of Commerce, held the view that the world only respects those who in a great crisis know how to make the most unscrupulous use of their power. Why, then, all the German protests when their U-boat heroes add to their "bag" another hospital ship, or one or two neutrals, who happen to be around when sport is going slow? Every wireless operator has a part in the anti-U-boat campaign. For the offensive of secrecy he is peculiarly fitted by his training. Marconi men therefore are justified in the belief that they have been an important factor in bringing about the position which inspires our First Lord with unmistakable confidence.

FLAGS, LAMP AND WIRELESS.

Very little imagination is required for appreciation of the important part which wireless plays on the tactical side of modern naval warfare. The engineer has given to our gallant sailors weapons such as Nelson could not have dreamt of, boats capable of riding into the teeth of a gale with a speed approaching that of a fast train, and guns which find no difficulty in accurately hurling shells weighing over one ton over distances which, owing to the earth's curvature, are often outside the gunner's range of vision. Had we reached the present development of naval construction and ordnance without the aid of wireless it is evident that the possibilities of both ships and guns would have been much more restricted, for ships would have had to manœuvre and guns confine their broadsides to the limits of visibility. We believe that we are justified, therefore, in claiming that many of the daring diversions undertaken by our squadrons against the enemy's outposts off Heligoland and the Jutland coast would not have been possible had radiotelegraphy been unknown. At any rate, a considerably modified scheme of action would have been necessary if undue risks were not to be taken.

Quite recently the British Admiralty issued a vivid pen picture of a thrust into the Bight of Heligoland in the middle of November last. The incident, by the way, will be remembered for all time by a captured German officer's angry but childlike protest: "Ach! it is not fair, shooting big shells at leetle ships." During that thrust our light cruisers, "mopping up" enemy outposts *en route*, conducted a running fight until Heligoland was but twenty-eight miles to the south-eastward and the outer fringe of the German minefields thirty miles astern. Then appeared



[Sport and General.

WITH THE ROYAL FLYING CORPS IN INDIA. RECEIVING A WIRELESS MESSAGE FROM AN AEROPLANE.

on the horizon the masts and funnels of a German battle squadron, and shortly afterwards a hail of big calibre shell—German big shell, be it noted, against British " leetle ships."

What followed we will give in the exact wording of the Admiralty's narrative :—" Turning simultaneously, the splinter-riddled little grey ships began their perilous retreat. Their task was accomplished ; they had drawn the big ships, ***and with flags, lamp and wireless*** the headlong pursuit was checked." Flags, lamp and wireless—how better could be expressed the positive, comparative and superlative of naval means of communication ! What a world of difference there would be in naval activity had we but flag and lamp as the only agent for putting into action the brilliant conceptions of our masters of naval strategy ! How indebted to " wireless," too, are the Germans for some of the wonderful escapes which they have been able to make from a decisive action !

German Wireless Developments at Nauen

The Latest Equipment

THE ***Frankfurter Zeitung*** recently devoted a special article to the Nauen wireless service, and said that it has immensely developed since the outbreak of war. Begun in 1916 with 35 h.p., it now has 1,000 h.p., permitting of a range of 10,000 kilometres (6,200 miles).

The plant is situated fifteen minutes' walk from Nauen, and covers 100 acres of ground, which is surrounded by a high wire fence. The principal building at Nauen, now being completed, has nine antennæ, two of which are 270 metres (891 feet high), and seven others vary in height from 120 to 150 metres.

Nauen, adds the German paper, has rendered the greatest services since the beginning of the war, especially, first, in linking up Germany with the Colonies, and then with North America.

The speed of transmission is shown by the example of one of von Bethmann-Hollweg's speeches in the Reichstag, early portions of which were received in America while the then Chancellor was still speaking.

In 1915 Nauen transmitted 1,330,000 words, in 1916 2,500,000 words, and up to September, 1917, 3,680,000. This rate of increase will certainly be maintained, for even after the war Germany for a time will have to content herself with wireless.

The Nauen services have proved invaluable for instructing cruisers and U-boats. Both the *Goeben* and *Breslau* received through Nauen instructions to steam into the Bosphorus.

Nauen, the paper further adds, will help Germany to make herself independent of England's news monopoly after the war.

The ***Frankfurter Zeitung*** considers the Nauen wireless service " a symbol of Germany's economic independence." Readers interested in the above particulars should read them in conjunction with the article on the Nauen station which appeared in our March 1917 issue.

The Story of Flambo

By "PERIKON"

FLAMBO'S one consuming aim in life was a medal. At least it wasn't exactly the medal he wanted; 'twas the ribbon, and the gaudier the better. His dream horizon was bounded by bank upon bank of glittering decorations; decorations with ribbons which made the elfin tints of the solar spectrum grey as a wet Sunday on the Menin Road, ribbons which made the coat of Joseph drab as a dirty sandbag. Gorgeous scheme of flaming scarlet, blues, greens, and yellows, which rose and smote one with the blare of a thousand trumpets.

Yes; Flambo's idol was colour. He could tell you off-hand the hue of any peace-time tunic from the Household Cavalry to the Belfast Militia. He could rattle off the review order of foreign units even: the Polish Lancers, the Imperial Russian Horse Grenadiers, the Death's Head Hussars, or even such an obscure body as the Umpteenth Dutch Dragoons. All their trappings Flambo knew. And as for medal ribbon, well, he could supply the colouring of any decoration from Waterloo onward. To Flambo the one particle of colour left in war was medal ribbon. The French ones with their bold scarlets, emeralds, and saffrons were after his own heart. These *were* ribbons. They knocked spots off our drab V.C. for instance. They outdid our D.C.M., whilst even the M.M. ribbon—the gayest of the trio—was but a sorry affair against the *Médaille Militaire*. And that's why Flambo would rather have had a Star of Mons than a V.C. 'Twas the colour he was out for—not the glory.

One evening he was describing a ceremonial parade of the Horse Guards he'd seen in pre-war days. He dwelt on the dark blue of the tunic, the scarlet of the facings and helmet plumes, the gold of the shoulder knots, the virgin white of the breeches and gauntlets. He went into raptures on the silvery glitter of the headgear with its appointments of burnished brass, the blinding dazzle of spur and cuirass, till McPhairson, swooping from the sublime to the "gawblimey," put the half-nelson on poor Flambo.

"Here you! Whit wid their fancy dress finery avail them against two dirty Fritzes in a hole wi' a machine-gun? Eh? Eh?" he howled.

"Look here," burred McPhairson, craning his neck forward and prodding Flambo somewhere about the fifth rib with his forefinger; "Efter the warrr, if I'm spared, I'm gaun tae hae a bit grrrunt aboot peyin' taxes tae provide reedeeculous uniforms, and incidentally," here McPhairson paused like the toreador who poises with dart uplifted to spear the labouring bull, "incidentally incrrrease the dividends o' a wheen theatrrrical outfitters and metal-polish combines."

"Hear, hear." "Encore, McPhairse. Stuff to give 'em," howled the crowd. And Flambo faded silently away like "snaw off a wa'."

Three nights later he had a fierce argument with Sapper Murphy. It seemed to centre round the hues of some little known ribbon.

"It's black and yellow, I tell ye."

"Rubbish! it's lemon and sepia."

"Away wid ye. Me grandfather himself has the medal. I've seen it."

"Then you're colour blind."

"I'll colour *you* in a minit, ye great—— "

"Chuck 'em out. Chuck 'em out," yelled the hut, and out they were going when the hut door swung open.

"Sappers Flamborough and Murphy," announced the Sergeant, consulting a paper in his hand, "will move off at 6 a.m. and report to the Signal Officer of the 306th Brigade at ——court, not later than 9 a.m. Got it? Right."

"Good old Flambo. Now's your chance for that beautiful breastful of silk. Damme; go in and win, my boy."

But Flambo went on with his packing without replying. To be frank, the prospect didn't enamour him.

Thirty kilometres from Fritz he was as ardent a rattler of the sabre as we possessed. At that distance war was a glorious institution, and Flambo felt like the mouse who recklessly asks, "Where's that damn cat?" but once he got within crump throw of the wily Bosch, his one consuming aim—the gorgeous bit of ribbon—dimmed and waned, and another desire—the desire to keep his head well down—sprang up with the rapidity of a beanstalk and the ugliness of a tare, and threatened to blot out the wondrous rainbow welter of his dreams.

Now when Flambo and Murphy arrived in ——court things were lively. The armies were swaying backwards and forwards just to the north-east where Cambrai lay, and as ——court was on the flank it came in for special attention at the hands of the Bosch, who "strafed" it daily.

Flambo and Murphy duly reported to the B.S.O., and were ushered to the deep dug-out where the instruments were installed. They were relieving the two Brigade wireless men who, much to be envied, were going on leave. Our two heroes "took over." They duly "inherited" the ex-oil-drum brazier, the ex-petrol-tin washbasin, and the inevitable German infantry mess-tin. This last utensil is used for the preparation of those dishes which would further blacken one's own mess-tins ("Burgoo," for instance); and nowadays in the pushes one hunts for mess-tins, not helmets. The Bosch understands, and instead of producing his purse proffers his mess-tin with the customary wish that you'll accept it as a souvenir.

Our heroes likewise "inherited" the mural decorations, which consisted of the again inevitable grinning galaxy of revue stars livened up by just a dash of Kirchner.

The oil-drum, the petrol-tin, the enemy billycan, and Kirchner are found in *any* dugout in *any* sector.

Well, Flambo and Murphy settled down. The next morning dawned dull and mistily. The struggle to the north seemed to have lashed itself out. The only sounds which Flambo heard, despite the 'phones on his head, were the ticking of the station timepiece, the scratching of some inquisitive rodent behind the dugout timbers, and, last, but decidedly not least, the loud and prolonged snores of Murphy. And when Murphy snored, he snored lustily: his lungs were of leather. It was an established and recognised truth amongst us that if one slept in the same billet as Murphy, and had the misfortune to wake through the night, one never got to sleep again. The one and only way was to wake Murphy, slip away unseen and try your hardest to doze off before the unearthly bray of his respiratory mechanism proclaimed the fact that once more he had made the bosom of Morpheus. But Murphy generally beat one. All our great thinkers and inventors came to the conclusion that nothing short of a bullet would silence him. Other missiles, such as boots, bandoliers, and dirty socks had failed.

Flambo wished he could devise some form of silencer. He wished, too, there had been some "strafing." Quiet mornings always gave him the "blink-before-the-blast" feeling, and he had it badly this particular morning. He kept imagining he could hear a curious snapping somewhere outside. He pushed the 'phones from his ears to listen. Hang Murphy and his pig-like trumpeting. He'd go upstairs just to see, and donning his shrapnel helmet he cautiously ascended the stairway. He listened. Heavens! There it was again. What on earth could it be? A vague suspicion was forming away at the back of his head. Could it be? "Snap-phut! snap-phut! Whir-r-r pe-e-eng." His hair bristled. Bullets! He'd heard the whir and whine and snap of flying lead too often not to recognise it. Suddenly a brigade runner came heading for the dugout. "Wireless! Wireless!!"

"Yes," panted Flambo.

"Stand to! They've broken through!"

Flambo's fingers slipped from the top step. Down the steep, timbered stairway he shot feet first. He grabbed wildly at the hand rope, missed it, and finished up with a loud thump at the bottom of the stairs.

"Fine," murmured Murphy drowsily. "Centre av targit."

"Murphy, Murphy! Get up. Get your togs on quick."

"Let me slape. It's not me time yit."

"But they've broken through and——"

"Thin good luck to the lads. I'll wager the Ulst——"

"No! No! No!" frothed Flambo. "The Germans. We've got to stand to."

"I'll stand to in me bed thin."

"But we might have to clear out if they come far enough. How'd we manage it?" choked Flambo.

"Hire a cab. The stuff wad sit on the roof av it easy."

"Murphy, what are we to do if they *do* come"? wheezed Flambo desperately. "I'm not joking."

"Send for the polis or else the fire brig——"

"Look here, Murphy," cried Flambo angrily; "I'm not pulling your leg. They *have* broken through. It's true."

"Not a word av it."

"Righto, lie there," gurgled Flambo wheezily, "and rot."

Just then the brigade runner came crashing down the stairway.

"Wireless! Wireless!! Signal Officer says pack up and get out of it."

"What's up thin?" asked Murphy, very much awake.

"Fritz. He's in the next village."

Murphy leaped from the floor like a salmon.

"Why didn't ye tell me?" he howled at Flambo.

"I've been trying to for the last——"

"Git out av me way. Where's me boots? Me boots?" yelled Murphy, rushing round the dugout without appearing to even touch the floor. "ME BOOTS? ME BOOTS?"

At last he found them. Hurriedly he laced them.

"Now we'll get the instruments out," said Flambo.

"We will," agreed Murphy. "At wanst, if not sooner."

Soon they had the collection of boxes and accumulators on the roadside. A limber streaked round the corner.

"Stop!" yelled Murphy, his arms semaphoring wildly. "Stop!"

The driver pulled his mules on their haunches with a wild string of oaths.

"Shut up," snarled Murphy, "or I'll blow the brains out av ye."

"Are ye passing Divisional Headquarters? You're going there. No room? But there's going to be room. Hand up the stuff," to Flambo, and the gear was loaded on top of the bundles in the limber.

"Now be off wid ye. Jump on, Flambo. I'll catch ye up in a minit," and he raced off to join a miscellaneous crowd of cooks, brigade runners, orderlies, labour company men, gunners, and others who were doubling laboriously forward to rising ground.

Nobody paid any attention to Murphy. They got to the rise in front of ——court, and crossing the hollow they saw groups of enemy troops strolling leisurely forward, their rifles slung across their shoulders, chattering, smoking, and apparently much amused. To Murphy it looked like a football crowd breaking up. He had expected long lines of grey infantry hurrying forward with glittering bayonets. He was disappointed. There appeared to be no method or order in their formations. There were twos and threes, tens of them, and single figures—but there was no mistaking the direction they were taking.

Murphy stayed till his ammunition was spent, his bandolier empty. There was no more to be had, so with the rest he bolted for it. Reinforcements came up. He returned to Headquarters and reported himself and was told to rest till further orders. In the hut he met Flambo.

"Well, Murphy, how'd you get on?"

"Fine. It was a bit of excitement. They had him retiring when I came away."

Three days later the C.O. sent for Flambo.

"I bet it's your M.M. for saving the station," opined the hut.

Evidently Flambo had been talking.

"Oh, no, it couldn't be," murmured he. "Still, you know, it might be. Just lend's a decent cap somebody and some better puttees. Thanks. My face dirty?"

"Black as the ace av Spades. Take a lend av me towel and soap and hiv a scrub," advised Murphy, and the about-to-be-decorated youth hurried forth and washed.

"Now I think I'll do," as he donned his cap and serge, and gave his borrowed puttees a final flick. "Think so?"

"Adonis out-donised," quoth the contributor of the toilet accessories. "Hurry on before the wealth av colour leaves yer homely fayiss before the——"

But the hut door banged. Flambo had gone.

He duly presented himself at the C.O.'s place.

"Ah, Flamborough! I wished to see you. I've had a communication from Brigadier Blankton-Blankby of the 306th Brigade." Flambo's ears pricked. A brigadier, eh? That meant a D.C.M. at the very least. His chest measurement leapt up two inches.

"He states that on Friday last one of my wireless men was observed to load some technical stores on one of his headquarters limbers." So they'd seen him do it. His noble action had been observed, and had been observed by the right people. Flambo's head swam. This *was* worth while. Possibly a *Médaille Militaire* would be thrown on top of his D.C.M.

He could already see the ribbon on his tunic, see the banners with their "Welcome to our hero," hear the crash, the blare, and the jingle of ten massed bands of brass, hear the cheers of the vulgar multitude. Heavens! this *was* worth while! This absolutely——

"The Brigadier thought the action of evacuating valuable stores admirable."

Flambo's third shirt button flew off. No doubt about it now. He'd see himself a week later in the *Daily Looking-Glass* with the usual "Decorated. He-did-not-fear-the-hiss-of-shell, instead-it-made-him-laugh-li——"

"But," continued the C.O., "he states my wireless man's action has had somewhat awkward results."

Heavens! What was this? Awkward results?

Flambo's tunic slackened just a shade.

"Now, Flamborough; can you imagine the Brigadier's surprise on donning his change of uniform to find patches, pieces, veritable tracts of it eaten away by acid—*acid from your accumulators?* Don't tell me they didn't upset now. They did."

Flambo's tunic suddenly felt quite roomy. He staggered—staggered mentally and physically—like the poleaxed ox. The ribbons, the massed bands, the cheering mob vanished, vanished like the mirage which mocks the weary traveller.

"The damage touches twenty guineas and——"

But Flambo only heard scraps of the rest. Presently he found himself returning hutward, returning hutward like the goat in the fable—much sadder, much wiser.

Loss of Seamen's Effects

The figures given below from the *Board of Trade Journal* show the amount which the Government has paid in compensation for the loss through war risks of the effects of masters and officers in British merchant and fishing vessels.

In August of last year, by which time a very large proportion of the British Mercantile Marine had been taken over by the Government, no premiums were charged to any masters, officers or seamen, and the whole of the compensation was paid from State funds. The present *maximum* amounts of compensation for loss of effects through war risks are as follows:

Merchant Vessels.

Rating.	*Amount.*
Master	£100 0 0
Certificated officers, surgeons, pursers, wireless operators	£50 0 0

Some Remarks on the Morse Alphabet

And on Some Other Things

By J. ST. VINCENT PLETTS

EDITORIAL NOTE.—*Right at the base of wireless telegraphy lies the alphabet usually known as the "Morse Code," and one result of the redoubled attention directed towards radiotelegraphy as a profession has been to stimulate interest in Mr. Morse's device, which forms the A B C of all telegraphists.*

THE WIRELESS WORLD *has reflected this enhanced interest, notable examples of this being found in an article entitled "The Human Morse Code," published in our issue of January,* 1917 (*vol. iv., pp.* 739–43), *and in an illustrated paper entitled "The Magic of Dot and Dash," which appeared in our September,* 1917, *issue* (*vol. v., pp.* 391–6).

The article which we print below, from an old and highly esteemed contributor to our magazine, continues a critical review of the extant system.

FRANCIS BACON.

FRANCIS BACON devised a cipher in which each letter of the alphabet was represented by a different combination of two elements, taken five at a time. His object was to conceal a secret message in an innocent-looking document by employing two different kinds of letters, such, for example, as sloping and upright writing, each five of which represented a letter of the secret message. As no

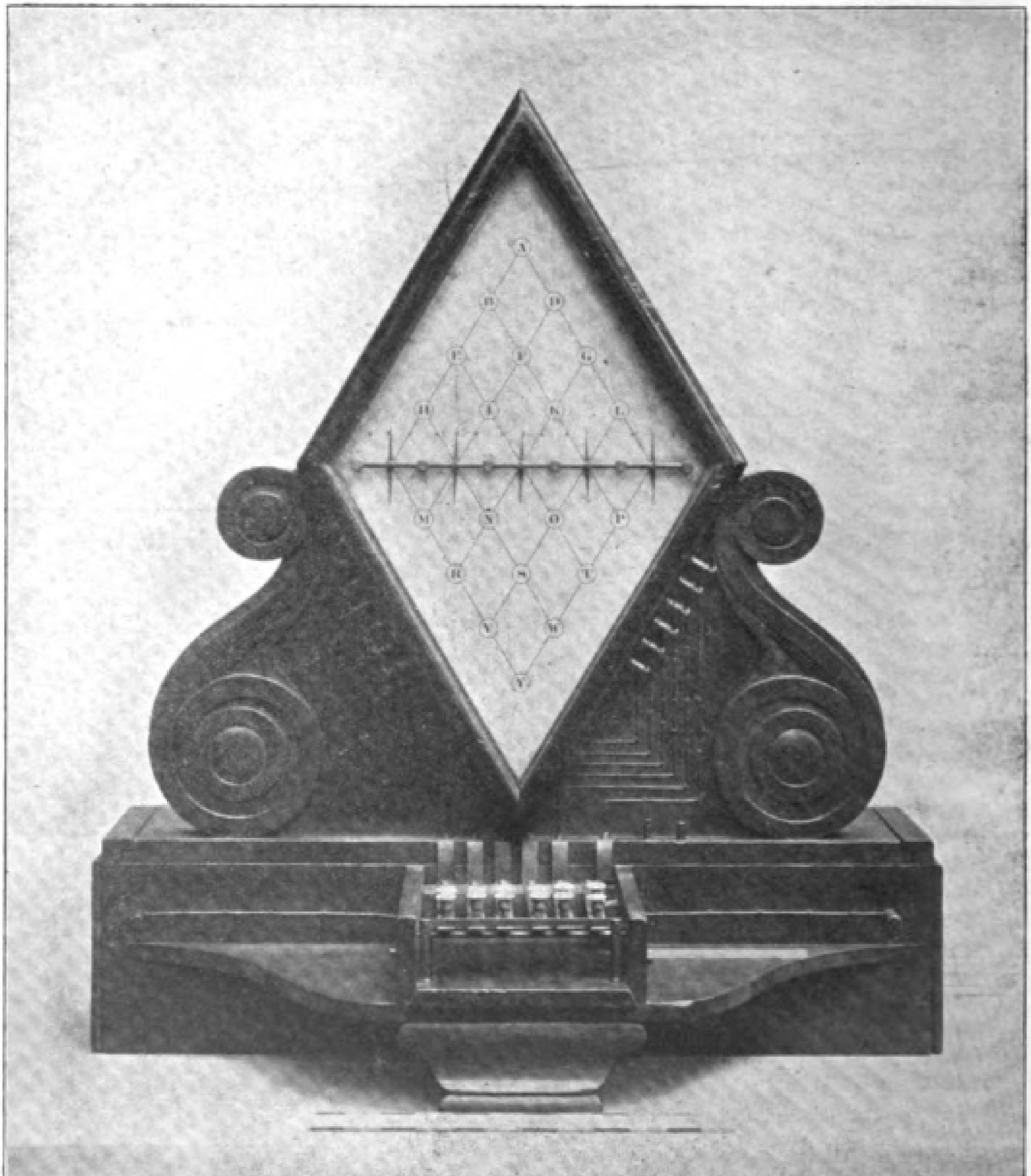
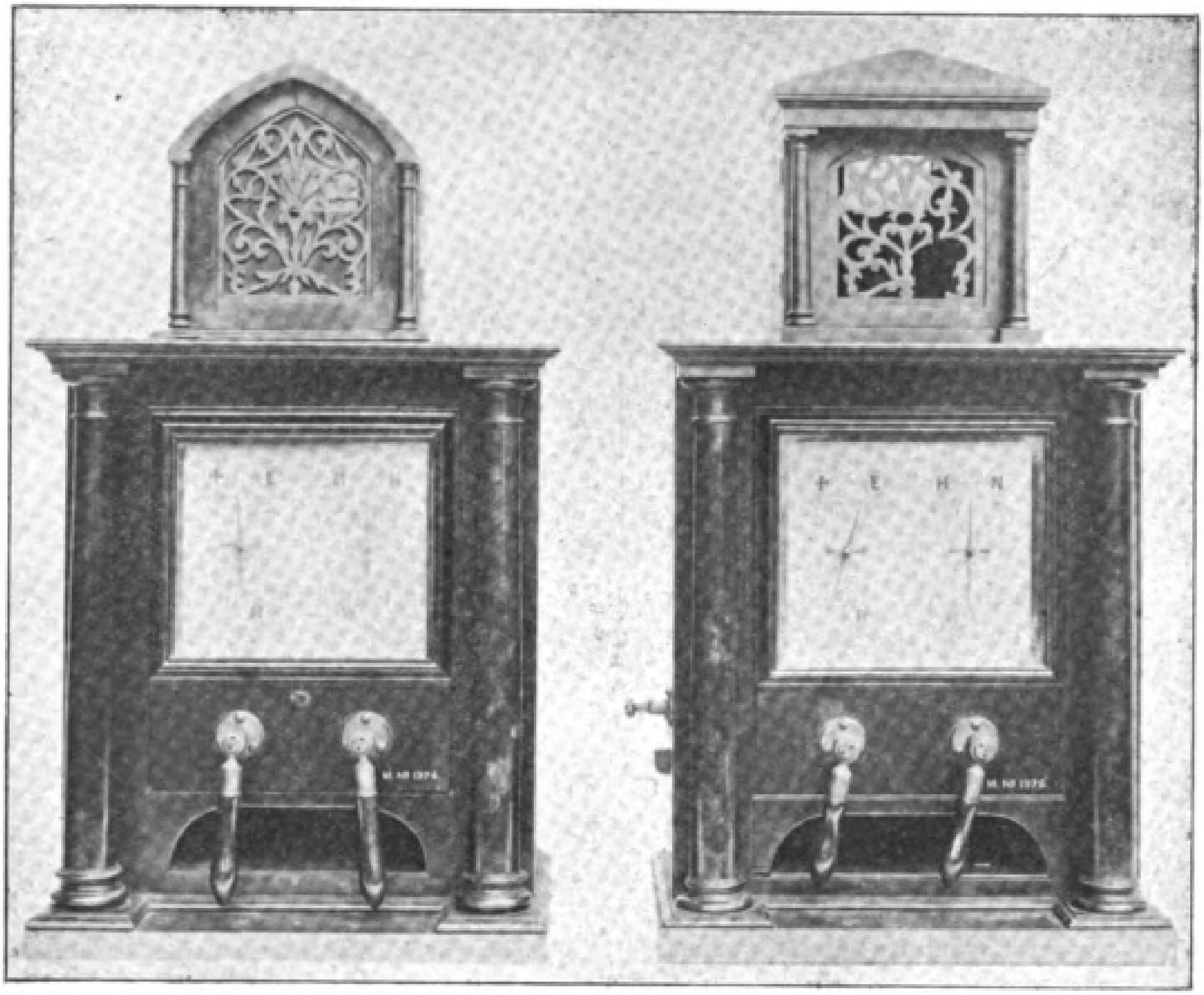


FIG. I.

MESSRS. COOKE AND WHEATSTONE'S FIVE-NEEDLE TELEGRAPH INSTRUMENT, A.D. 1837.



MESSRS. COOKE AND WHEATSTONE'S DOUBLE-NEEDLE TELEGRAPH INSTRUMENTS, A.D. 1837.

spacing was possible he could not use groups of different lengths, and therefore could not use less than five elements to each group, for, though this gives thirty-two possible groups, four elements per group would give only sixteen. Mrs. Gallup claimed to have discovered that the italic portions of the original folios of Shakespeare's works were printed with two founts of type; and her famous *Biliteral Cipher* gave translations of the hidden messages, which alleged that Bacon was the rightful King of England, besides being the real author of Shakespeare and of most other contemporary works of note. Be that as it may, the fact remains that Bacon was the first to devise a cipher with the minimum number of different kinds of elements, and, if we represent his two elements by dots and dashes respectively, we get a possible though clumsy telegraphic alphabet.

Naturally enough, the earliest telegraphists did not look to the past for their alphabet, and it was some time before they produced anything which was not clumsier even than Bacon's. One of the earliest electric telegraphs had five needles, each capable of turning either way from its position of rest, so that each pair of needles could point out, by their imaginary intersection, two of the twenty spaces containing the letters of the alphabet, as shown in Fig. 1. For the remaining six letters, C, J, and U were represented by K, I, and V, and Q, X, and Z by KW, KS, and DS respectively. It was not long, however, before it was realised that five needles, each capable of taking up two positions besides that of rest, could give no less than 242 different signals, and that three such needles would exactly give the twenty-six different signals required for the alphabet. Up to this time all the movements required to indicate any letter were made simultaneously, as they were with the semaphore, which was then in familiar use, and, with the possible exception of sending a different number of impulses for each letter, no one seems to have realised that the elements of a signal could be separated by intervals of time.

Samuel Morse made the use of a single needle possible by the introduction of an alphabet consisting of two elements taken one, two, three or four at a time, and sent immediately one after the other. The two elements were the two motions of the needle, which originally occupied the same time, and the groups of elements forming letters were separated from each other by longer intervals than those between the elements of groups. This became the so-called Morse Code which we know so well.

Now the first thing to note about the Morse Code is that it is not a code at all. The word "code" has two meanings, one being a system of laws, and the other a method of condensing telegrams by substituting conventional words for phrases of common occurrence. The word "cipher" has also two meanings, one being analogous to insignificant, and the other being the substitution of other characters for the ordinary letters of the alphabet. It would therefore be quite correct to talk of the Morse Cipher, but it is perhaps best to call it simply the Morse Alphabet.

Taking the time interval between two elements of a Morse character as equal to the time occupied by the motion of the needle in either direction, and making this time our unit, we find that the characters take one, three, five or seven units of time to send. The hackneyed phrase "time is money" is probably truer of telegraphy than of anything else, unless it be the Tube Railways, so that it is a matter of some importance that the commoner letters should be allotted to the shorter characters.

Length of Character.	Possible Number of Different Characters.	Letters Allotted to Characters.	Letters which ought to have been Allotted to Characters.
1	2	E T	E T
3	4	A I *M* N	A I N O
5	8	D *G* *K* O R S U *W*	C D H L M R S U
7	16	B C F *H* J *L* P Q V X Y Z	B F G J K P Q V W X Y Z

Fig. 2.

Fig. 2 gives in tabular form the actual and proper allotment, and shows that C, H, L, and O are two units too long, and G, K, M, and W two units too short. I have heard it suggested that the Morse Alphabet was not intended to give the best results with English, but with all languages. I have tried and failed to find any language or combination of languages having an alphabetical frequency which fits it so well as the English frequency does. And there is every reason why it should be so. The English-speaking peoples produced and developed the telegraph, they are more scattered over the surface of the globe, and therefore require to make more use of the telegraph than any other people, and the position of England at the centre of the land hemisphere makes her the natural telegraph exchange of the world. Taking into account the frequency of the letters in ordinary English, and allowing for the spacing between letters and between words, I find that with the single-needle instrument the transmission of each hundred letters takes on the average 768 units of time, whereas with the alterations suggested above it would take 743 units. It is true that this would only effect a saving of 3⅓ per cent., or two minutes per hour, but the matter does not rest here.

The introduction of the earth return and central battery made the reversing of the current impossible, and the time had again to be drawn upon to make a distinction between the two elements of the Morse characters, one of which became the dash having three times the length of the dot. This increased the time of transmission of most letters, and gave J, Q, and Y the entirely unnecessary length of

Length of Character.	Possible Number of Different Characters.	Letters Allotted to Characters.	Letters which ought to be Allotted to Characters.
1	1	E	E
3	2	*I* T	A T
5	3	*A* N *S*	I N O
7	5	D H *M* R *U*	D H L R S
9	8	*B* F G *K* *L* *V* W	C F G M P U W Y
11	13	*C* *O* *P* X Z	B J K Q V X Z
13	21	*J* *Q* *Y*	

Fig. 3.

thirteen units. Fig. 3 gives the actual and proper allotment of the English letters to the Morse characters, arranged in their new order of length, and shows that O, which was badly treated before, is now no less than six units too long, Y four units too long, and A, C, J, L, P, and Q two units too long, while B, I, K, M, S, U, and V are all two units too short. To send a hundred letters of ordinary English in dots and dashes with the usual spacing takes 968 units of time, which with the alterations here suggested would be reduced to 929.

Do I advocate this change? Lord Kelvin once said: "I look upon our English "system of units as a wickedly brain-destroying piece of bondage under which we "suffer." Yet three and a half years of the most awful upheaval the world has ever seen—an upheaval which was probably made possible and has certainly been prolonged by our pre-war social and political antagonism to industry and our general neglect of science—has failed to give us the metric system, phonetic spelling, or decimal coinage. These would be enormous time-savers with a huge cash and much greater intellectual value; but the gigantic octopus which calls itself Education still thrives on brain-destruction and our youth continue to be robbed both of opportunity and of their ability to take advantage of it. A 4 per cent. increase in the earning capacity of a telegraph line is, in comparison, a small matter, but nevertheless one worthy of consideration by anyone but a Government Department.

There are, however, some more interesting and important conclusions, which I think are not generally recognised, to be drawn from the figures I have given. The central battery system in sparsely populated districts, wireless telegraphy, the heliograph, etc., are bound to continue using dots and dashes, but there must be many cases of busy lines where the reintroduction of the single-needle instrument would present no difficulties. In such cases the capacity of the line would be increased by 26 per cent., or, in other words, four lines could do the work of five. But a much more surprising conclusion is that in the case of three fully occupied lines between the same two places, whether using dots and dashes or single-needle instruments, it would pay to discard the Morse Alphabet altogether, and to revert to the old three-needle instrument, which, with its simultaneous signals, takes only 240 units of time to send a message of a hundred letters. Its speed is therefore more than four times that of dots and dashes, so that, sending only one message at a time, it increases the total capacity of the three lines by 34 per cent., even although they can send three messages simultaneously. In other words, it enables three lines to do the work of four. Moreover, unlike the Morse signals, its speed is unaffected by the use of code words or foreign languages, and there is no reason why it should not be duplexed and adapted to fairly high-speed automatic transmission.

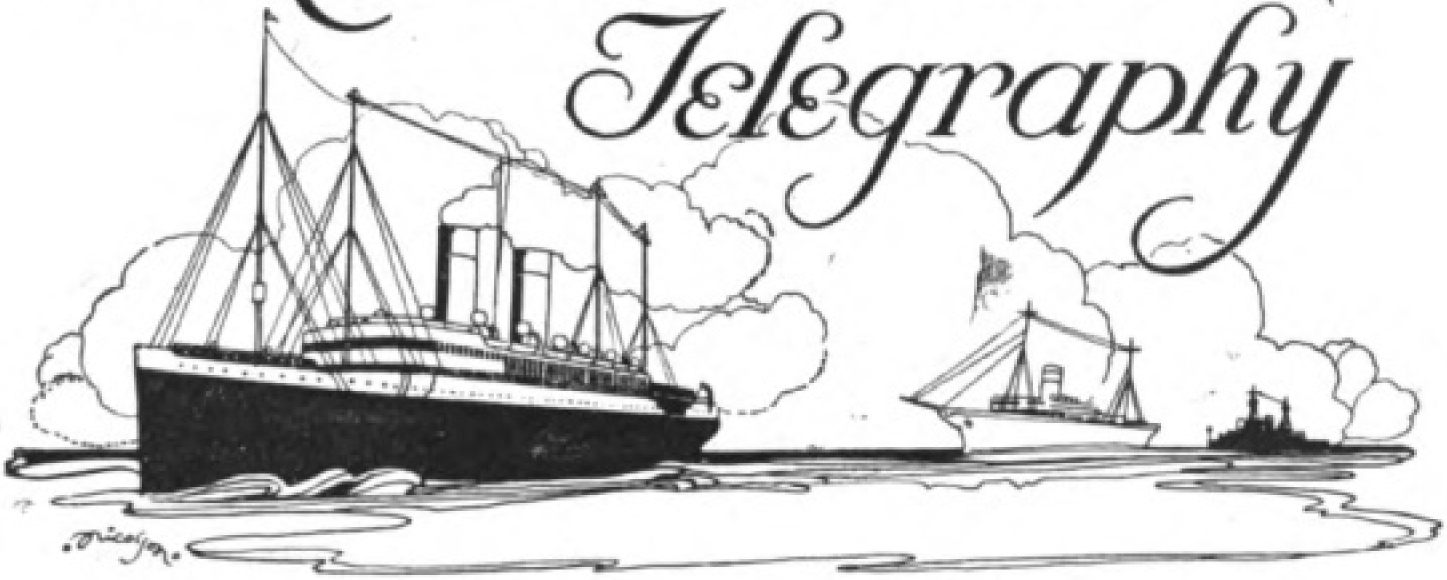
It is not often that congested traffic can be relieved by using an older type of apparatus, but perhaps it could also be on the Tube Railways.

The Editor will be pleased to receive remarks or criticisms on the foregoing article.

Save and Serve

TWO IMPORTANT BANNERS ON PORTSMOUTH TOWN HALL.

Maritime Wireless Telegraphy



THE "GOEBEN'S" DAY OUT.

THE situation which inspired the sortie of the *Goeben* and the *Breslau* is still obscure, but some day, perhaps, when the Bolsheviks of the Central Powers have proclaimed on the housetops the secret treaties now hidden amongst the sweet-scented archives at Constantinople, the adventure will be made "all clear." Whilst the *Goeben* was in the limelight during her enforced rest at Nagara Point, certain newspapers thought it opportune to revive the wireless jamming fable, created in Germany to explain the *Goeben's* escape from our Mediterranean squadron at the outbreak of war. The "Jam the wireless! Jam it like the devil!" legend certainly looks well in print, but, as it has been pointed out before, jamming is a two-edged sword and in practice often proves as great a handicap to the station creating the interference as to those it is intended to hinder. We doubt very much if jamming had anything whatever to do with the *Goeben's* escape, although it is well known that the wireless equipment of all the German big ships is of a powerful order. The sinking of the *Breslau* will undoubtedly handicap the *Goeben* in any enterprises which, for political or other purposes, her commander may think fit after the necessary alterations and repairs.

WOUNDED SAVED BY "REWA'S" "S O S."

The loss of the hospital ship *Rewa* merely lengthens the list of atrocities which will haunt the German people so long as print endures. The German authorities have endeavoured to prove to the world that the *Rewa* was sunk through collision with a British mine, but they overlook the fact that their guilt is made doubly certain by their self-confessed submarine activity in the Bristol Channel in the very week during which the *Rewa* was sunk. The British authorities have denied that a mine sent this famous ex-trooper to her doom, and we think the world at large will prefer to believe the British Admiralty. There is no doubt the fact that the wounded on board were saved from a watery grave is largely due to the "wireless" signals, which brought patrol boats to the spot from all parts of the channel, and if we are not mistaken this same wireless equipment also served the *Rewa* well in a predicament in which she found herself some two and a half years previously when steaming off the North-East Coast. Do the Germans really believe that the *Rewa* incident will commend to the British people their feigned pacific desires? If they do, then Central Europe will have a rude awakening. Whatever conditions may be agreed upon by the belligerents at the end of the war, the German submarine campaign has invoked a curse which will hinder the activities of the German mercantile marine for many years to come. Even the "Freedom of the Seas" would have little attraction for mariners branded with the mark of Cain.

"ACROSS THE BAR": THE MERSEY DISASTER.

Each port naturally displays great pride in its pilots, those men who, by their knowledge of the peculiarities of the waterways, make safe the entry and departure of the ships upon which the prosperity of the place depends. The disaster which befell Liverpool at the end of December, but was not made public until nearly a month later, when nineteen of her foremost pilots were lost near the Mersey Bar through a boat striking a mine, was keenly felt throughout the whole of the British mercantile marine, many of the victims having a wide circle of friends and business acquaintances. The wireless service through that unfortunate accident has also to mourn another loss, for amongst the 43 men on board at the moment of disaster were two Marconi operators. Happily Barrett, the junior operator, was one of the two survivors. Barrett, it appears, was at his post on the upper deck when the explosion occurred. He was

S.S. "REWA," ALONGSIDE AT SOUTHAMPTON. A FAMILIAR SIGHT IN PEACE TIME.

thrown off his feet, and the cabin was plunged into darkness. Commendable efforts to send out emergency signals failed, as sparks were unobtainable owing either to the stoppage of the dynamo or the severance of the cables. Barrett, with but one thought, that of his duty, went on deck to find the cause of the disturbance, but the deck was already under water. Almost immediately he was carried overboard by the swirl, and in a few seconds the boat was lost beneath the waves. Barrett was saved by securing a floating lifebelt and an oar. His only fellow survivor was an apprentice pilot named Sweetham.

American Control of Wireless on Neutral Ships.

The drastic regulations brought into action by the United States War Trade Board on February 1st for the control of neutral shipping have as their purpose the destruction of any possible remaining channels through which the enemy may receive information. Particularly necessary is it, at a time when America is about to transport many thousands of troops across so wide a space of ocean, that no possible risk shall be run of the enemy submarines getting news of the ships' movements.

The regulations require, amongst other things, that all wireless apparatus on neutral vessels visiting America shall be sealed and that no message shall be sent without the knowledge of the master, who is responsible that no communication shall be sent to the enemy and that no message of any kind shall be sent within 200 miles of England, France, Portugal or Italy except in case of distress. The regulations also give to the War Board control over the captains, officers and crews of neutral ships, and any person, firm or corporation which fails to act as required in respect to a captain, officers or crew, or to observe the whole of the regulations, may find itself or themselves penalised, not only in respect to the vessel on which the offence is committed, but in the case of all vessels under the same control.

Die Wacht am—Drahtlose.

Some years ago one or more travelling dentists, dressed as cowboys and claiming to be "Sequahs," toured the provincial cities of this country giving exhibitions of their "skill." With each was a brass band which generally managed a *crescendo* at the moment a tooth was being drawn—a sort of atmospheric disturbance around the patient's "S O S." The idea, which very probably originated with the North-west tribes who accompanied their scalping operations by a "Cancan," has apparently also found favour in the mind of the Germans, for, according to an interesting message from Honolulu, the German cruiser, *Grier*, which was interned in that harbour after the outbreak of war, spent useful hours relaying by wireless messages between America and Japan which were intended to embroil those two countries in a separate war. The wireless equipment of the *Grier* was sealed by the American authorities, but the seal was broken by the Germans, and in order that all tell-tale sounds might be obscured when this underhand business was afoot the ship's band was detailed off to play lively airs. Captain Grasshof, of that vessel, is now in the safe keeping of the American authorities following the discovery of a diary containing this and other incriminating evidence. We always nursed suspicions that German bands were something in the nature of *camouflage*.

D

THE WRITING ON THE SLATE—WIRELESS IN A U-BOAT HUNT.

Prominent amongst the limited number of first-class articles on war routine which have been permitted publication in the daily Press is a series contributed to the *Daily Chronicle* by " Bartimeus," a writer who appears to be singularly well-informed on the technical side of his subjects. One of these articles entitled " The Hunt " vividly detailed a submarine chase by a " blimp " and motor launches ; " blimp " being the service name for a submarine-hunting airship. " The old bus," to use the author's language, " was running like a witch, when . . . the wireless " operator in the rear leaned forward and tapped him on the shoulder. . . . He was " scribbling something on a slate. 'S O S—S O S'—a bearing from a distant " headland—' fourteen miles—S O S—S O S—come quickly, I am being shelled " —S O S—Subma——' The operator paused with his pencil above the slate, " waited a moment, and handed the slate forward. The message, soundless, appeal-" ing, that had reached them out of the blue immensity has ceased abruptly," etc., etc.

Then comes a graphic description of the " blimp's " race at eighty miles an hour to the rescue, and the dropping of a bomb.

" The ' blimp ' turned round, dropped another bomb ahead of the rapidly " vanishing wake, and then marked the spot with a calcium flare, whilst the wire-" less operator jiggled a far-flung ' Tally ho ! ' on the sending key of his apparatus." " Bartimeus " now turns his attention to the motor launches and we next read of the " blimp " as engaged in sending signals with a Morse lamp to these mobile craft which are " carrying, like hornets, a sting in their tails." " ' Wake 3 points on " your port bow,' winked the ' blimp.' Over went the motor launch's helm and " the seaward boat suddenly darted ahead in a cloud of spray. . . . For an hour " that relentless blindfold hunt went forward, punctuated by exploding bombs and " depth charges and the crack of the launches' guns as the periscope of the " submarine rose for an instant's glimpse of his assailants, and vanished again."

Considerations of space do not permit of more than meagre excerpts from this most interesting article. In the end, the submarine is forced to the surface by the asphyxiating effects of the chlorine liberated by the storage batteries from the incoming sea water. Manning their gun, the submarine crew manage to hit one of their pursuers, but seeing the approach of some destroyers the commander opens the seacocks and waves his hand in token of surrender just as the " blimp " returns to give the U-boat a *coup de grâce*. With a little of the love element thrown in—we are sure the wireless men can also play sentimental parts—this little pen picture would make an excellent cinema film.

ARGENTINE WIRELESS CHAIN.

At the end of 1917 the Argentine Government opened a new radiotelegraphic station at San Julian (Santa Cruz), whilst a further station is in course of erection at Punta Delgada (Valdes Peninsula).

When the Punta Delgada station is finished the Argentine will possess a complete chain of stations permitting wireless intercommunication along the coast of Patagonia extending from Buenos Aires to the extreme south of the South American Continent. It is quite clear that this progressive Latin-American State is fully alive to the importance of radiotelegraphy, and is taking active steps to avail itself of this latest method of organisation and development.

Notes of the Month

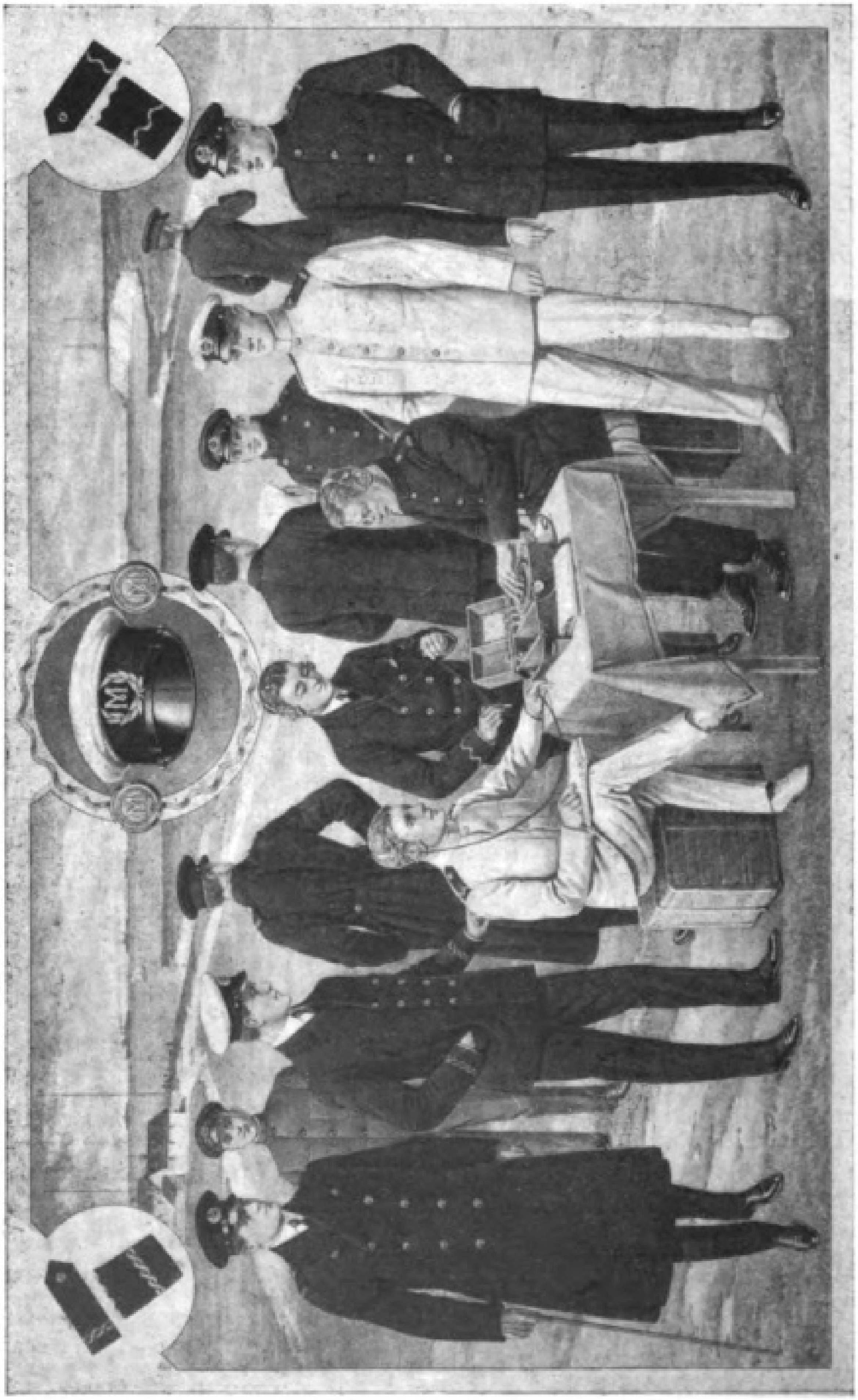
Uniformity in Uniforms.

That the tailors of Great Britain have scented unusual activity in the world of "wireless" is evident from the attention shortly to be given to Marconi men's dress in that important sartorial weekly, the *Tailor and Cutter*. Amongst the supplements lately issued is one in colours showing the exact cut and essential details of the various uniforms designed for operators. Whilst this plate conveys anything that may be new to those tailoring firms which advertise in The Wireless World and are fully alive to the requirements of this service, it will also afford valuable assistance to operators who prefer to give their orders for clothing to their regular tailors. The monochrome reproduction appearing on page 840 would suggest at first sight that a Marconi man's wardrobe is an unusually extensive one. This is not so. Of the twelve figures reproduced, three give back views; of the remainder, some are of uniforms merely designed for personal convenience. The drawing should be examined in conjunction with the excellent article on "The Operator at Sea" which appeared in the January issue. Reading from the left, figures 1 and 4 show the correct "bridge" coat; figure 3 the senior "ordinary" uniform, and figure 6 the junior "ordinary" uniform. Figures 5 and 10 indicate the white "tropics" uniform, and figures 8 and 12 the "patrol" jacket. The "boiler" suit, useful for cleaning purposes, is indicated by figure 2.

The essential uniforms are the "ordinary" and the "white"; the rest are optional. The braidings for sleeves and shoulder straps on the uniforms of senior and junior operators are shown in the left and right-hand corners respectively.

Music Hall Appeals for Marconi Men.

Harsh things have been said at times about the music halls of Great Britain. Some day it will not be difficult to furnish the critics with proofs that these places of amusement, instead of "breeding crime," have actually assisted the nation in her fight for right. It is not at all unlikely that many young fellows now embarking on a "wireless" career first received their "call to the sea" through the excellent series of appeals now being flashed on the screen at many important music halls throughout the country. "Young men, what of the future?" is the searching question which has set many thinking and has paved the way for the reminder that "You can serve your country as a wireless operator." Those who thus have their thoughts aroused by the foregoing are finally asked "to examine the programme for full particulars as to free instruction."



TYPES OF MARCONI UNIFORMS.

Alongside this "wireless activity" in the amusement palaces an extensive poster campaign has been conducted. For the purpose of making known the vital need for Marconi men, attractive drawings have been placarded on the London railway stations and in the most prominent positions in the great provincial cities. Portsmouth, the headquarters of Britain's great maritime strength, has not been content with ordinary posters; instead, it has placed at the disposal of the organiser of the "wireless recruiting campaign" a portion of the façade of the magnificent town hall. He who runs may read this appeal virtually "miles away."

Marconi "Amazons."

An impression is spreading abroad that because young women are being trained in America and elsewhere as "wireless operators" the time is not far distant when the young "sparks" in the merchant service will be extinguished and the Marconi cabin will be "manned" instead by a bevy of fair ones whose knowledge of waves, hirsute, tidal and etheric, will be even more extensive than their predecessors.

Now, although wireless folk are by nature progressive in ideas and will be the last to throw cold water on any new idea, we feel sure that they will support us in the belief that maritime wireless telegraphy is quite unsuitable as a field for feminine activity. It has to be remembered that wireless is installed on ships primarily for protection in time of crisis. Operators are trained not so much to decorate a "painted ship upon a painted ocean" as to sit calmly and unruffled at their posts when face to face with death and disaster. They have to be prepared to endure the severest tests that can be imposed upon mind and body. Experience has shown that, from the earliest times on record, although there have been and are exceptions to the rule, the feminine temperament is an uncertain factor in times of emergency, and although a woman might prove an excellent student in the wireless schools there is always the likelihood of her natural weakness revealing itself at a critical moment.

We feel sure that, however much a feminist movement might press for the extension of activity in this direction, the shipowners themselves would refuse to be party. There is also the certainty that ships so "manned" would instantly lose popularity.

An examination of the composition of a ship's staff will show that—except in the case of stewardesses, who exist for the comfort of passengers rather than as a measure of safety—no place is found for womenfolk, and a moment's reflection will show how natural is this arrangement.

This does not imply that there is not a growing field for women in "wireless work." On the contrary, there are many operations which experience proves can be performed to advantage by the fair sex, duties which provide congenial employment without the strain and discomforts of sea-going life. The care and precise thoroughness displayed by the average young woman suggest her fitness for operating on land, and for many constructional tasks requiring patience and delicacy of touch outside the common virtues of mere man. The romance of wireless is real and unending; so, too, are the perils of the seas; but to introduce women for ship work would be unfair to womankind and the mercantile marine.

On the Æther and the Electromagnetic Theory of Light

An Elementary Explanation specially Adapted to the Needs of the Student of Wireless Telegraphy.

THE reader is doubtless already aware that the electromagnetic effects utilised in radiotelegraphy are considered to be propagated by the agency of the æther, and if he is a purely practical wireless worker he might well let his knowledge of what occurs between the transmitting and receiving antennæ rest at that point, seeing that the æther is hypothetical. In order, however, to gain a clearer mental grasp of what may be conveniently termed the mechanism by which, according to modern ideas, energy is transferred across space, it is first necessary to understand the need for postulating a physical medium and to examine the facts which have led scientists to the æther hypothesis and the electromagnetic theory.

It must be understood that the æther hypothesis does not satisfy the mind along every line of thought and a number of questions concerning it are bound to assail the thinker. We have, like the generations before us, arrived at only a fraction of the truth, but in so far as our belief is supported by accurate observation and sound reasoning we may rely upon it. Modern science, seeking to fathom the mystery of the ultimate structure of matter, has made a step beyond the Atom to the Electron, and what has been considered hitherto as the unit of matter, as an indivisible particle, is now known to be divisible. Yet the great fabric of chemical science woven round the indivisible atom has not been rent, and the advance of knowledge, though it has revealed more, has not discredited the partially complete theory based on facts which, though inadequate, are still true and undisputed. In the same way there are gaps in the theory of æther which a later stage of investigation may fill in.

The student may be apt to consider it waste of time to trouble about a theory which, besides being unessential to the commercial practice of radiotelegraphy, is in the nature of a half-guess at truth, unless he realises that the objective existence of the æther is something more than a mere assumption. It is more than a philosophical necessity, it is a physical necessity, and is, in fact, actually proved by numberless experiments and a train of profound mathematical reasoning. No one would doubt the existence of that intangible entity known as electricity, yet we are only made aware of it by the phenomena to which it gives rise, and in the same way by reasoning from effect to cause we are enabled to infer the existence of æther.

II.

ACTION ACROSS SPACE.

There are instances of physical actions taking place across space without the co-operation of any visible means acting as a connection or as a carrier between the two points considered. It will be seen at once that sound, light and electromagnetism present examples of such action. In the case of sound it is proved that we are dealing with the movement of material particles, and that in the absence of such particles, forming a link between the sound-making (vibrating) body and the receiver, such as, for instance, the ear, the latter does not respond. Thus an alarm clock ringing in vacuo cannot be heard. Light, on the other hand, is transmitted across a vacuum and across space which we have reason to believe contains no matter, as, for example, between the earth and the sun. Similarly, it has been observed that electromagnetic effects take place across a vacuum.

Let us take the case of the electromagnetic induction of a current in a circuit and suppose that the whole action occurs in an air-exhausted globe. Now the energy which is expended by the primary circuit reappears in the secondary but the passage of this energy occurs at a finite speed, that is, the energy does not disappear from the primary and reappear in the secondary *simultaneously* and therefore it must have existed apart from both circuits for a definite period. The intervening space in which it existed during that time contains no matter because the experiment takes places in vacuo, so that we are confronted with the choice of two theories, namely, that the energy was transferred across space devoid of any matter or connecting link whatever, or that it was propagated by virtue of some medium, which, subtler than ordinary matter and endowed with the property of transmitting energy, fills all space whether occupied by matter or not. The mind intuitively rejects the former idea. One cannot conceive of energy existing apart from matter any more than it can conceive of thought existing independently of a brain. How much we are justified in accepting the promptings of intuition in matters of scientific investigation is a question for the philosopher, but it is certain that, within limits, it is more fruitful of error to oppose intuition than to form hypotheses in accordance with it. In this case we hypothecate a connecting medium, immensely strengthened in our arguments by the fact that it has been done in an analogous case, that of light, with excellent results. This case we will now briefly consider and then return to the idea of an electromagnetic medium.

LIGHT-ÆTHER.

At a certain stage in the investigation of light physicists found that they had to choose between the alternatives mentioned in the preceding paragraph and it was discovered, by assuming light to be an undulatory movement in an elastic medium which permeates space and matter, that the phenomena of light can be explained satisfactorily; as a matter of fact many effects of light are deducible from the properties assumed for the æther. The number of its properties has by definition been limited to just those which are necessary to a medium in which transverse waves can be created, and which is capable of propagating such waves at the enormous velocity of 3×10^{10} centimetres per second, that is, at the speed of light, a value which has been calculated by direct experiment. These properties, so far as we are justified by the present state of knowledge in assuming, are: (1) Inertia; (2) some form of elasticity; (3) extreme tenuity; and (4) imponderability. In regard to the last, it may perhaps seem a hard saying that a material medium is non-gravitative, but when it is considered how small the mass of the æther is compared with its volume, and that we are able to assume for it a degree of tenuity more or less akin to that of the matter composing the "tails" of comets, it will be recognised that to describe it as imponderable is approximately correct. When we think in tons, or even in grammes, the weight of an electron is negligible, and, volume for volume the weight of æther compared with that of the lightest known material is negligible. Mendeleef, the Russian chemist famous for his work on atomic weights, is said to have stated that in his opinion there exist two elements whose atomic weights are less than that of hydrogen, æther being one of these. That his opinion is worthy of note, especially in regard to a forecast of this nature, will be readily admitted by the reader who is familiar with the remarkable precision with which the existence of several elements was foretold by certain gaps in his periodic classification of the elements.

The æther undoubtedly has other properties but there is no direct proof of them, and in the absence of any need to assume them it would be unscientific to extend the hypothesis further in that direction. Neither is there any direct evidence of the existence of the æther—the student should be quite clear about this—but the hypothesis rests on firm foundations and enables us to explain action through space in a manner which has satisfied the majority of scientists.

THE ELECTROMAGNETIC MEDIUM.

Reverting now to the subject of the electromagnetic medium, it will be seen that with the example of the light-æther before us the question of a choice between the adoption of a mentally unsatisfying and distasteful conclusion and the conception of a special medium to account for the propagation of energy is greatly simplified. For if the latter course has been so amply justified in the case of light we may, *a fortiori*, employ a similar reasoning in the case of electromagnetism. Another question now arises. Are we to assume a new medium for every kind of action which calls for an hypothesis of this nature to explain it, and thus fill space with a number of different æthers much in the same way as the ancients filled the Pantheon with a multiplicity of deities each with his or her special functions? Maxwell, in whose footsteps we are now treading, said that it would be unphilosophical to do so, and by this he probably meant that such a course would be an infringement of the Law of Economy, which is the scientific rule to employ the least possible number of assumptions in formulating an hypothesis. Obviously the same rule applies to the hypotheses themselves, since it would be absurd to introduce a new theory in regard to new facts if the latter admit of explanation by a theory already in existence. Accordingly Maxwell's theory asserts that light is an electromagnetic phenomenon because the so-called luminiferous æther is the electromagnetic medium and light waves are propagated at the same velocity as electromagnetic waves. This theory we shall now consider.

III.

THE ELECTROMAGNETIC THEORY.

All physical quantities, excepting those defined in the case of heat, can be fundamentally defined as dimensional expressions in terms of length [*L*], mass [*M*], and time [*T*]. For instance, a velocity of five miles per hour can be written

$\frac{5 \text{ (miles) } [L]}{1 \text{ (hour) } [T]}$, giving as the unit of velocity $\frac{[L]}{[T]}$ or $[LT^{-1}]$, which, it must be remembered, is only a *ratio*. Now, commencing from the definitions of the unit pole and unit charge, two absolute systems of units have been evolved called respectively the electromagnetic system and the electrostatic system. The following table shows the dimensions of four units under both systems of measurement:—

Unit.	Electrostatic.	Electromagnetic.
Current	$[L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-2}]$	$[L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}]$
Quantity	$[L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-1}]$	$[L^{\frac{1}{2}} M^{\frac{1}{2}}]$
E.M.F.	$[L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}]$	$[L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-2}]$
Resistance	$[L^{-1} T]$	$[L\, T^{-1}]$

It can be seen by inspection that the dimensions are not alike in the two systems. Let us actually compare them by finding the ratio of the electrostatic dimension to the electromagnetic dimension in each case.

Current.

$$\frac{L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-2}}{L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}} = \frac{L\, T^{-2}}{T^{-1}} = \frac{L\, T^{-2}}{\frac{1}{T^1}} = L\, T^{-2} \times T^1$$

$$= L\, T^{-1} = \frac{L}{T} \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Quantity.

$$\frac{L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-1}}{L^{\frac{1}{2}} M^{\frac{1}{2}}} = L\, T^{-1} = \frac{L}{T} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

E.M.F.

$$\frac{L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}}{L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-2}} = \frac{T^{-1}}{L\, T^{-2}} = \frac{T}{L} = L^{-1}\, T \quad . \quad . \quad . \quad (3)$$

Resistance.

$$\frac{L^{-1}\, T}{L\, T^{-1}} = \frac{T}{L^2\, T^{-1}} = \frac{T^2}{L^2} = L^{-2}\, T^2 \quad . \quad . \quad . \quad (4)$$

Remembering that $\frac{L}{T}$ (or $L\, T^{-1}$) is the dimensional expression for the unit of velocity the reader will recognise the fact that each of the four results just obtained partakes of the nature of a velocity. Now, if a quantity measured in electrostatic units be divided by the same quantity measured in electromagnetic units and the quotient be v, then the electromagnetic *unit* is v times greater than the electrostatic *unit*. A rough example will make this clear. $\frac{1760 \text{ (yards)}}{1 \text{ (mile)}} = 1760$; hence the *unit* when the same distance is measured in miles is 1,760 times greater than when it is measured in yards. Our comparison of current under the two unitary systems gave us the expression $[L\, T^{-1}]$ which equals v, a velocity which has been found to be 3×10^{10} centimetres per second. Thus the E.M. unit is 3×10^{10} centimetres per second greater than the E.S. unit. That a physical quantity can possess two different fundamental units, that one of these can be enormously greater than the other, and that these units shall contain terms such as $L^{\frac{3}{2}}$, are irrational conceptions for which the failure to take into consideration not only the means by which the law of inverse squares acts but the properties of space itself is responsible. In order to rationalize our unitary systems some constants must be fixed upon which will rectify the omissions just referred to. By way of explanation it may be pointed out that the *calculation* of the resistance of a piece of copper wire is impossible unless the formula includes a certain constant known as the specific resistance of copper, because this constant has to do with a property peculiar to copper, as distinct from the length of the wire and the area of its cross-section. In the same way, in the case we are dealing with, we have to induct into our formulæ constants which will correct the ratio of the two sets of units. These constants are the magnetic permeability, μ, in the electromagnetic system, and the dielectric constant, k, in the electrostatic system.

The reasons for selecting these constants can be stated as follows. We are examining the case of the propagation of stresses and strains across an elastic medium, the æther. The velocity of a wave in a medium the elasticity and density of which can be computed in absolute units is $\sqrt{\frac{e}{\rho}}$, where e is the elasticity and ρ the density. If we can only apply this expression to the æther we should have a rational formula for the velocity of electromagnetic waves, but the paucity of our knowledge of the elasticity and density of æther renders it necessary for us to consider whether it possesses any other properties which bear the same relation to it as elasticity and density bear to ordinary matter. If the reader will study their definitions he will see that k and μ represent the two properties we are seeking.

From a detailed consideration of the displacement produced in a dielectric by electric force it can be shown that the elasticity of the dielectric is proportional to the reciprocal of the dielectric coefficient. Therefore, for $v=\sqrt{\frac{e}{\rho}}$ we may write $v=\sqrt{\frac{1}{k\,\mu}}$ or $\frac{1}{\sqrt{k\,\mu}}$, μ being unity in the case of the æther.

Returning to the two unitary systems let us take the case of the unit of strength of magnetic pole. In the dimensional system force, F, is the product of mass and acceleration.

That is, $$F=\frac{M\,L}{T^2}=M\,L\,T^{-2} \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

But the force between two magnetic poles varies as the product of their strengths and inversely as the square of the distance between them.

That is, $F \propto \frac{m_1 \times m_2}{d^2}$, where m is an arbitrary unit. If the poles are equal we may write $F \quad \frac{m^2}{d^2}$, and, taking into account the magnetic permeability of the intervening medium, $F=\frac{m^2}{\mu\,d^2}$ . . . . (6)

Therefore (5) $M\,L\,T^{-2}=\frac{m^2}{\mu\,L^2}$, where L denotes distance between the poles.

Whence $$m^2=(M\,L\,T^{-2})\,\mu\,L^2$$
and $$m=M^{\frac{1}{2}}\,L^{\frac{3}{2}}\,T^{-1}\,\mu^{\frac{1}{2}}.$$

As has been stated, we do not know much about the properties of the æther, and are therefore unable at present to designate the *dimensional* value of μ in that medium; its numerical value is taken as unity. A similar statement holds good for the dimensions and numerical value of k for the same medium. From the definition of m as derived above the system of electromagnetic units has been constructed so as to include the arbitrary dimensions of μ.

We will now consider the case of unit charge. Here $F \propto \frac{q_1 q_2}{d^2}$, where q is the magnitude of the charge. By similar reasoning to that employed in the instance of the unit poles, $q = M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-1} k^{\frac{1}{2}}$, where k is the rationalizing constant. From this definition of q the electrostatic system of units has been derived, each unit containing the factor k, which is taken as unity in the case of æther.

We can now write our four examples thus :—

Unit.			Electrostatic.	Electromagnetic.
Current	...	...	$[L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-2} k^{\frac{1}{2}}]$	$[L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1} \mu^{-\frac{1}{2}}]$
Quantity	...	...	$[L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-1} k^{\frac{1}{2}}]$	$[L^{\frac{1}{2}} M^{\frac{1}{2}} \mu^{-\frac{1}{2}}]$
E.M.F.	...	...	$[L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1} k^{\frac{1}{2}}]$	$[L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-2} \mu^{\frac{1}{2}}]$
Resistance	...	...	$[L^{-1} T k^{-1}]$	$[L T^{-1} \mu]$

If, as has been suggested, the inclusion of k and μ in these formulæ corrects the ratio between the units in the two systems, we ought to be able to equate the two expressions found for any one unit. For example,

Electromagnetic unit of quantity, $L^{\frac{1}{2}} M^{\frac{1}{2}} \mu^{-\frac{1}{2}} = L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-1} k^{\frac{1}{2}}$, which is the electrostatic unit of quantity.

From this equation, by simplification, we get

$$\mu^{\frac{1}{2}} = \frac{L^{\frac{1}{2}} M^{\frac{1}{2}}}{L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-1} k^{\frac{1}{2}}}$$

$$k^{\frac{1}{2}} \mu^{\frac{1}{2}} = \frac{L^{\frac{1}{2}} M^{\frac{1}{2}}}{L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-1}}$$

$$k^{\frac{1}{2}} \mu^{\frac{1}{2}} = \frac{1}{L T^{-1}}$$

$$\sqrt{k \mu} = \frac{T}{L}$$

$$\frac{1}{\sqrt{k \mu}} = \frac{L}{T}$$

Now $\frac{L}{T}$ is the dimensions of unit velocity v, in centimetres per second, so that we may conclude that $\frac{1}{\sqrt{k \mu}}$ also represents a velocity, and we should arrive at a similar conclusion by equating the units of any electrical quantity as we have just equated those of quantity. By calculations from certain formulæ well known to mathematicians Maxwell was led to the belief that $\frac{1}{\sqrt{k \mu}}$ is the velocity of waves in the electromagnetic medium, and this velocity has been determined by the direct measurement of electrical quantities. The mean of the best results can be taken as 3×10^{10} (or 30,000,000,000) centimetres per second, or, roughly, 186,000 miles per second. *This value has also been found for the speed of light.* Maxwell therefore stated his opinion that light is an electromagnetic phenomenon, light waves being actually electromagnetic waves. In view of the foregoing explanation Maxwell's theory should appear to the reader to be an eminently reasonable one, as the chief alternative would be to regard the identity of the numerical value of $\frac{1}{\sqrt{k}\,\mu}$ and the velocity of light as a mere coincidence, a position which could not be seriously maintained.

IV.

THE THEORY TESTED.

As a test of the theory we will take as examples two media, say air and flint glass, which have equal magnetic permeability but different dielectric coefficients. Now μ in both air and glass is by necessity considered to be unity, therefore in each case $v \propto$ inversely as $\sqrt{k}$. Calling the dielectric coefficient of air k_1 and that of glass k_2 (the subscripts being added simply to distinguish the two media), the ratio of the velocity v_1 in air to that of v_2 in glass is shown by the equation :—

$$\frac{v_1}{v_2} = \frac{\frac{1}{\sqrt{k_1}\,\mu}}{\frac{1}{\sqrt{k_2}\,\mu}}$$

$$= \frac{\sqrt{k_2}\,\mu}{\sqrt{k_1}\,\mu}$$

and as μ is taken as unity in both cases, we get :—

$$\frac{v_1}{v_2} = \sqrt{\frac{k_2}{k_1}}$$

Now, $\sqrt{\frac{k_2}{k_1}}$ represents, as was stated, the ratio of v for air to v for glass, and this ratio is known as the refractive index of glass. Moreover, k_1 is taken as unity, so that the refractive index can be written $\sqrt{k_2}$. If we square this expression we get k_2, which is the dielectric coefficient of glass. Hence the square of the refractive index of glass should equal the dielectric coefficient of glass, and in general it follows that k for any transparent medium equals the square of its refractive index.

At first it was found that this conclusion was not borne out by the results obtained from actual tests. In certain cases the theory was confirmed in a remarkable manner, whereas for some substances no agreement could be noted. For example, for flint glass the dielectric constant has been computed at 6·57, whereas the square of its refractive index has been found to be about 2·4. Later researches have shown that the coincidence of the theory with practical results depends to a great extent upon the temperature of the medium and the wave-length of the light employed for the determination of the refractive index. It is fairly evident that the same wave-length should be used for determining both values, but as it is most convenient to ascertain k by means of fairly large wave-lengths, whereas the measurement of the refractive index can only be carried out for small wave-lengths, the discrepancies observed between fact and theory are fairly numerous. Yet it is possible to calculate approximately the refractive index for large wave-lengths from the existing data for short ones, and it may now be held that, in general, k is equal to the square of the refractive index.

As another result of Maxwell's theory it should be true that all conductors are opaque to light. This, in the case of metallic conductors, is well known to be supported by facts, and, further, it is stated that a metal beaten into the form of a sheet transparent to light will no longer act as a conductor of electricity.

BETA.

Among the Operators

MONTH by month, as will be noticed, it is our sad duty 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 information reaching the enemy, the names of ships and localities of action cannot be published, and in view of the fact that but few particulars are available of what are, perhaps, some of the worst cases of Hunnish piracy, full tribute cannot be paid to many gallant deeds.

Both for our own part and on behalf of our numerous readers we extend to the parents and relatives of these young men, who so nobly upheld the "wireless tradition," the deepest sympathy in their bereavement.

OPERATOR D. E. BEATY.

FEARED LOST AT SEA.

As the ship on board which Mr. David Edmond Beaty sailed from Liverpool in October last has not since been heard of, it is feared she has been lost at sea with all hands. Born at Cambus, N.B., on February 10th, 1898, Mr. Beaty was educated at the High School, Dunfermline, and George Heriot's, Edinburgh, receiving his wireless training at the North British Wireless Schools, Ltd., Edinburgh. He joined the Marconi staff in July, 1915, and made his first trip, of 17½ months' duration, on one of H.M. Australian transports, subsequently serving on two other vessels before that on which he last signed on.

SUNK BY TORPEDO.

Mr. Charles Alexander McLaren, who was in his eighteenth year, was born at Braemar, educated at the Braemar Public School, and trained at the Scottish Wireless College, Aberdeen. Entering the service of the Marconi Company, in February, 1917, Mr. McLaren served on two ships previous to the one on which he lost his life on December 28th last, when she was torpedoed and sunk by a German submarine.

OPERATOR C. A. McLAREN

TORPEDOED AND SUNK.

Another case of death as a result of U-boat activity is that of Mr. Philip Ewart Parker, whose ship was sunk by torpedo on December 13th, 1917. The first ship to which he was appointed suffered damage from shell-fire, but Mr. Parker on that occasion escaped injury, afterwards making trips on two other vessels. Born on October 15th, 1898, at

OPERATOR P. E. PARKER.

Clitheroe, where he was educated, Mr. Parker spent some time as clerk in an accountant's office, later taking up a position as cinematograph operator. Desiring to enter the wireless service, he attended the Liverpool Wireless Telegraph Training College, and was appointed to the Marconi Company's operating staff in November, 1916.

Fatally Injured on Board.

Even when so many lives are being sacrificed as a consequence of the war, accident and illness still claim their quota. Mr. Herbert Charles Moore, who was making his first trip, died in hospital as the result of injuries sustained when he accidentally fell down the ship's hold. Eighteen years of age, he was born at Farnham, Surrey. After being educated at the Farnham Grammar School, he held an appointment in the Army Audit Office at Aldershot, which he relinquished to undergo training in wireless at the British School of Telegraphy, London, where he gained his Postmaster-General's certificate. He joined the Marconi Company last August.

OPERATOR H. C. MOORE.

Collision at Sea.

Mr. David Owen Davies, 18½ years, was born at Liscard, Cheshire, and there received his education. After leaving school he was employed by the American Express Company, Liverpool, for over two years, and gave up his situation to study wireless at the Liverpool Wireless Telegraph Training College, where he obtained his Postmaster-General's certificate.

In July last, Mr. Davies was appointed to the Marconi staff, and went to sea shortly afterwards. Unfortunately, the ship on board which he was making his initial voyage was in collision, and sank in British waters, Mr. Davies's body being washed ashore.

OPERATOR D. O. DAVIES.

Killed by Enemy Gunfire.

News is to hand as we go to press of the death, from wounds inflicted by gunfire, of Mr. Charles

Lombard Audigier, who was killed when the ship on which he was serving was attacked by the enemy.

Of London birth, Mr. Audigier was nearly seventeen, and went first to the Icknield Street School, Birmingham, completing his education at the Acton Higher Grade School. Previous to being trained in wireless telegraphy at Marconi House he was employed as a tracer in the drawing offices of the Fairey Aviation Company's works at Hayes, Middlesex, and the engineering works of Messrs. W. & G. du Cros, Acton, W. After qualifying for an operator, Mr. Audigier sailed on his first voyage in December of last year.

OPERATOR C. L. AUDIGIER.

Our New Volume

THE present number brings to a close Volume V. of THE WIRELESS WORLD—a volume produced in troublous times, but one we venture to think well up to our usual standard of interest. With the total suppression of amateur working, the prohibition of the publication of any matter relating to the construction of wireless apparatus, and the heavy hand of censorship upon practically all of the most interesting phases of wireless work in the war, it has been no mean task to select and produce matter of general interest to our readers, and we take this opportunity of expressing our deep appreciation for the help we have received from subscribers in all parts of the world. We pride ourselves on not only having retained the support of a very large number of subscribers who have joined His Majesty's Forces but also on having gained many new friends. Let us trust that before the new volume is completed the present terrible conflict will have ceased, and that we shall be able to print once more, in full, the results of modern investigation and research.

These are not the times for drastic changes in the make-up of a magazine. We hope, however, still to improve the coming numbers, while retaining those features which have been very much appreciated.

A bright new cover design will be the main change in the April issue, while a new feature will be the presentation each month of a double-page diagram of some interesting piece of wireless apparatus. Our valued contributor, Professor Paul Baillie, will also contribute a special article with numerous abaci showing a number of new ways of facilitating wireless calculations.

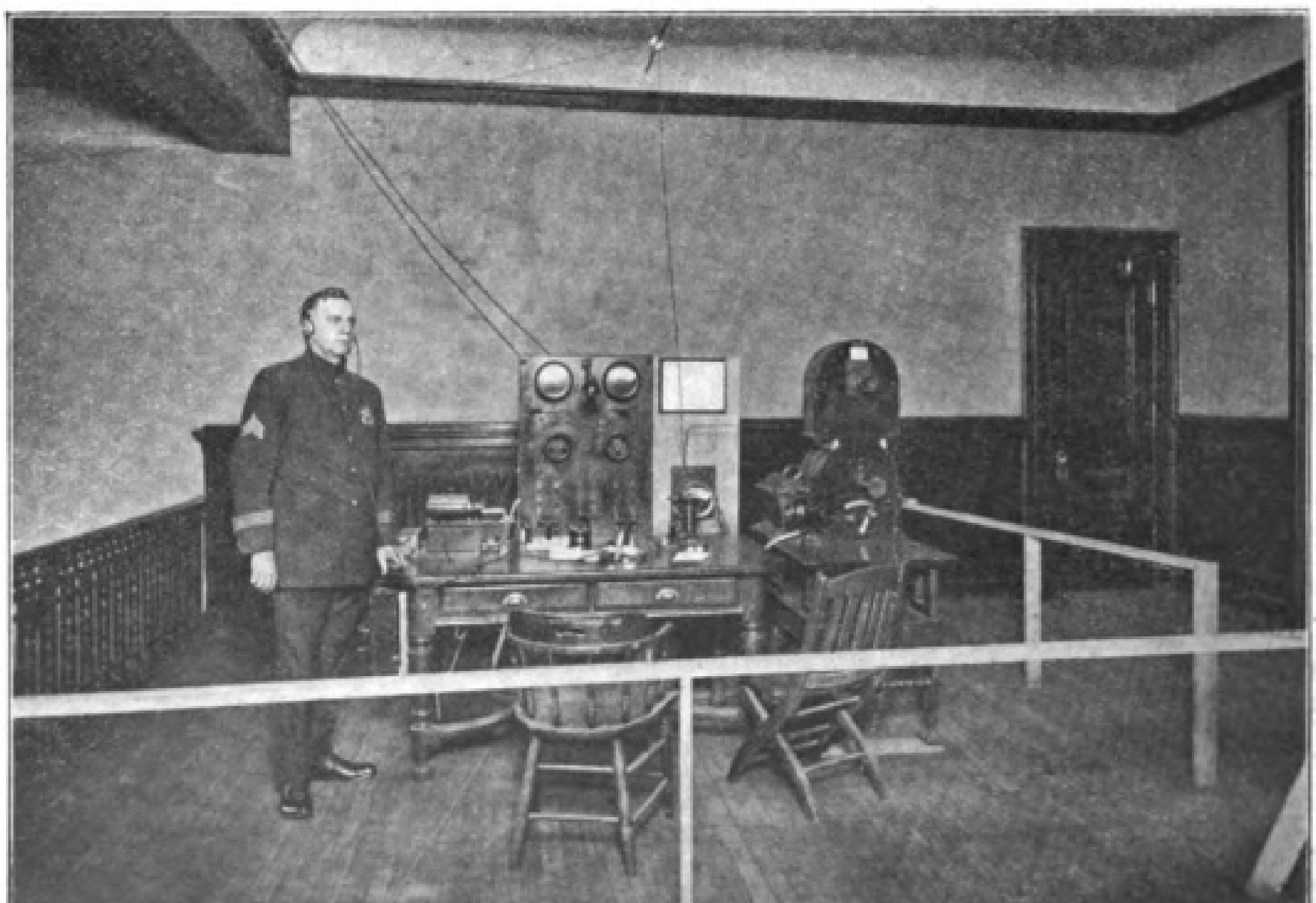
Readers who have friends interested in wireless telegraphy, but who are not subscribers to our magazine, will render us great service by reminding them of this excellent opportunity of starting to take in THE WIRELESS WORLD regularly. The more new readers we gain the better value we can give, and showing any assistance in this way is beneficial not only to ourselves but to the subscribers who so help us.

Wireless Service in New York Police Department

By FRANK C. PERKINS

THE Manhattan Police headquarters wireless station is seen in the accompanying photograph under the charge of Sergeant Chas. E. Pearce. Wireless telegraphy was adopted in the programme of general preparedness instituted by the Police Department of New York City as an added means of communication between the different divisions of the force, and it is held that as such it is the first instance on record where wireless telegraphy has been brought into use in a municipal department in the United States. Although the Police Department already had a large private telephone system, the necessity of a dependable means of communication in addition was realised.

Considerable work has been done with signal flag and Morse light systems, and also with portable field telephones, but wireless telegraphy has received the most attention of these auxiliaries. In introducing this part of his plan for police preparedness Commissioner Woods first established a school of instruction in radio work at headquarters, one of the classrooms of the training school being fitted up with a buzzer system for code practice and with blackboards for demonstration work and circuit diagrams. Sergeant Chas. E. Pearce, a member of the uniform force and a



WIRELESS STATION AT MANHATTAN POLICE HEADQUARTERS.

former telegraphist, who had been studying and experimenting with wireless in his spare time for several years, was given charge of the school, and thirty of the members of the Department who had had experience in telegraph, telephone or signal work were assigned for the course of study. It is of interest to note that on completion of the course all passed the Federal examination and received licences as first-class radio operators. High-grade commercial wireless equipments were then installed in the headquarters buildings in Manhattan and in Brooklyn, and also on the Department steamer *Patrol*. This ship is the flagship of the Marine Division of the Department—the Division which gives the same protection to New York's six hundred miles of waterways that the rest of the Force gives the land part of the city. With the outbreak of the war, although practically all the other privately owned wireless plants were closed, these three stations were continued in operation, under supervision of the Navy Department, and now work in conjunction with the New York Police Department's wireless service, several Government wireless stations covering the metropolitan district.

A thousand or more important radiotelegrams connected with the work of the Police Force have been exchanged between the *Patrol* and the headquarters stations, which could not have been handled in any other manner. The promptness with which orders and reports can be exchanged with the *Patrol* is, therefore, of valuable assistance to both the Federal and the Municipal Government. The *Patrol* is stationed at Pier A, at the lower end of Manhattan Island, and cases where police aid is needed on the surrounding waters are reported immediately to headquarters or the Pier A precinct by telephone. When the boat is at the dock it is sent to investigate, and, when circumstances require it, the commander of the boat sends a wireless report of the matter investigated to the headquarters wireless operator for delivery by telephone.

When the *Patrol* is cruising around the bay such messages are sent by the headquarters wireless operator direct to the boat. Previous to the installation of wireless, when the boat was cruising, it was necessary to tie up at some dock and for an officer to find a telephone in order to communicate with headquarters or the precinct. This took considerable time, particularly at night. Now communication is practically instantaneous, which increases the efficiency of the Harbour Police considerably. A few of the many cases in which the wireless has enabled prompt police service to be rendered are mentioned below. In each instance, although the *Patrol* was away from the pier, communication with it was established instantly, whereas valuable time would have been lost in notifying the crew of these occurrences under the old system.

On one occasion two barges broke away from the pier at the foot of East 54th Street, and, driven by a strong wind and tide, swept up the East River and carried three more away from the pier of East 70th Street. The five then drifted out through Hell Gate, in the path of the fleet of steamers that come in through Long Island Sound early every morning. The *Patrol* was off Staten Island when this information reached headquarters, and was notified by wireless about 4 o'clock. At 5.35 a.m. it reported by wireless that four of the barges had been caught and docked by the police boat and that the fifth was taken in charge by a tug.

In another instance a small fire occurred in the Metropolitan Hospital on

Blackwell's Island. The *Patrol*, cruising around the lower bay, was notified by wireless, and to stop at the East 51st Street pier for a battalion fire chief on the way. When the fire was out, wireless orders were given the boat to continue cruising. The Richmond Telegraph Bureau notified Harbour A of a fire on board a municipal ferry boat bound from New York to Staten Island. The information was wirelessed to the *Patrol*, which was in the East River at 3 o'clock, and promptly investigated, and at 3.39 p.m. it reported by wireless that the fire was extinguished with slight damage.

The Brooklyn Telegraph Bureau was notified by a citizen at 4.35 p.m. that people in a motor boat off Manhattan Beach were waving distress signals on another occasion. The Brooklyn wireless operator sent the message to the *Patrol*, which was cruising up the East River, but immediately started to the rescue. At 5.16 p.m. the commander of the boat inquired by wireless if any further information had been received, and the Brooklyn operator, after communicating with the citizen who reported the matter, sent the following message to the boat at 5.28 p.m.: "Party in motor boat off Manhattan Beach still waving white flag. Coney Island Life Corps tried to reach them and failed." The *Patrol* reached the location at 6.15 p.m., just as the disabled launch was taken in tow by a fishing steamer.

Scores of similar uses of the wireless plant occur with the same valuable results. A citizen notified Richmond Telegraph Bureau at 10.30 p.m. on a recent date that a large Transatlantic steamer was sinking, after collision with another boat in the Narrows. The *Patrol* was ordered to the scene by wireless to assist in handling passengers, and at 12.15 p.m. forwarded a full report of the accident to headquarters by wireless, which was telephoned to the precinct. Four days later, at 6.20 p.m., a schooner which had grounded in the bay near Ellis Island floated at high tide and drifted up the Hudson River with no one on board. Harbour A was notified by telephone and relayed the message to the *Patrol* through Manhattan headquarters wireless station. At 6.40 p.m. a wireless message was received from the boat that the schooner had been anchored and lighted.

At 9.40 p.m. several days following Harbour A was notified by the pier watchman that a lighter had broken away from the West 30th Street pier and was drifting up the river. The *Patrol*—off the Statue of Liberty—was notified, and at 10.15 p.m. reported by wireless that the lighter, carrying a cargo of coffee valued at $50,000, had been returned to the pier.

Showing the prompt service possible with this wireless equipment, at 5.25 p.m. a report was received at headquarters, Brooklyn, that a party in a row-boat off Coney Island were being carried out to sea. The Brooklyn wireless operator forwarded the report to the *Patrol*, which started for the scene. Seven minutes later, at 5.32 p.m., the Brooklyn station was notified that the boat had been picked up, which information being wirelessed to the *Patrol* prevented an unnecessary trip of several miles. The next day, at 6.45 p.m., a citizen notified Harbour A of a tug going up and down the East River, apparently not under control, as it had collided with other boats. The *Patrol* was sent to investigate, and found that two intoxicated boatmen had stolen the tugboat *Gen. I. J. Wistar* from a pier in Brooklyn and were having a "joy ride." A crew was put on the tug, the men were arrested, and the matter reported by wireless at 7.50 p.m. The tug was returned to the owners only slightly damaged.

The steamer *Patrol* has also met at Jersey City and brought to New York each of the seven foreign Commissions that have visited this country on official business during the summer, and it is stated that in several inspection trips made by the different Commissions accompanied by city officials, around New York Harbour on the *Patrol*, the wireless was in almost constant use, handling urgent communications between the official and his office, *via* Police Headquarters and the telephone system. An extension of the wireless system to ten or twelve of the seventeen inspection districts of the Department is now planned.

Senatore Marconi on the Victories of Science in War

Senatore Guglielmo Marconi, fresh from war service in Italy, gave a little time recently—he was returning almost immediately to his naval duties—to talk with a special correspondent of the *Daily Chronicle* on a number of matters relating to Italy, and to touch lightly on what had been accomplished scientifically in the war. These inventions and improvements form a fascinating page of war history; but, alas! military regulations are against revealing them in any detail.

Mr. Marconi was wearing the dark blue uniform of a commander in the Royal Italian Navy. Across his chest were two rows of war-bars—insignia of his skill and intrepidity. Still a young man in the early 'forties, he showed uncommon alertness in the conversation, notwithstanding that he had just risen from a sick-bed.

Turning, first of all, to inventions, Mr. Marconi said: "There has been considerable progress in wireless telegraphy and in other sciences utilised by the war; but, unfortunately, one cannot speak about it. The man in the street can see for himself the progress in aviation, which is mainly destructive; but some day he will realise what has been accomplished in a humanitarian sense. I assure you it is very interesting to social progress and civilisation.

"Wireless telegraphy is of greater use to us than to the Germans, for we are scattered all over the world and they are a compact block. The distances from which messages can be sent and the improvements effected in various ways will astonish scientists not in close touch with war developments when they read about them some day. The entry of America has certainly exemplified the great utility of rapid communication over wide spaces.

"I think that the Allies should assign a greater *rôle* to science. It could be used more effectively, no doubt, in torpedo work and in the artillery. What is needed is rapidity in the conception and execution of scientific ideas. This implies closer union amongst the experts employed by our numerous Allies. There should be a complete mobilisation of scientific brains and greater opportunities given for mutual consultation and discussion—in fact, the organisation should resemble the War Councils.

"America has set the example of a Naval Consulting Board, which I had the honour of attending in Washington last July. It is composed of experts under Mr. Edison. We should imitate that. Speed is wanted. We should push our scientific advances so quickly that the enemy cannot overtake them or copy them. Success would result, I think, from such a course, especially if the civilian populations showed an equal readiness with the soldier to endure hardships."

Instructional Article

NEW SERIES (No. 12).

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

60. Rotating Field Alternators.—It has previously been mentioned that in the larger sized alternators the position of the field and armature winding is transposed, the armature forming the stator or fixed coils, while the field winding forms the rotor or revolving coils.

In alternators of the revolving armature type the question of the insulation of the sliding contacts is of primary importance when the machine is designed to generate high voltages.

When the armature is stationary and the field magnets revolve, then it is quite a simple matter to design contacts to carry the low voltage current necessary to magnetise the field magnet poles.

Alternators can be divided roughly into two classes :—

(1) Alternators with the magnet poles excited by a single coil called a mono-coil field.

(2) Alternators with a coil for each magnet pole called a multi-coil field.

61. Mono-Coil Alternators.—The first alternator constructed with revolving field magnets and stationary armature is that due to Mordey in 1888 in which the field is excited by a single field coil.

The exciting coil of the magnet is wound round an iron core, and from this core radiate the polar projections, which are bent towards the centre in the form of a claw. The poles on one side of the field magnet will therefore be of marked polarity, and will be opposed on the opposite side of the field coil by poles of unmarked polarity. The ends of the field exciting coil are brought out to two

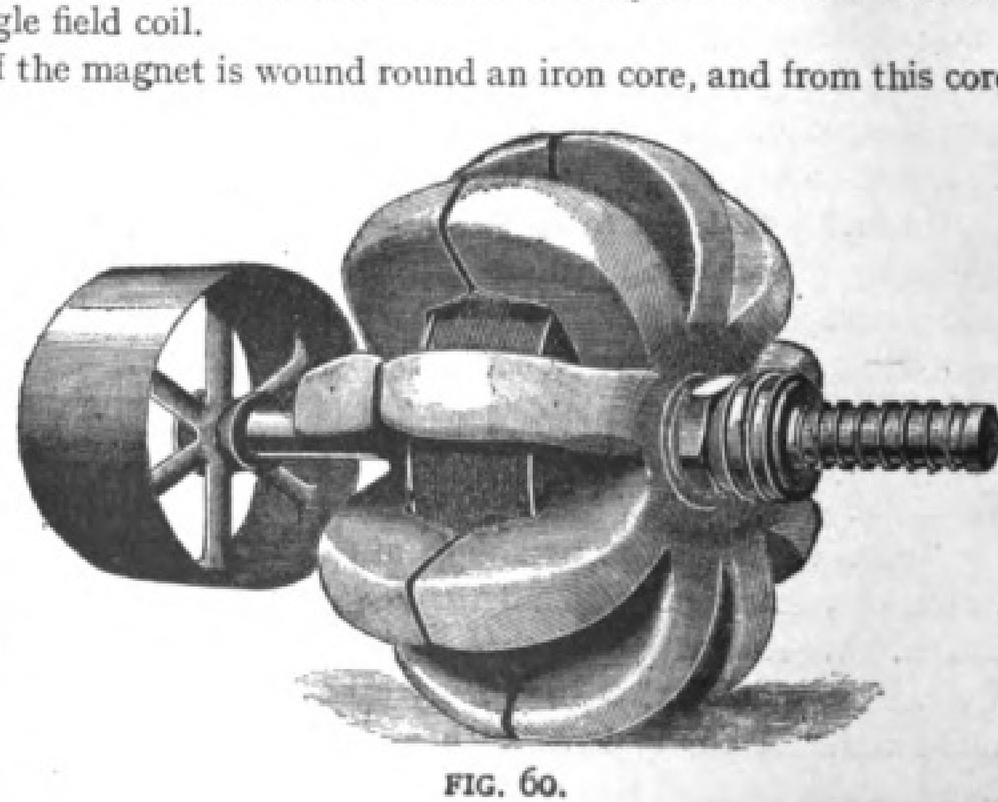


FIG. 60.

FIG. 61.

slip rings to which is supplied the direct current. These two collector rings can be seen at the right hand end of the shaft in Fig. 60, the shape of the field magnet being also clearly shown.

The ends of the opposing magnets are brought as close together as possible, and in this space are fixed the armature coils. The whole of the field magnet and the exciting coil revolve, the magnetic field of each pair of poles therefore cutting in turn an armature coil.

The armature coils are constructed of copper strips wound on a pear-shaped former of wood. Each coil comprises several of these strips insulated from each other and the whole bound together with tape. The method of mounting the coils is shown in Fig. 61, and a point to note is that, since the magnetic field only passes through the armature coils and the wood former, no lines of force are wasted through magnetic leakage.

In Mordey's machine there were nine magnet poles on each side of the field coil and eighteen coils on the armature. It therefore follows that when one coil is opposite a space between two magnet poles the two adjacent coils are opposite two magnet poles.

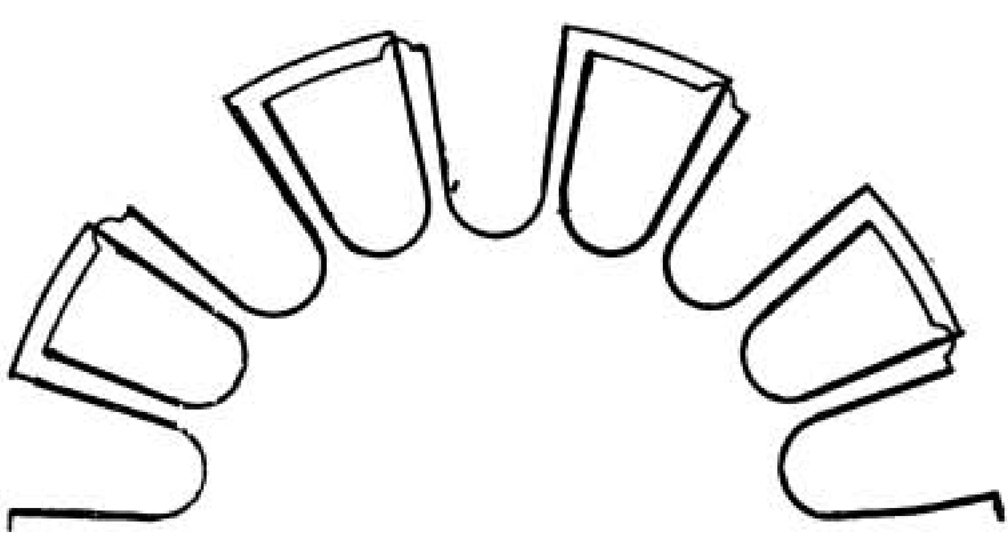


FIG. 62.

The method of connecting the armature coils is shown in Fig. 62, only one-half of which are shown. The connections of the other half are, of course, the same, the two halves then being connected in parallel. The reason for this is that if all the coils were connected in series the potential between the two coils connected to the slip rings would be the maximum voltage developed by the machine, and, since alternators are usually desired to produce a high difference of potential, the insulation of these two coils would be a matter of difficulty. If, however, the two halves of the armature are connected in parallel the total voltage induced is only half that if the armature coils are connected in series, but the potential difference between any two adjacent coils is only that developed by one coil.

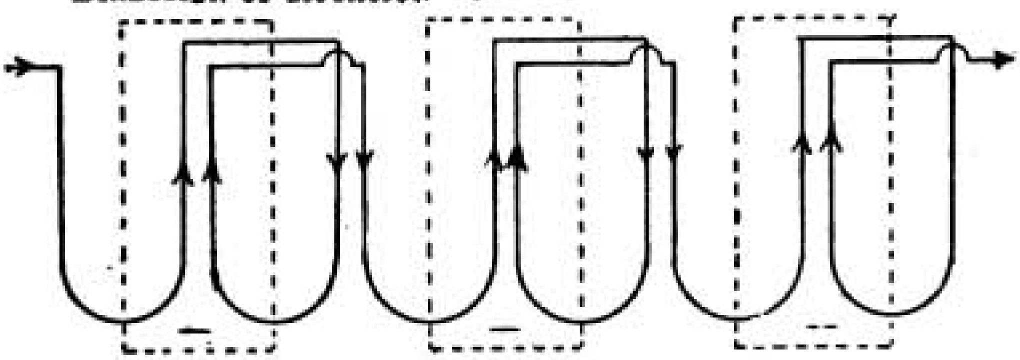


FIG. 63.

It will be seen that an electro-motive force is induced in the armature coils in **one** direction as the coils leave a magnetic field of **minimum** strength and enter a magnetic field of **maximum** strength, and in the **opposite** direction when the coils leave a magnetic field of **maximum** strength and enter one of a **minimum** strength.

Figs. 63 and 64 show the position of the armature coils with respect to the field magnets, the first position showing the coils generating the maximum E.M.F. in **one** direction, and the second position showing the coils generating the maximum E.M.F. in the **opposite** direction.*

Each **reversal** of the induced electro-motive force occurs, therefore, when the coils have the **maximum** and **minimum** number of lines of force passing through them. The induced electro-motive force depends, therefore, on the **variation** of the strength of the magnetic field and not on a reversal of the magnetic field.

Although the Mordey alternator is now only of historical interest, it is the forerunner of all alternators with revolving field magnets, and the principles underlying the machine are the same as those of all modern mono-coil alternators.

69. Multi-Coil Field Alternators.—The majority of alternators now designed with rotating field magnets are those with the magnet poles having a separate exciting coil for each limb.

The design of such alternators varies, of course, with the work for which the alternator is required, but the same general principles apply to all multi-coil field alternators.

The field magnet cores are bolted round the periphery of a revolving flywheel and are so wound that the

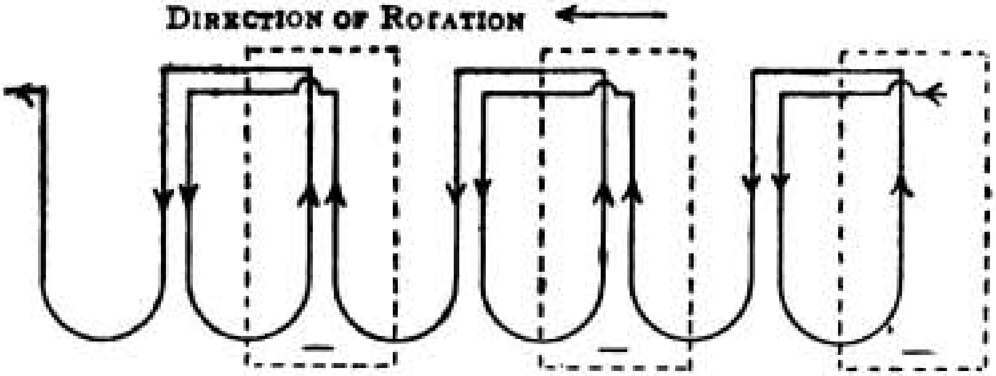


FIG. 64.

* The magnets shown are those at the back of the armature. The lines of force therefore pass down from the reader.

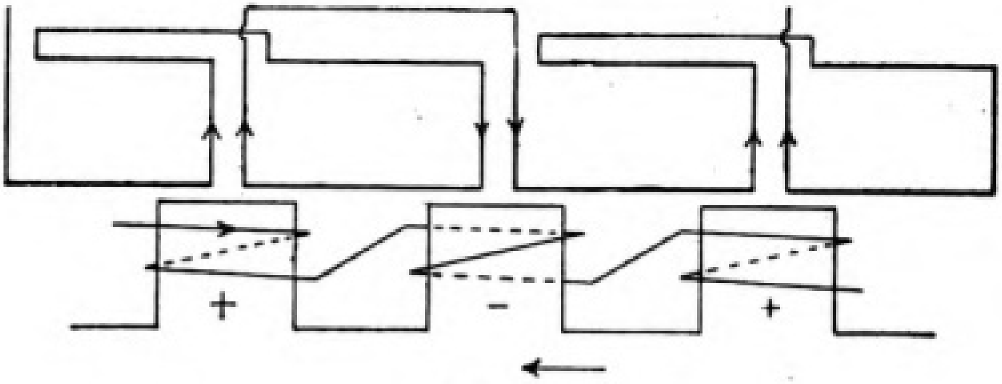


FIG. 65.

polar projections are alternately of **opposite** polarity as shown in Fig. 65.

Fig. 66 shows a typical field magnet system of a revolving field alternator.

Since there are a number of magnet poles of opposite polarity, it follows that there are a great number of magnetic circuits around the rim of the flywheel; the length of any magnetic path cannot, therefore, be much greater than the pole pitch.

The armature is usually constructed of a heavy frame ring, made in two halves and bolted together. The laminated iron of the armature to carry the armature coils is then built up inside the ring. Fig. 67 shows a typical armature of a revolving field alternator, the iron cores carrying the armature coils being clearly shown. The iron cores are, of course, laminated to prevent eddy currents being set up in the core by the rapidly changing armature currents.

The lines of force are practically all confined to the laminated portion of the armature ring, so that few find their way into the yoke or solid casting of the armature ring.

Since the **polarity** of the field magnets is alternately **opposite**, it follows in order that the electromotive force induced in each armature coil shall be in the same direction at the same time that the direction of the winding of each armature coil must be **opposite** to that of the two adjacent coils. Instead of winding the coils in opposite directions the same end is obtained by connecting the start of one coil to the start of the second coil and the end of the second coil to the end of the third coil, the start of the third coil being connected to the start of the fourth coil, and so on.

This is shown in Fig. 65, the position of the armature coils with respect to the field magnet being such that the maximum

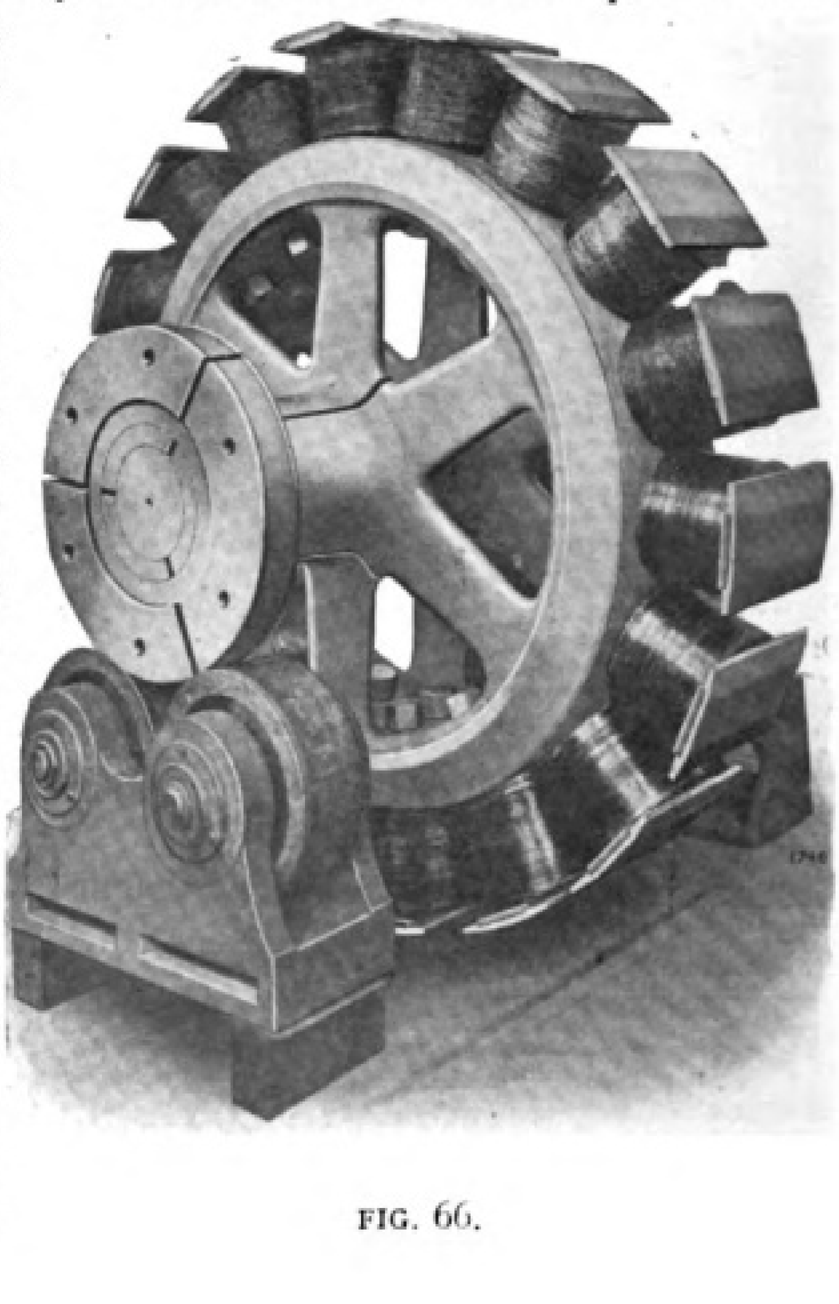


FIG. 66.

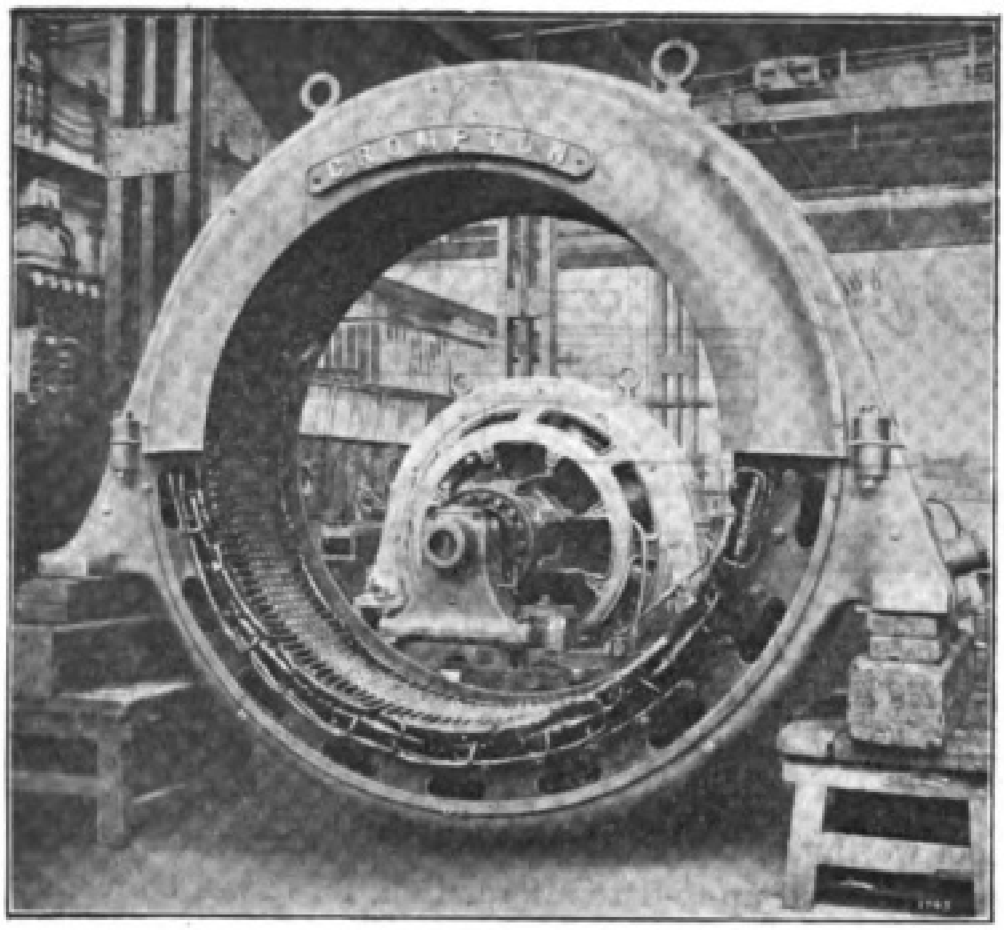


FIG. 67.

electro-motive force in one direction is produced.

In the Figure shown the armature coil is the same length as the pole pitch. There is, therefore, the same number of armature coils as polar projections, and it will be seen from the diagram the direction of the induced electro-motive force in the armature coil.*

In single-phase machines there are generally from two to six slots in the armature stamping per pole. The armature coils are first wound on a former, taped and varnished, and then placed in position in the armature slots and held in position by means of wooden wedges.

An important point of difference between mono and multi-coil alternators is that in the former the electro-motive force is induced by a magnetic field varying from maximum to minimum and back again, whereas in the multi-coil alternator the induced electro-motive force depends on the reversal of the magnetic field in the armature coils.

The author is indebted to Messrs. Crompton & Co. for photographs of revolving field alternators.

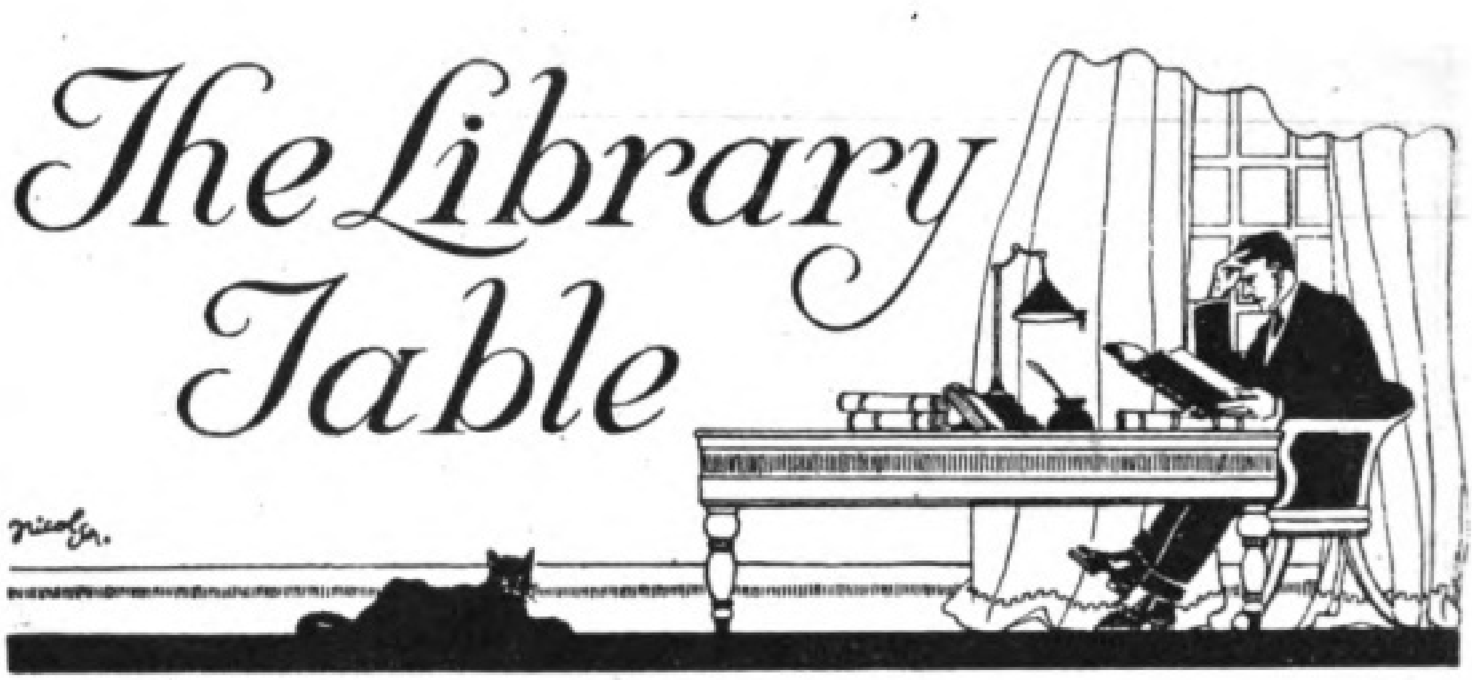
* To make the diagram clear the armature coils have been drawn in a vertical position.

Share Market Report

LONDON, *February* 14th, 1918.

DEALINGS in the shares of the various issues have been more active during the past month. The preliminary statement issued by the Marconi Wireless Telegraph Company of America giving a comparative summary of receipts and expenses for the past four years was very favourably received, and brought in considerable investment buying. The market in the shares is very firm at the present time, the closing price of all issues as we go to press are: Marconi Ordinary, £3 2s. 6d.; Marconi Preference, £2 12s. 6d.; Marconi International Marine, £2 10s.; Canadian Marconi, 11s. 3d.; American Marconi, £1 5s. 9d.; Spanish and General, 9s.

The Library Table



EASY LESSONS IN WIRELESS TELEGRAPHY FOR THE USE OF STUDENTS, EXPERIMENTERS AND OPERATORS. By A. F. Collins. New York: Theo. Audel and Company; London: Geoffrey Parker, West Ealing. 3s.

In every wireless school worthy of the name the course of instruction is carefully designed to impart accurate and up-to-date information, for it will be readily admitted that inaccurate instruction imparted to a student may eventually have a very vital bearing upon his manipulation of the apparatus on board ship. Let us imagine a case in which the operator, confronted in an emergency with a rare fault, is thrown entirely upon his own resources for its elimination. An accurate knowledge of principles will enable the man to remedy the fault in a minimum of time, and may be the means of saving many lives and a valuable cargo.

This leads up to the point we are endeavouring to elucidate—namely, that the selection of a text-book on wireless telegraphy is a serious matter, and the responsibility devolving upon the author no light one.

From the title-page of this book we learn that the small volume is supposed to cover "a practical course of instruction on the principles, construction and the workings of wireless apparatus for the use of students, experimenters and operators," and the author, amplifying this in a foreword, states that it is "a rational course designed to teach not only the beginner the elementary principles of electro-magnetic phenomena as utilised in the wireless art, but to enable the practical telegraph operator to acquire a thorough working knowledge of this newest and most promising branch of applied electricity."

The book is divided into twelve lessons dealing respectively with (1) Forms of Electricity; (2) Magnetism and Electro-magnetic Induction; (3) Disruptive Discharge; (4) Electric Oscillations; (5) Electric Waves; (6) The Aerial Wire System; (7) The Grounded Terminal; (8) The Transmitting Apparatus; (9) The Receiving Apparatus; (10) The Aerial Switch and other Apparatus; (11) Installing the Apparatus; (12) Some other Considerations.

That the aims of the author are by no means achieved is evidenced by a perusal of the first few pages. We find, for instance, the following remarkable paragraph in Lesson I., entitled "Forms of Electricity."

"There are four principal forms of electricity—namely, (1) Static, or electricity at rest; (2) Current, or electricity in motion; (3) Magnetism, or *electricity in rotation*." (The italics are ours.)

What the fourth form actually is we are left to guess, but in view of the extraordinary definition of magnetism we can only presume that it is something beyond the descriptive powers of the author. Other descriptions in the chapter are slipshod and inaccurate, such as the statement that "current electricity is usually understood to mean electrical energy of considerable *current strength* and long duration as compared with a static discharge."

On page 21, speaking of primary cells, the author states that there are many types of cells, yet none has been devised to develop more than two volts, having presumably overlooked the bichromate cell; and how little attention is given to important matters is illustrated by the fact that Ohm's law is dismissed in a dozen lines.

One of the worst and most inexcusable of the many errors in this volume occurs in Lesson 4, where we see an illustration of the Marconi ½-kw. converter with disc discharger. Although the illustration clearly shows a machine with the vertical armature, the author states that the shaft runs horizontally, and ends his description with the remarkable statement that "this converter is the English Marconi Co.'s apparatus, and is used principally by wireless inspectors for inspecting vessels." The unconscious humour of this will be much appreciated by practical operators, seeing that the machine weighs something over two hundredweight. In Lesson 5, entitled "Electric Waves," various diagrams, several of which are quite inaccurate and many hopelessly confusing for the student, are given in an attempt to explain propagation of electric waves over the surface of the earth. Figure 129 shows a section of the earth surrounded by a circle entitled "atmosphere at 45 miles," at which height the air is said to act as a reflecting surface. Signals from one station are shown to proceed in a straight line until they meet with this conducting layer, when they are reflected, proceed in another straight line to a second point of contact with the layer, reflected again, and so on. This is said to be the way a station may receive signals below the horizon, notwithstanding the fact that on a later page a diagram is given to show how waves slide along the surface of the earth or water without reflection, following the contour of the earth's surface.

Space will not permit of our naming the many other errors which disfigure this book, except to mention in passing the statements that when an aerial is formed of one or two parallel wires it is termed a plain aerial, while if it is made up of two or more it is known as a grid; and in making a "ground," in a city, water pipes, gas pipes, and plates buried in the earth, are connected together to form the ground. We would like to hear the views of a New York underwriter when they informed him that the earth lead of a wireless station had been connected to the gas pipes! Numerous diagrammatic and other illustrations are interspersed throughout the volume, some modern, and a number quite out of date. In the former category we would place Figure 245, showing the connections of a Marconi 1½-kw. set, and in the latter figure 208, showing the Lodge Muirhead Syntonic System with Metal Cones We cannot recommend this book from any point of view.

F

Personal Notes

The Honours List.

Wireless men have been holding their own in the honours list recently. We learn from the *London Gazette* of February 6th that Corporal W. J. Guyver, of the Tank Corps, has been awarded the Distinguished Conduct Medal for conspicuous gallantry and devotion to duty. As chief wireless operator, after having erected the aerials, this non-commissioned officer remained at duty for eighteen hours continuously under heavy shell fire. On several occasions the aerials and masts were shot away, but on each occasion he went out and repaired the damage under an intense bombardment. By his initiative and courageous perseverance the wireless station was kept open during the whole action.

A "C.P.R." Change.

Mr. W. J. Sergent, who has for about 18 years been associated with the Land Line and Canadian Pacific Ocean Services, is retiring from active duties as Chief Superintendent Engineer, but continues his connection as official of the company in a consultative capacity. Mr. Kenneth McKenzie, who has been his chief assistant, has now been appointed Chief Superintendent Engineer of all the company's fleets, with headquarters in Liverpool.

MISS A. P. MORRISON.

Woman Electrician.

The first woman to enlist in the United States Navy as an electrician has joined the Colours. She is Abby Putnam Morrison, and is now an Electrician 1st Class in the Navy. She is a member of the wireless class for women at Hunter's College, New York. In the photograph Miss Morrison is not wearing naval uniform, but she is wearing the navy insignia of her rank and branch of the service on her sleeve.

SERGT. A. W. CHILDS.

A Serbian Decoration.

The accompanying illustration shows Sergeant A. W. Childs, of the Second Wireless Squadron, Sappers and Miners, M.E.F., who has been awarded the Cross of Kara George, Second Class, with Swords, by the King of Serbia for distinguished services rendered during the campaign.

American Lady Operator.

Baltimore has the distinction of producing a woman wireless operator, who has just begun her duties on the sea. She is Miss Elizabeth Lansdale du Val. Miss du Val comes of an old American family—one of her great-grandfathers was Judge Gabriel du Val, being one of the first justices of the Prime Court of the United States. She started on her trip as junior operator on board the *Howard*, of the Merchants and Miners Transportation Company. The vessel sailed for Savannah and Jacksonville, and during the trip Miss du Val will take watches in turn with the senior operator.

We take this opportunity of stating that it is not the intention of the English Marconi Company to employ ladies as operators on board ship.

A Lucky Escape.

We learn from the *Derby Daily Telegraph* that Mr. R. S. Gaunt is lying seriously injured at the Haslar Naval Hospital, Portsmouth. He has been serving on H.M.S. *Hazard* as wireless operator for the last two years. On January 28th, during a thick fog, the ship was sunk in a collision, and Gaunt had a fortunate escape from death. He was jammed amongst the wreckage and was extricated just in time. He was taken on board a hospital ship and brought to Haslar Naval Hospital.

An Anzac M.C.

Lieut. Samuel James Whyte, Australian Engineers, Anzac Wireless Signal Squadron, has been awarded the Military Cross. We have no information as to the circumstances for which it was awarded.

With the W.A.A.C.

The accompanying photograph shows Miss Margarite P. Carter, late of Marconi's Wireless Telegraph Company's City Office, who, as mentioned in "Personal Notes" for January, is now a member of the W.A.A.C. serving in France.

[Photo: Johnstone, Motherwell.
SAPPER GEO. RUSSELL, R.E.

A WELL-EARNED AWARD.

Another winner of the D.C.M. is Sapper George Russell, of the Royal Engineers, attached to the Royal Field Artillery as a telegraph operator and signaller. He has been awarded the Medal for conspicuous bravery in carrying a wounded comrade a mile under heavy fire. They were taken prisoners by the Germans, but succeeded in making their escape. Before enlisting Sapper Russell was employed at the Admiralty.

KILLED BY SHELL BURST.

A shell bursting outside a pill-box has killed a promising young fellow in 2nd Class Air Mechanic W. G. B. Collingham, wireless operator in the R.F.C., says the *Brighton Herald*. Educated at the Brighton Municipal Secondary School, and having passed both Cambridge University examinations with honours, he was for eight months teacher at St. John's School. In March, 1914, he joined the wireless operators' school at Farnborough, was passed out for service in August, and was drafted to France, where he had been ever since. His death was a terrible blow for his parents, following in a few days the death of a sister aged eight.

JACK BINNS.

We learn from an American publication that Jack Binns, the wireless operator who leapt into fame some years ago in connection with the wreck of the White Star Liner *Republic*—the first large ship to be saved by wireless—is now a lieutenant in a Canadian instruction camp.

IMPORTANT APPOINTMENT.

Capt. Charles Prince, who before the war was engaged on important work with Marconi's Wireless Telegraph Company, Limited, and who is now of the Signals Experimental Establishment, has been fortunate in obtaining a post where his skill can be fully utilised for the benefit of the country. Very considerable progress in connection with the use of wireless in aviation has been made since the war began, and Capt. Prince's work in this connection has been most valuable.

A FURTHER STEP.

It is with pleasure that we have to record further promotion for Mr. S. B. Balcombe, late of the Traffic Department of Marconi's Wireless Telegraph Company, Limited, and his old confrères will be delighted to hear that he has now obtained his captaincy.

FOR EAST AFRICAN WIRELESS WORK.

Major Thirkhill, Royal Engineers, who is in charge of wireless work in East Africa, has been awarded the Military Cross. He is a Bradford man, and a Fellow of Clare College, Cambridge.

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.

Corporal D. P. (B.E.F.).—For particulars and instruction regarding accumulators we would refer you to *The Maintenance of Wireless Telegraph Apparatus*, by P. W. Harris, price 2s. 6d., post free 2s. 10d., from the Wireless Press, Ltd. With regard to the fault you mention (namely, the deterioration of the central cell of three cells made together in a celluloid case) we have experienced this on several occasions, although we cannot explain it. It is possible that the central cell enclosed between the other two becomes slightly heated and not having so much surface exposed to the air as the two end cells gets raised to a higher temperature than the other two. This would cause a more rapid deterioration of the cell. If, as you say, you cannot get any reading on the voltmeter of the central cell, and it is impossible to get it in good condition again, it would be best to cut it out and join up the two external cells. In any case you should find great help from the book we have mentioned above.

Corporal T. H. P. (B.E.F.).—We cannot give you any particulars of this code. Any information which we might give on the subject would be helpful to the enemy as indicating the extent of the British knowledge.

E. C. (South Shields).—We thank you for your suggestion, which has been considered and will probably be incorporated in the new volume. With regard to your questions: (1) Tesla's scheme of transmission of power by wireless has never had any practical results. The large and expensive plant erected on Long Island some years ago was allowed to run to wrack and ruin and we believe that some while ago those portions of the plant which had not fallen down were removed and the site cleared. This also answers your second question. (3) We regret we cannot give you a list of issues in which articles on high frequency electricity have appeared. Practically all wireless work is concerned directly and indirectly with high frequency currents, and if you will let us know more definitely the type of article to which you refer, we will endeavour to give you the necessary information.

C. G. G. (Kettering).—(1) Wireless operators sign the ship's articles and are in the same position with regard to the National Insurance Act as other members of the crew. (2) Students in wireless schools who do not receive salaries are of course not employees, and therefore are not affected by the Act.

W. E. B. (Belfast) asks how much more training a man holding the British Postmaster-General's Certificate would require to enable him to operate the United States naval apparatus? (2) Does the Marconi Company of America control the appointment of wireless operators in the United States Mercantile Marine? (3) As regards any naval wireless apparatus are the 1½ kw. and 5 kw. sets the only ones used, the former on small craft and the latter on the larger vessels such as battleships and cruisers? (4) Has the United States Navy any headquarters in England where one could obtain particulars and conditions of service for wireless operators? Answers:—(1) The apparatus used on board the United States naval vessels is different from the commercial apparatus used on British mercantile vessels. In view of war conditions we cannot give our correspondent any particulars as to the sets in use, although it is permissible to state that a number of different types of apparatus are installed. In any case it would be impossible to state definitely how much more training would be required, the United States Navy having their own schools of instruction and the length of the course would be dependent upon the extent of the students' knowledge and the requirements of the authorities at the time. (2) In normal times the Marconi Wireless Telegraph Company of America controls appointment of wireless operators on a very large number of vessels in the United States

Mercantile Marine. At the present time all operators in the American Mercantile Marine come under naval control. (3) We do not know whether in this question our correspondent refers to the United States naval apparatus or to that of all Powers. In view of the differences between mercantile marine and naval requirements, the apparatus on the two classes of ships varies considerably. For obvious reasons we cannot say more than this. With regard to question (4), there are, of course, various United States Government Commissions in this country at the present time and our correspondent is mistaken if he thinks that a young man of military age would be allowed to leave this country for the purpose of enlisting in the service of a foreign Power, friendly or otherwise, unless, of course, he were sent by arrangement with the British Government.

H. L. (Windsor).—(1) It is advisable that every wireless operator should be able to swim, but a knowledge of this art is not obligatory. (2) £8 to £10. (3) Yes, it is necessary to be passed as medically fit by the Company's doctor.

I. T. (Plumstead).—The Wireless Equipment Officer.

R. B. L. (Scotland) does not give his address. His queries will be answered when this is forwarded.

A. H. (Heath).—(1) The Marconi uniform is properly worn only by members of the Marconi Company. Any person not in that Company's employ who wears the uniform is quite unauthorised to do so. (2) The badge you mention is not regulation. The regulation badge consists of the letter M surrounded by a laurel wreath.

STUDENT P. (Liverpool).—(1) Whether or not an operator is granted leave on arrival in port depends upon the circumstances of the case. If, for instance, a ship is likely to remain in port for six weeks, the operator will not be kept standing by for the whole of that period, but will be appointed to another vessel. On the other hand, where circumstances permit, if the ship is only remaining for a short period, leave is granted for that time. (2) A reasonable period is usually allowed for the man to get his kit together. (3) A new operator is sent out as junior to an experienced senior. Whether it is for a long or short voyage depends upon circumstances.

J. W. (Westfields).—(1) Yes, free training is offered at the present time in London to suitable young men between the ages of 16½ and 18. Apply to the Traffic Manager, The Marconi International Marine Communication Company, Limited, Marconi House, Strand, W.C.2. (2) This is by far the cheapest way of learning wireless telegraphy.

E. R. T. (Welshpool).—(1 and 2) The youth can remain at home until just before he reaches military age.

A. C. D. (Ilford).—We do not quite understand your first question. Twenty-four studs are fitted to the asynchronous disc because it has been found that this number gives a spark of good quality and note. Arrangements are made to shift the position of the disc slightly so that those studs on which the least sparking has taken place may be put in a position, in order that they do their share of the work. (2) The disadvantages of inserting a second intermediate circuit in the multiple tuner more than outweigh the advantages.

H. B. H. (Birmingham).—The account of the instrument you mention was not published in the WIRELESS WORLD, although we have heard of it. We cannot place our hands upon any information regarding this device at the present time, and as it is not a wireless instrument we would suggest that you write to one of the medical papers for the information.

H. R. (Eltham).—A man with a partially disabled left arm would, we fear, be rejected by the Marconi Company's medical adviser. Full use of both arms is absolutely essential.

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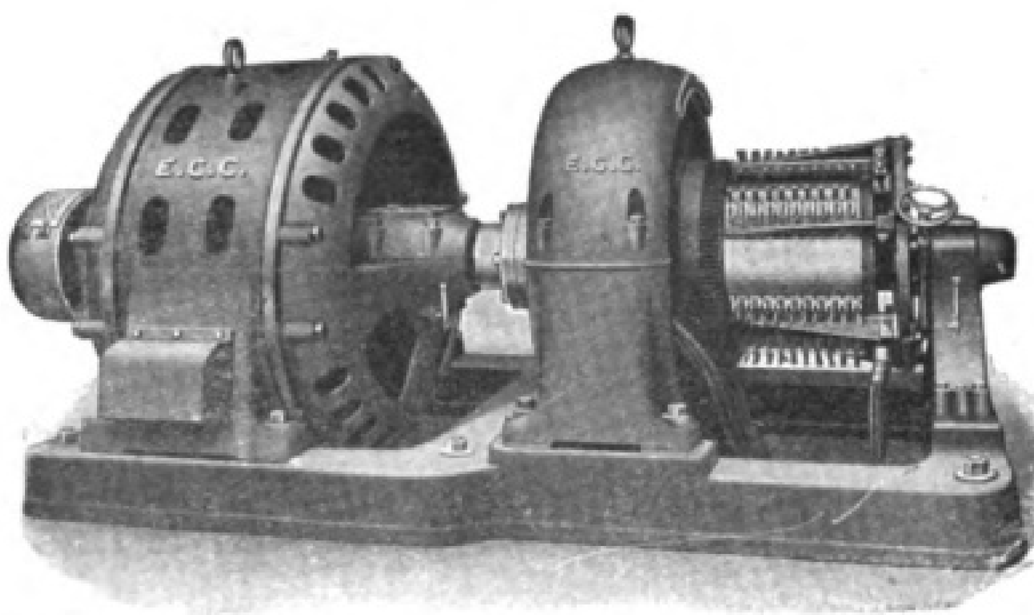

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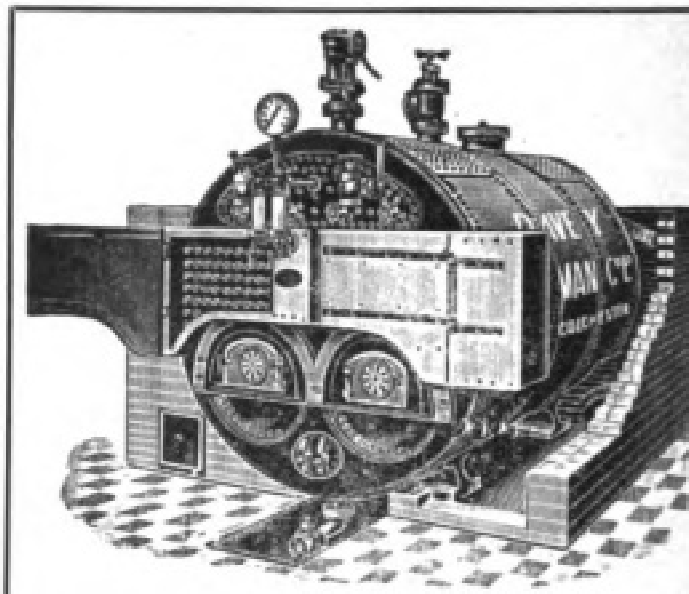

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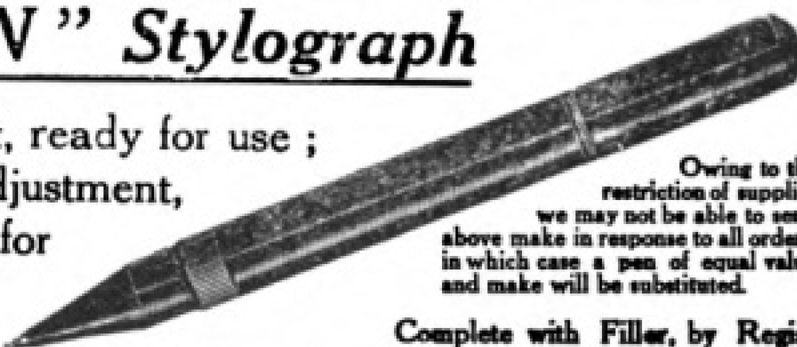

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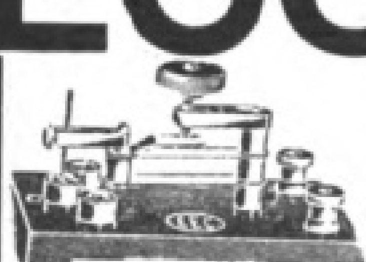

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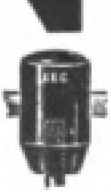

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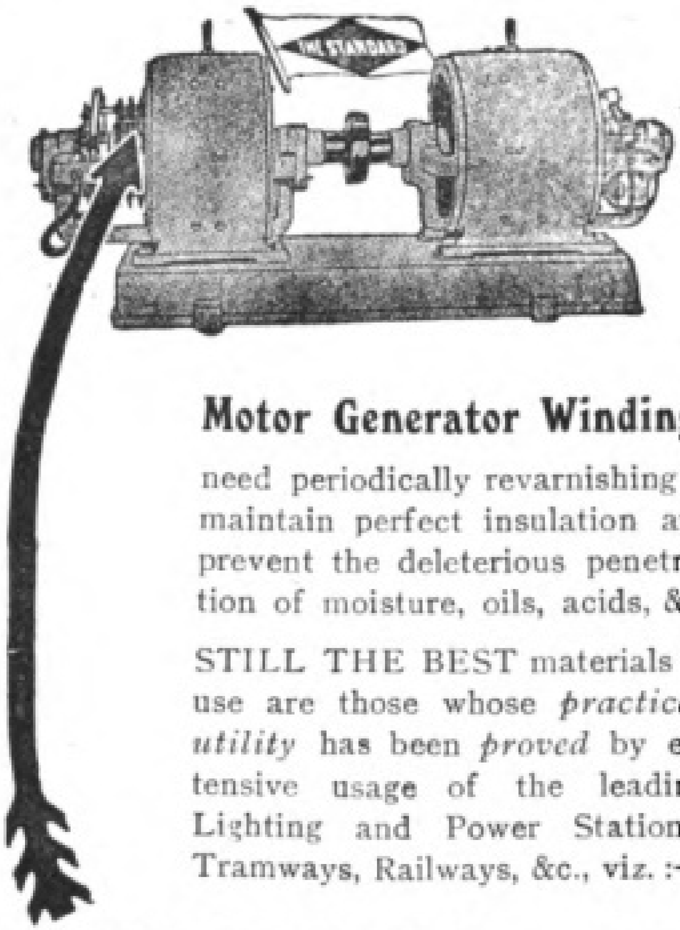

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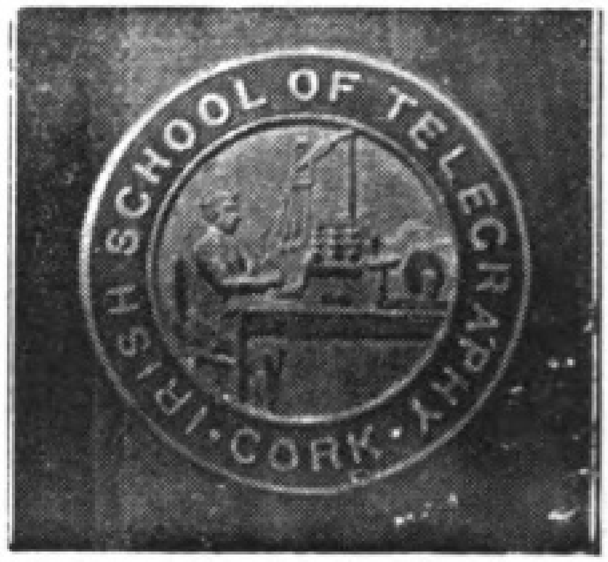

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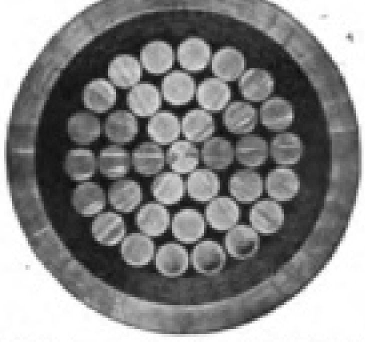

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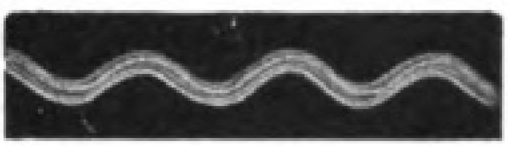

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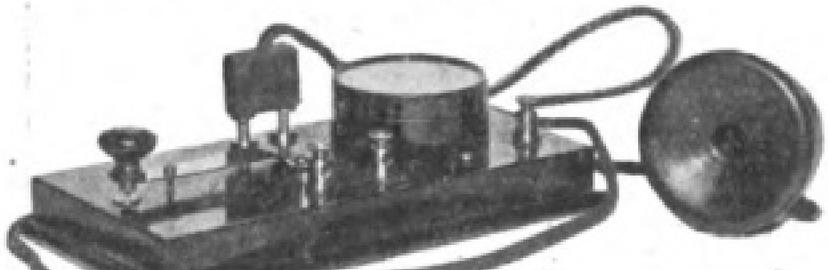

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