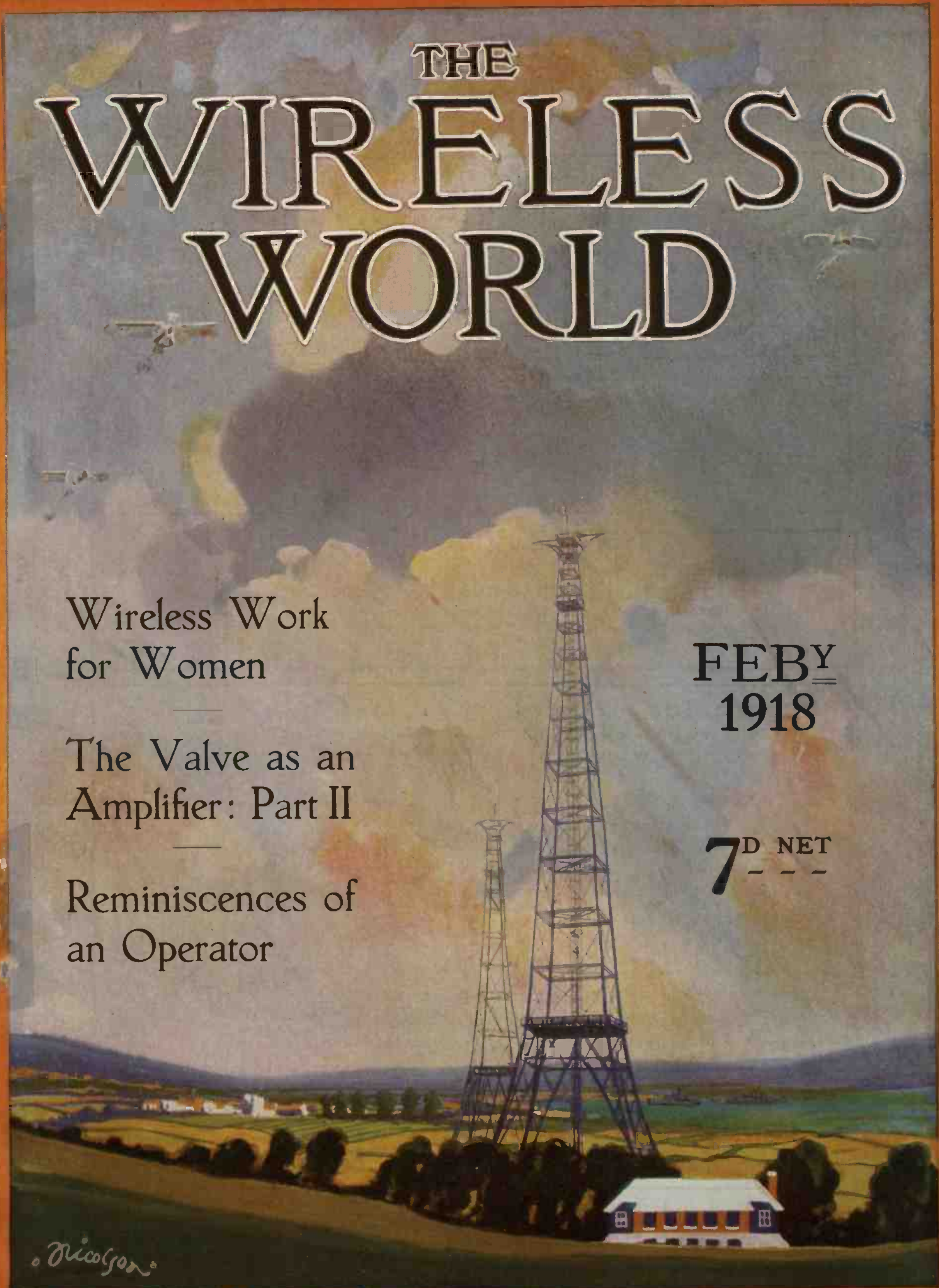
THE WIRELESS WORLD



Wireless Work for Women

The Valve as an Amplifier: Part II

Reminiscences of an Operator

FEB^Y 1918

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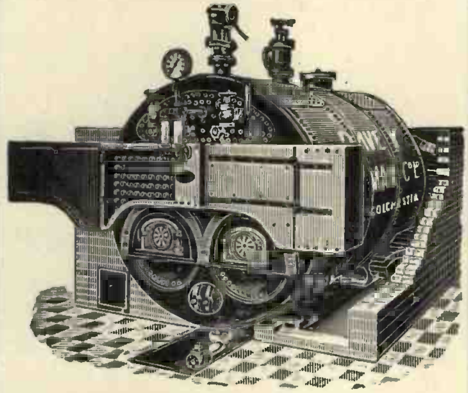

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THE WIRELESS WORLD

With which is incorporated "The Marconigraph."

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GENERAL.

The
WIRELESS
WORLD

Volume V. No. 59. FEBRUARY, 1918.

Reminiscences of an Operator

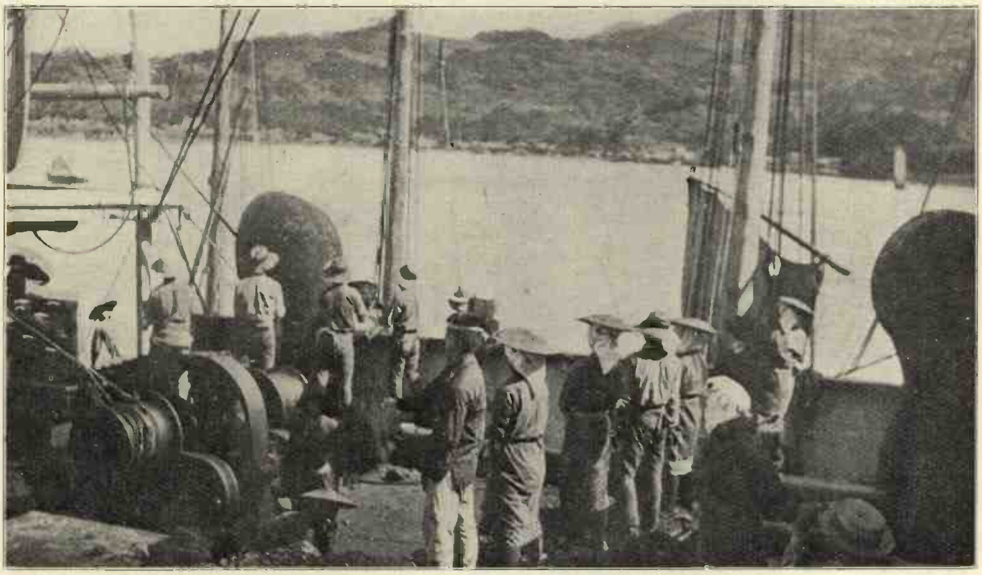
By W. D. OWEN

Kutchinutsu—in Sunny Japan

IF you look on the map for Kutchinutsu the chances are you won't find it, unless yours happens to be an unusual map: for Kutchinutsu is an unusual place. It lies well to the south near Nagasaki, and its redeeming feature is its coal.

When a ship is coaling everybody who can get away leaves the ship, for coaling is a messy business, however done. But when coal is handled as it is in Kutchinutsu, one leaves the ship as quickly and completely as possible, for coal drizzles down upon everything and everybody for hours on end. Just imagine hundreds of tons of coal being handed over the ship's side in little baskets by boys and girls, and dumped into the bunkers a few pounds at a time! Now in Birkenhead the coal-barge, with its automatic feeder, fairly squirted coal at us, and it was all over before we landlubbers had recovered from our surprise. Besides, one doesn't wear white suits in Birkenhead.

Is it any wonder, then, that we succumbed to the wiles of the persistent guide whose one anxiety in life seemed to be to take somebody to the Sacred Caves? Well, the day was warm and the road to the caves long and dusty, so nobody felt



COALING SHIP. COOLIES PASSING BASKETS OF COAL FROM HAND TO HAND.

like walking. The guide then managed to conjure up a few rickshaws that had seen better days, and headed the procession.

The ride was full of interest, as it took us into the heart of rural Japan. No Satsuma specialist held us up, nor did we have to defend our purse from the ravages of the Damascene expert ; tourists are far too few to support such luxury trades in Kutchinutsu. In place of the polished silk-merchant with his wondrous designs we see native women at their primitive looms weaving the true " homespun " for their own use. Instead of the silver-tongued vendor and his attractive bazaars, we see only the worker on the land and the homely domicile of the fisherman adorned with the nets and paraphernalia of his calling.

Our passage through the streets seemed to provide at least as much interest for the natives as we ourselves found in them. They left their work to regard us, but fled from the camera pell-mell.

After a while we came to a shady spot, where we made a brief halt for the benefit of the rickshaw coolies, who were in danger of drowning in their own perspiration, and here the inevitable camera-fiend got to work. The picture is of interest because it shows the " terrace " or " step " system of rice cultivation in the background. The object apparently is to make the most of the scanty water supply by letting it drip from step to step.

Another long pull brought us to the foot of the hill wherein the caves lay hidden. About two hundred wide stone steps led up to a Buddhist temple, and from here ran a rocky path to our goal.

I must say we hadn't bargained for such a stiff climb, and one philosopher dropped out of the procession with the quaint remark, " Gee ! ain't that some slope ? Guess I'll wait here till you perpetual-motion guys get back. Life's too short for me to start making work of my pleasures," with which he propped himself up against a convenient boulder and commenced to fill his pipe from a little linen sack of Bull Durham, and refused to budge an inch. To be honest, I must admit that by this time I didn't care whether I saw the Sacred Caves or not, but I meekly followed our energetic guide. In places the climb was so stiff that a wire rope had been laid across the face of the cliff to hold on by; but at last we got there, and once again the camera-fiend got busy.

As for the caves themselves, they were much about the same as any other caves, except that a number of stone idols chose to reside therein. One of these idols held a lot of rice-paper shreds that had to be manipulated by the worshippers according to the rites of their religion.

The return climb was as bad as the upward journey, but in due course we joined our less energetic friend below. The journey home was much easier for the coolies, as it was largely downhill, and the only incident of interest was the snapping of a lonely peasant carrying the fruits of his day's toil in the characteristic manner of the Orient.

It is said that "Nature abhors a vacuum," and we were reminded of this fact by the time we got back. I would cheerfully have paid a sovereign for a railway sandwich and thirty shillings for a ginger ale, but these are not for sale in Kutchinutsu; so our guide was instructed to find us some food. He ultimately led us to a fair-sized shanty that seemed to be the local hotel, and in accordance with the national custom we removed our boots before entering. The building was mainly of wood, with a number of light panelled sliding screens instead of walls. These were covered with paper, and could easily be punctured with the little finger, thus affording a spyhole into the next room.

We were ushered into one such room, the floor of which was covered with finely woven straw mats, and a little round cushion was provided for each person.

TAKING A REST. A RICKSHAW PARTY ON THE ROAD TO THE CAVES.

KUTCHINUTSU STREET SCENE. COOLIE METHOD OF CARRYING GARDEN PRODUCE.

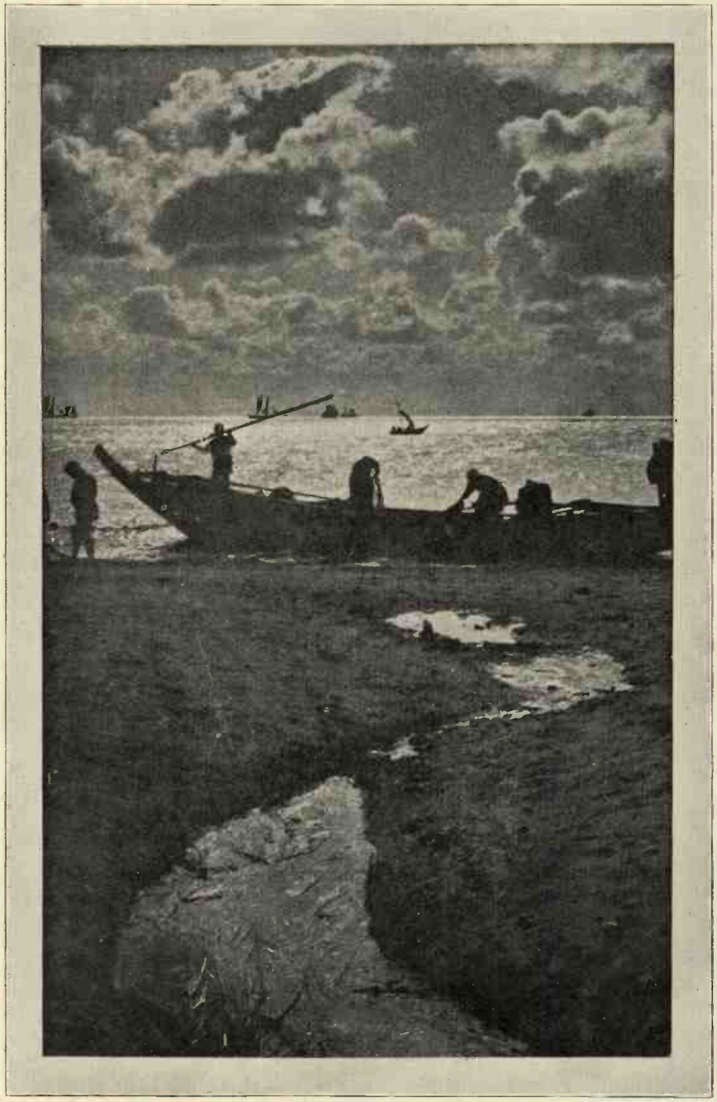
Thus we all squatted on the floor in a circle, and two Jap girls brought in a set of lacquer-work dishes for each person, some half-cooked fish, vegetables, rice, and eggs; also some shredded ginger as a condiment. Each person was given two new "chop-sticks," and we set to work. We were hungry, I can assure you, so we didn't let those chop-sticks worry us a little bit, but I must admit that for the manipulation of soft-boiled eggs they are not ideal.

Picture to yourself a party of sober tourists, with boots removed, squatting in various attitudes according to the individual idea of comfort, with a couple of chop-sticks each, eating rice and fish out of a collection of lacquer-work curiosities, while two Jap girls, who should be ministering to our comfort, vainly attempt to conceal their amusement.

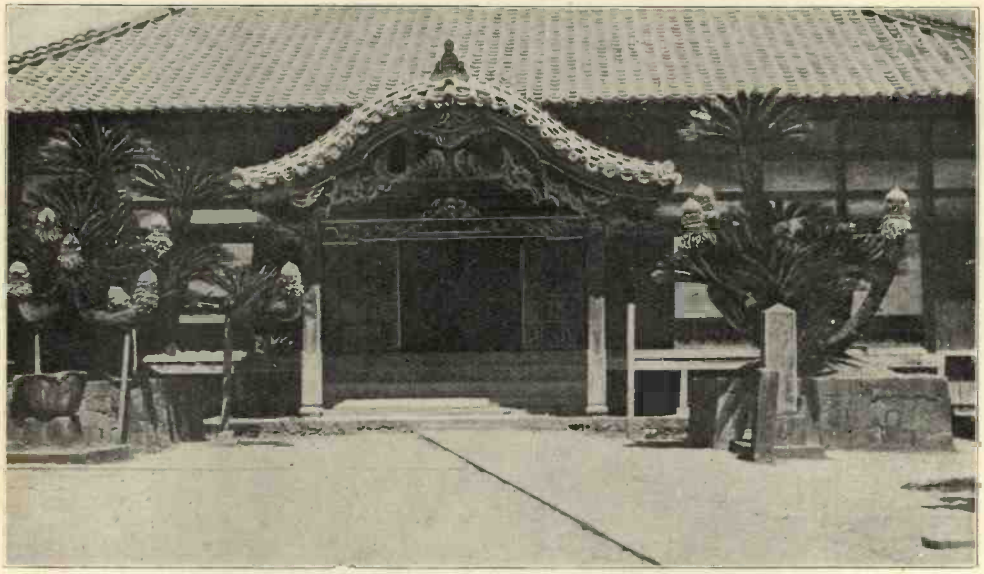
After "chow" the girls poured us out a cup of "tea"—a lemon - yellow beverage without milk or sugar—and found us some cigarettes. Thus ended the quaintest meal I have ever taken.

ON THE ROAD TO THE CAVES, KUTCHINUTSU.

The day was still comparatively

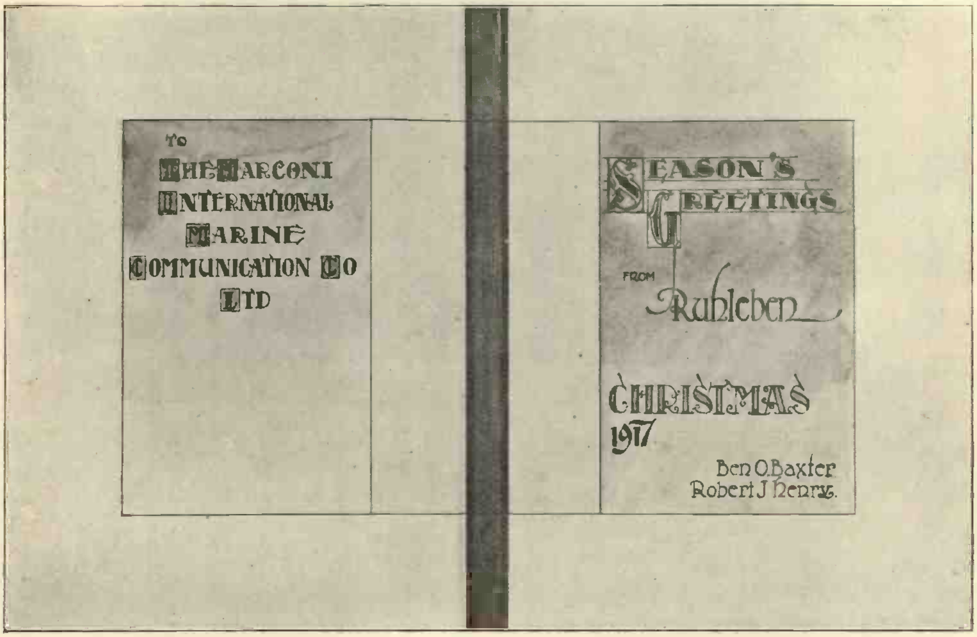


KUTCHINUTSU FISHERMEN LANDING THE EVENING CATCH.



A BUDDHIST TEMPLE AT KUTCHINUTSU.

young, and we decided that there was time for a swim before dinner, so after a respectable interval for digestion we found what we considered to be an ideal stretch of beach. In less time than it takes to tell our clothes lay in disorderly heaps on the sand, and six tired travellers sought rejuvenation in the Sea of Japan.



CHRISTMAS CARD FROM RUHLEBEN CAMP, GERMANY, DESIGNED BY INTERNED OPERATORS. FOR COVER, SEE PAGE 778.

From the Mercantile Marine to the Germans

ERE Bessie's ships had left the slips or Drake stood off the Hoe,
Or fighting Blake his whip did take to bid the Mynheer go,
The little things of sticks and strings our fathers called their boats,
Had steered the seas and felt the breeze wherever timber floats.
Yeoman, bowman, seaman, gleeman—the salt is in the breed,
And we were a race of sailors ere the Teuton heard the Creed.

You made yourselves a navy close-copied from our own,
Spoon-fed on pious moonshine by the Prussian on your throne ;
Though you ape our crafts and customs, our discipline and ships,
You taught yourselves to murder with Gott's name upon your lips.

An imitation empire you had got by guile and gold,
You *kultured* hapless natives till they did as they were told ;
You paid your greasy money down to buy colonial mud,
Not like we foolish Britishers who bought ours with our blood.

You call us " island shopkeepers " intent on pelf alone,
Yet some Briton diced with Death—for sport—where'er our flag is flown.
The German plays to win the game, to lose he counts a blot,
But the glory of a Briton is to lose like Captain Scott.

When to the south from harbour's mouth your first sea-traffic crept,
It owed its luck to British pluck, for we the track had swept.
The pirate crew, and slaver too, the derelict and reef,
We hacked 'em down, we tracked 'em down, for such is our Belief.
We pioneered the ocean to the ends of all the earth,
For we were a race of sailors ere your empire had its birth.

PERSONALITIES IN THE WIRELESS WORLD

RADIO-COMMANDER F. G. CRESSWELL
R.A.N.

THIS month we have pleasure in introducing to our readers Radio-Commander F. G. Cresswell, R.A.N., Acting Director of the Radio Service in Australia. Commander Cresswell is the son of the Rev. A. W. Cresswell, M.A., of Camberwell, Victoria. In 1897 he entered upon his professional career, having received his training and experience with engineering firms in Victoria and in the Electrical Engineers' Branch of the Postmaster-General's Department, Melbourne. In 1907 he gained a commission in the Commonwealth Naval Force as Engineer-sub-lieutenant for electrical duties, and entered the Royal Australian Navy at the time of its inauguration. In 1912 he was appointed Fleet Wireless Telegraph Officer. In the early stages of the war he took part in naval operations in the Pacific, and on his return was appointed to take over the control, under the Naval Board, of the Wireless Telegraph Department of the Commonwealth, which had been transferred by Act of Parliament to the control of the Royal Australian Navy. His first work on taking over was to reorganise the Commonwealth Radio Service on Naval Service lines and under Naval discipline. In 1916, Mr. Cresswell was appointed Radio Commander and Acting Director of the Radio Service, which position he has held with credit since that time.

Commander Cresswell has had many interesting experiences during the war and was at the capture of the German high-power wireless stations at Samoa, Naru, and Rabaul, and was mentioned in despatches by Admiral Patey, R.N., then Admiral-Commander of the Royal Australian Navy.

Commander Cresswell is an Associate Member of the Institution of Electrical Engineers, England, and a Member of the Institution of Electrical Engineers, Australia.

The Valve as an Amplifier

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

II.

In the January issue it was shown how two or more valves may be connected in cascade to magnify telephonic speech or wireless signals to 50 or 100 times their normal strength. Before passing on to the methods employed to amplify high-frequency oscillations, let us consider a few more points which arise when several valves are used in cascade for low-frequency amplification.

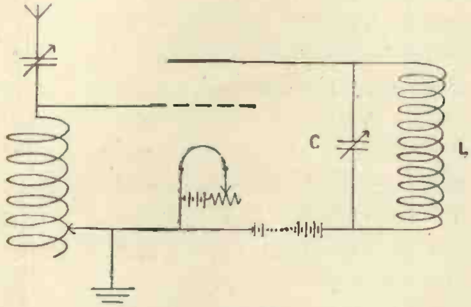


FIG. 8.

As has been stated before, every additional valve tends to complicate matters. It might at first be thought that a large number of valves could be joined in cascade, and that amplification could be carried on to an indefinite extent. This is not so. In practice it is difficult enough to control only three or four valves. This is particularly the case when we are magnifying speech, as in wireless telephony. It is of the utmost importance that the character of the speech and its clearness should not be impaired by amplification. This is very liable to happen when several valves are used in cascade, partly due to the fact that valves generally tend to rectify to a certain extent, even when used for amplifying. In the case of ordinary wireless signals, of course, this trouble is not experienced.

There are, however, several other difficulties which it is necessary to overcome when several valves are used for amplifying. The design and construction of the inter-valve transformers present the chief difficulty. The efficiency of a multi-valve amplifier might almost be said to depend on the nature of its transformers. The degree of magnification depends largely on the ratio of turns in the primary and secondary windings, their resistances, and the nature of the iron core. Any tendency which the iron core may have to retain magnetism is going to cause inefficiency and extra noises in the telephones. The cores of amplifier transformers generally consist, therefore, of bundles of very soft iron wires, in order to avoid hysteresis effects. For similar reasons open-core transformers prove more suitable than those of the closed-core type. With regard to the windings, it is found that very high resistance windings give the best results. The actual values, of course, vary with the different commercial types. Moreover, present conditions prevent the publication of the results of recent research work on valves.

Apart from theoretical considerations, we are confronted with a number of practical troubles, which are, however, being eliminated as the development of amplifiers proceeds. One of the greatest troubles is the persistency of various noises heard in the telephones, other than those due to the varying currents operating the amplifier.

These noises are heard on all amplifiers, and are traceable to leakages in the batteries, the unsteady current from an accumulator or high-tension battery, transformer leakages, various capacity and inductive effects, peculiarities of valves, microphonic effects, and numerous other causes.

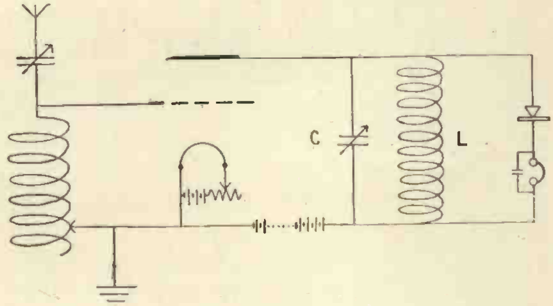


FIG. 9.

Many of these troubles can be overcome. They can all be overcome by curbing the natural desire to amplify signals to too high a degree. It must be remembered that when signals are still further amplified by the addition of extra valves, all the noises due to causes mentioned above are magnified at the same time, and are very liable to drown signals which were only weak originally. For such signals low-frequency amplification is obviously unsuitable.

Mention has been made of microphonic effects. These are very noticeable in all amplifiers, and the least vibration will cause a rattle in the receivers. To avoid this, the amplifier may be suspended on rubber tapes, or any similar shock-absorbing device may be employed.

The fact that microphonic effects are very noticeable indicates that the amplifier is in a very sensitive condition. The sensitiveness of an amplifier may, in fact, be gauged by its microphonic sensitiveness. On tapping the first valve of, say, a three-valve amplifier, a loud rattle should be heard in the telephones. On tapping the second valve a less pronounced noise should be heard, since the current variations produced by tapping are now only amplified by one valve—the last one. On tapping the third valve a still fainter noise is heard. If it is found that, on tapping the first and second valves, practically equally strong noises are heard in the receivers, it may be assumed, generally, that the amplifier is not functioning properly. Changing the valves will probably make the amplifier work more efficiently.

The working of a multi-valve amplifier depends largely on the valves used. No two valves are ever alike, and only by trial of a number of valves can the best results be obtained. Some valves work practically silently, while others often give rise to the various additional noises of which we have already spoken. Generally speaking, valves with not too high a vacuum work most efficiently on amplifier circuits. Since the sheath-circuit current is very small—usually

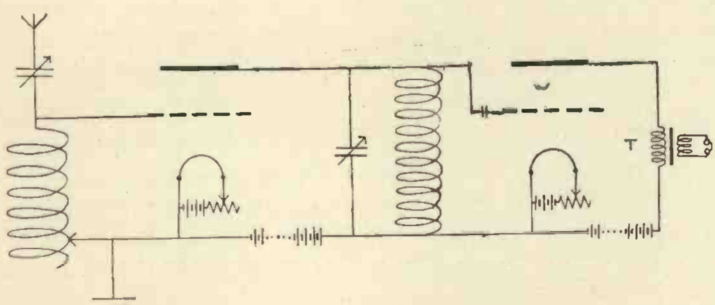


FIG. 10.

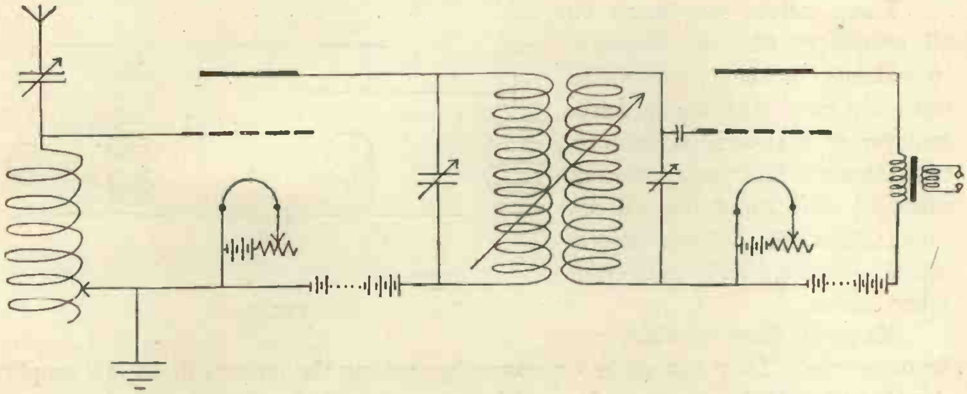


FIG. 11.

about two milli-amperes per valve—the dimensions of the valve may be made small.

Many other noises may be prevented by other precautions, such as the careful insulation of all batteries and apparatus. Care should also be taken that none of the leads cross, as otherwise complications will immediately arise. They should be short, and should not be near any earth-connected conductors. The component parts of amplifier circuits should be placed well apart, if practicable, to avoid undesirable capacity and inductive effects.

Trouble is often experienced when several valves are used through internal oscillations set up in the inter-valve transformers. Oscillations of two different frequencies are often set up, producing beats of an audible frequency. The shrill noise heard can generally be stopped by judicious adjustment of filament current and high-tension voltage, or by changing the valves.

The telephone receivers shown in various circuits already described are of high resistance—say, 4,000 ohms or more—and are necessary on account of the high resistance of the sheath circuit. When the telephones are directly in this circuit, care should be taken that the steady current passing through the telephone coils does not tend to demagnetise the magnets, and so ultimately affect the sensitiveness of the receivers. The ends of cords of telephones for this purpose are generally marked positive and negative to prevent this mistake being made.

Instead of having the telephones in the sheath circuit, however, it is preferable to substitute for them the primary of a transformer, to the secondary of which is connected a pair of 'phones. If the transformer is of the step-down type, as is generally the case, low-resistance 'phones are used. If a one-to-one ratio transformer is used, high-resistance 'phones are employed. The main steady sheath-circuit current does not now pass through the telephones, and therefore cannot injure them by demagnetising them, or by breaking down the insulation of the windings. Leakage to earth through the operator is also not likely to occur, as only *changes* in the normal sheath-circuit current will affect the receivers. In Fig. 10 a telephone transformer, *T*, is shown. In most of the subsequent diagrams, however, the telephone receivers will be shown directly in the sheath circuit for the sake of simplicity.

We will now consider various methods of amplifying as applied strictly to the reception of wireless signals. The types of amplifier described above are used only to magnify current variations of low frequency, such as telephonic currents or the rectified pulses from a wireless receiving set. They do not rectify, nor are they designed to amplify high-frequency oscillations.

The development of both low and high-frequency valve amplification is largely due to Lieben and Reisz, Lee de Forest, Langmuir, Armstrong, Round, and many others who have specialised in the study of the vacuum valve. We are also indebted a great deal to French and American experimental work for the present efficiency of amplifiers. The circuits described in these articles are their patented circuits or modifications of them.

Fig. 8 shows a method by which high-frequency oscillations produced by incoming waves may be greatly magnified by means of a valve. The filament current and high-tension voltage are adjusted so that the valve is being used as an amplifier and not as a detector. Every oscillation in the aerial circuit will therefore set up exactly similar oscillations on a magnified scale in the coil *L*, which forms part of the sheath circuit. The frequency of the oscillations in the coil *L* will equal the frequency of the incoming waves, even if the coil *L* is not actually tuned to the same wave-length. In the latter case the oscillations in *L* will be forced oscillations. In Fig. 8 the oscillatory portion of the sheath circuit includes a variable condenser, *C*. If this oscillatory circuit is tuned to the same frequency as that of the high-frequency current in the sheath circuit, the two will assist each other, and greater amplification will be obtained than if the sheath oscillatory circuit were aperiodic.

The capacity of the condenser, *C*, should be kept as small as possible, as otherwise it will have an appreciable effect on the rise and fall of current in the circuit, thereby lessening the degree of amplification through damping. This applies to all the circuits we will have to deal with. In all cases the parallel condenser should have a small capacity, and the inductance should consequently have a large value.

We have now an oscillatory circuit in which comparatively strong oscillations are taking place, of about five times the strength of the original oscillations. We now require to rectify these oscillations. This we can accomplish in a variety of ways. Fig. 9 shows how the rectification is carried out by means of a crystal detector. Either a Perikon detector or a carborundum combination may be used. The latter is the more reliable, but generally the less sensitive. In some valve circuits, more-

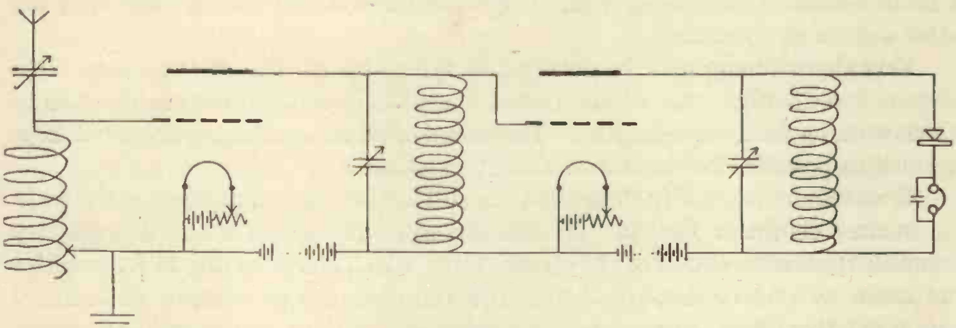


FIG. 12.

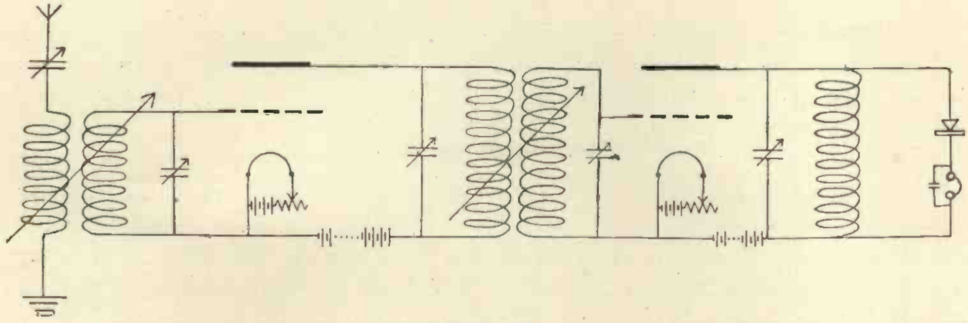


FIG. 13.

over, the use of a battery and potentiometer causes undesirable noises in the telephones, although by careful adjustment they can generally be eliminated.

Fig. 10 shows how a valve used as a detector, with a small condenser in series with the grid, may be employed to rectify the oscillations. This second valve is functioning at the rectifying point of its characteristic curve. In the case of the first valve the high-tension voltage will be about 100 volts to obtain the greatest magnification. The second valve will need a much lower value of high-tension voltage, which is found by experiment, as all valve adjustments are.

Slightly improved results would be obtained if we included a variable inductance in the sheath circuit of the second valve. Armstrong showed that this gave extra amplification when the variable inductance was tuned to the same frequency as the original oscillations.

It should be noted at this point that whenever an oscillatory circuit forms part of the sheath circuit of a valve, a small condenser of about 0·0005 mfd. should be shunted across both the high-tension battery and the telephone receivers. This condenser does not affect the tuning of the system in any way, but offers an easy path for any high-frequency oscillations which may be produced in the sheath circuit.

In Fig. 10 the detector circuit is shown directly across the inductance coil which is part of the sheath circuit of the first valve. Much greater selectivity, however, may be obtained by the arrangement shown in Fig. 11. We have now coupled the sheath oscillatory circuit to another oscillatory circuit which is connected across the grid and filament of the second valve. Both oscillatory circuits are tuned to the frequency of the incoming waves, and the coupling between them may be varied. A small condenser is in series with the grid of the second valve in order that the latter will act as a rectifier.

Very sharp tuning may be obtained by using this method of amplifying high-frequency oscillations, and so the circuit is especially suitable for use on stations which work on fixed wave-lengths. The values of all the condensers should be kept as small as possible, for the reason already explained.

If we require to amplify the oscillations still further, we can use a second valve in the manner shown in Fig. 12. In this arrangement there is a tuned oscillatory circuit in the sheath circuit of the second valve, which is now acting as an amplifier and needs no grid condenser. Across this tuned circuit we connect an ordinary crystal detector and telephones, or use a valve as a rectifier, just as we used one for this purpose in Fig. 10.

By combining the essential features of Fig. 11 and Fig. 12 we arrive at a very sensitive and selective arrangement which is shown in Fig. 13. Two valves are used purely for amplifying the original high-frequency oscillations, and a sensitive crystal detector is used as a rectifier. If desired, a third valve could be used instead of a crystal detector.

In Fig. 13 loose-coupled connections are shown on the left as an alternative to the arrangement shown in Fig. 11.

Any number of variations of the above circuits may be tried. The ones given are merely examples which may be modified as desired. Circuits may be made variable or aperiodic; auto-transformer connections or loose couplings may be used; oscillations may be rectified and the resultant pulses amplified afterwards, or the oscillations may be amplified and *then* rectified; a further variation is to amplify the high-frequency oscillations, rectify them, and then to amplify the low-frequency pulses.

The relative advantages of these variations are discussed later, as also are other forms of valve amplification.

Radio Telephones for Load Dispatching

Emergency Installations in U.S.A.

WHILE the Government will not permit the use of wireless telegraph and telephone equipment at present except under its supervision, the Public Service Company of Northern Illinois is investigating the practicability of using radio-telephones for load dispatching so that some development can be made along the line when conditions will permit. Two radio-telephone sets suitable for communication between sections 150 miles apart have been purchased and are being tested with the co-operation of the United States Navy Department. If the units prove satisfactory on test, and the indications are that they will, one unit will probably be installed in the system operator's office, which is in the new Joliet (Illinois) generating station, and the other will be placed in the Company's generating station at Blue Island (Illinois). It will be possible to use the instruments in these locations to facilitate load dispatching in emergencies that may be occasioned by failure of the Company's private metallic-circuit line. If the units prove practicable in these locations, their use will probably be extended to other important switching centres. The use of the radio-telephone rather than the wireless telegraph was favoured by the engineering department of the Public Service Company of Northern Illinois because the instrument can be used without a knowledge of the Continental Morse code and because it is possible to transmit messages with greater speed by telephone than by telegraph.—*Electrical World.*

Digest of Wireless Literature

Inter-Communication between Wireless Stations.

Dr. C. J. de Groot, whose excellent paper on "The Matter and Elimination of Strays" terminated in our last number, contributes to the *Jahrbüch der Drahtlosen Telegrafie* for June, 1917, an interesting article which is summarised in "Science Abstracts." In working in the tropics it was noted, said Dr. de Groot, that when the two stations were separated by a hill, communication became impossible at night, although it was good by day. It is concluded that waves can bend round the surface of the ground better by day than by night. This conflicts with the requirements of the theory of Fleming, which postulates a bending of the rays away from the earth in the day time, and corroborates the theory of Eccles. Tests made between Noesanivé (Ambon) and the warship *Tromp*, stationed in the Northern Bay of the Island Ceram, showed this feature, and it is calculated that during daylight transmission of waves of 600 m. length were bent into a circle of a radius one-quarter of the earth's radius. Other tests showed that it is possible to bend the waves to a radius as small as one-sixth of the earth's radius. One would expect even sharper bending to be possible with greater wave-lengths, so that waves are, without doubt, able to follow the curvature of the earth in daytime. At night this bending becomes impossible and stations at any appreciable distance apart can only communicate by waves reflected down from upper layers in the atmosphere. Allowing for the variable transmission of reception intensities at various angles to the vertical, it is shown that the reception by the reflected waves would improve rapidly to a maximum, as the receiving station recedes from the sending station, and then increase again slowly. If the emitted waves are undamped, interference may be produced at a receiving station between waves reflected once at the upper reflecting surface and waves reflected back by the earth's surface and reflected a second time from the upper surface. It follows that if this is the case the strength of the received signals will depend upon the resultant signals produced by the super-position of waves reflected various numbers of times before they reach the receiver. If the difference between the paths traversed by two such waves is an even number of wave-lengths, they will add their effect and the signals will be strong. If, however, the wave-length is only slightly altered, *e.g.*, so that the same difference shall be an uneven multiple of the half wave-length, the effects of the two waves will be subtracted and the signals will be weak. The theory of propagation by repeatedly reflected rays is used to explain the occurrence of silent zones at a series of distances from the sending station and of "freak" signals at unexpected distances.

THICKNESS OF TELEPHONE RECEIVER DIAPHRAGMS.

The natural frequencies of a circular plate diaphragm such as is used in telephone receivers should, according to Lord Rayleigh, be proportional to the plate thickness and inversely proportional to the area of the plate.

Some experiments made by Dr. C. H. Calder in the Electrical Engineering Department of the Massachusetts Institute of Technology are recorded in a recent issue of the *Journal of the Franklin Institute.* These experiments do not quite confirm Lord Rayleigh's theory and they also show one reason why there should be a deviation from the law. The five pairs of diaphragms experimented with were of ferrotype steel and ranged in thickness from 0·14 mm. up to 0·325 mm.; one diaphragm of each pair was japanned, the other not; this feature did not seem to make much difference. The inner diameter of the clamping circle was 5 cm. The tests were made by obtaining the motional impedence circle of the instrument over a range of impressed frequency from 400 cycles to 1,500 cycles per second. It resulted that the natural (or resonant) frequency did not increase proportional to the thickness, but decreased first from 950 cycles to 900 cycles, as the thickness increased from 0·13 mm. to about 0·2 mm. and then rose to 1,175 cycles. The air gap changes would partly account for this deviation. The thinnest diaphragm was possibly attracted by its magnet and bulged inward instead of being plane, so that the air gap was only 0·1 mm., whilst the thickest diaphragm had an air gap of 0·32 mm. The diaphragm was hence not really a plate but rather a stretched membrane.

The sensitiveness of the instruments would depend upon the air gap and on the mechanics of the diaphragm in general. The highest sensitiveness was observed with the diaphragm of 0·23 mm. The resonant range—defined as the difference between the two frequencies (greater and smaller than the resonant frequency) at which the kinetic of vibration under constant excitation by the alternating currents falls to one-half—did not give a regular course.

WIRELESS ON GERMAN AEROPLANES.

A highly interesting article on communication with aircraft and wireless telegraphy on German aeroplanes appeared in a recent number of our French contemporary, *La Nature.* After pointing out the immense importance of aircraft in warfare, the author briefly reviews the methods used by the Germans since the outbreak of war for communicating from their aeroplanes to the earth. One of the first methods adopted by the enemy was to signal by means of various evolutions of the aeroplane, a turn to the right having one meaning, a turn to the left another, a spiral giving a third signification and so on. Obviously this method is crude and when the airman is subjected to gunfire, either from anti-aircraft batteries or other aeroplanes, his evolutions are no longer under perfect control. It was not long before this method was abandoned, its place being taken by smoke and light signals of various colours and forms. In this manner a much more complete code of signals was able to be transmitted and the method had the advantage that the observer could carry out the work independently of the pilot, who of course controls the evolutions. Signals of this nature could not be read over a distance exceeding seven or eight kilometres, particularly in dull or misty weather. If the aviator had to signal the results of gunfire over a distance greater than ten kilometres, he was prevented from flying over the target and had to keep himself between the objective and the battery.

A further method utilised by the Germans while fighting was going on, and a means, we believe, still in use at times, was to enclose messages which were lengthy or needed to be particularly accurate in a small container. This consisted of a metal tube to which were attached streamers for rendering it more visible, together with a small percussion fuse which ignited on striking the ground and created a cloud of smoke. By this cloud a container could be quickly located.

The disadvantages of this method are that the container may be carried by the wind several hundred metres out of its course and may fall in water or on bad ground where it may be lost or only found with difficulty.

Certain German aeroplanes told off for long-distance flights have carrier-pigeons, which are liberated immediately after the object is achieved. At night messages can be transmitted by means of the small searchlight which normally serves to facilitate landing. The Morse Code is used for these light signals, which of course have only a short range.

None of the above methods is able to satisfy the present exacting requirements of communication and the use of wireless telegraphy was soon pushed forward. In peace time attempts had been made more or less successfully to communicate from aeroplanes by wireless, but the apparatus had not proved entirely satisfactory. At that time, too, reception of signals on aeroplanes was impossible owing to the noise of the engine, which made the comparatively weak signals inaudible. It was nevertheless necessary to signal to the aeroplane from the ground, and this was done by means of sheets of various colours and forms laid upon the ground in such a way that they could be seen by the aeroplane aloft. Smoke and light signals on the ground were also utilised. For long messages the Germans utilised small projectors, known as the " Mitlehrerschlinwerfer " which enabled them to transmit light signals in Morse. This method of signalling is particularly delicate as it is necessary to keep the projector trained on the aeroplane, whilst the observer, no matter how he may be harassed by the enemy, must keep his eye fixed upon the tiny light.

The author then goes on to describe the actual apparatus used on German aeroplanes at the present time. Three types of transmitter are described, known respectively as the Sender Type C 1916, the " Hüthsender " and the " Telefunken " sender. As a source of power a generator known as the " J. d Fleig, 1917 " is used. It is driven by an air screw and is designed in such a way that a constant current of air flows through the windings for cooling purposes. The three types of transmitter mentioned above require different voltages, but this machine is so made that it can be rapidly connected to suit any one of them. The generator not only provides current for the wireless transmitter but also for the searchlights and lamps on the aeroplane. With the screw and connecting wires this generator weighs 10·3 kg. The screw is designed to rotate at a speed of 4,500 revolutions per minute in a 150 km. wind. The variations in speed do not sensibly influence the output of the generator. While it might seem that it would be simpler to drive the generator direct from the aeroplane motor, it should be remembered that the air-screw method enables the generator to be driven so long as the aeroplane is in flight, whether the motor is stopped or not, which is, of course, a valuable feature in the event of the engine breaking down.

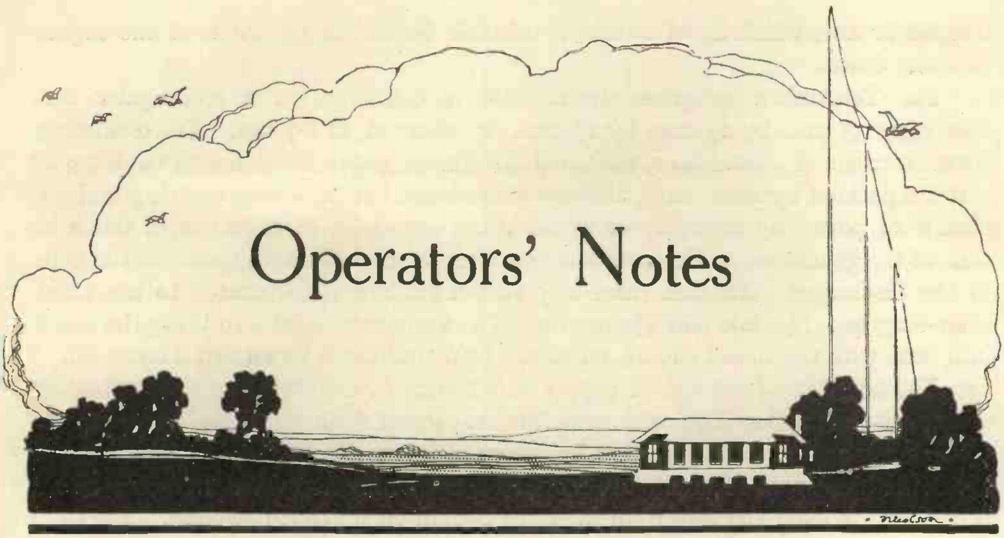
The Telefunken aeroplane transmitter is contained in a rectangular box measuring 35 cms. by 25 cms. by 15 cms., weighing in all 8·7 kgs. The oscillating circuit consists of a condenser, the usual Telefunken multiple discharger made up of plates separated by mica rings, and the variometer. A three-way switch permits a change of power by inserting or withdrawing resistance in circuit with the field coils of the generator, at the same time opening or short-circuiting some of the gaps of the discharger. Another three-way switch enables the operator to use three wave-lengths: 150, 200 and 250 metres. The variometer serves to bring the aerial into tune with the closed circuit, resonance being indicated by an aerial ammeter.

The aerial itself consists of copper wire 1 mm. in diameter and approximately 40 metres in length. This wire, which is suspended from the aeroplane, tends to take an almost horizontal position by reason of its inertia and the resistance of the air at the high speed of flight. It terminates in an egg-shaped weight which makes it easier to pay out the wire from the large bobbin on which it is wound. The total weight of the installation, including the generator, aerial bobbin, key and all other fittings, is 25·7 kgs., and the normal range is said to be 35 kilometres.

The "Wireless" Diary and Note Book

A Useful Publication

THE need for a strong and well made case in which to keep the Postmaster-General's Certificate has often been felt by the wireless operator at sea. Fortunately there is available an excellent means of preserving this important document in the "Wireless" Diary and Note Book. This valuable publication consists of a leather case with pockets for Certificates, cards and stamps, enclosed in which are two booklets, one a Diary and Note Book containing, in addition to much valuable wireless matter, ruled spaces for a record of appointments held on board ship, apartments, best adjustments for various wave-lengths, and some of the wireless diagrams most frequently needed by the practical man. In the Diary Section spaces are given for one week to each page, and suitable rulings are included for memoranda, addresses, etc. The second booklet contains squared paper invaluable for recording particulars of new circuits, special apparatus, etc., as well as for the working out of the operator's original diagrams. The whole production consisting of the leather case, two booklets and a lead pencil, is of a convenient and not too bulky size, and sells for the price of 3s. 3d. post free from our publishers, or 6s. 3d. post free in the brown morocco leather de Luxe edition. Those operators who have not yet acquired this book are advised to do so before the edition is exhausted.



Operators' Notes

THE ROTARY SPARK DISCHARGER.

THE increasing number of installations being fitted with rotary disc dischargers makes it appropriate for a few notes upon the subject. The requirements of the Post Office examiners necessitate a theoretical and practical knowledge of the working of both synchronous and non-synchronous forms of discharger. It would also seem that a better understanding of its operation would not come amiss to some operators already at sea. In the course of my experience I have heard many sparks which, judging by the note in the receivers, could, in many cases, have been improved by very slight adjustments. The advantages of the disc discharger over the fixed gap may be briefly summed up as follows :—

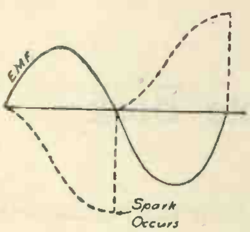


FIG. I.

1. Better note heard in receivers, making it possible for receiving operators to read through atmospherics and jamming which would seriously affect low frequency signals.

2. Closer coupling may be used between the closed and open oscillatory circuits of the transmitter, thereby allowing a greater transfer of energy to take place.

3. With the non-synchronous disc, lessened potential strains on the condenser dielectric, owing to a spark occurring several times in each half cycle of the alternating current, thus preventing the condenser, P.D., rising to such a high value.

4. Lower potential on aerial insulators and therefore less electrical strain for reasons just mentioned.

5. Discharge occurs at regular intervals, thus giving a distinctive note.

With the fixed gap these good qualities are absent. The first point to be considered in connection with the synchronous gaps as used with the ½ and ¼ k.w. sets is the correct phase adjustment, *i.e.*, the adjustment which allows the spark to take place when the condenser, P.D., is at its maximum. Fig. 1 illustrates the instant at which the moving studs should come opposite the fixed electrodes. The full line represents the charging E.M.F., and the dotted line the condenser, P.D.

Obviously, by getting the discharge at this instant we shall obtain the maximum oscillatory energy, whereas if the spark occurred either before or after this moment some of the charging energy would be lost by a premature or delayed discharge.

This is what happens if the fixed electrodes are not placed in their proper relation to the phase of the charging E.M.F.

Any tendency to arc can easily be detected by the sound and appearance of the spark, and should be corrected by giving the electrodes either lag or lead, accordingly as the spark is either taking place too early or too late in the cycle.

It will be seen from Fig. 1 that with a synchronous spark there is only one discharge per alternation, and therefore the disc will be provided with one stud per pole of alternator. Spark frequency therefore = A.C. frequency × 2. The energy of each discharge will be equal, and therefore the wear on the studs will be even, but in practice after a disc has been in use for awhile the ends of the studs and electrodes become worn as shown in Fig. 2, thus giving the spark a trifle late. This should be corrected by giving the electrodes a slight lead to compensate for the worn condition. It should only be done temporarily until an opportunity occurs for trueing the spark surfaces. The non-synchronous disc acts somewhat differently in practice. In this we have a greater number of studs than there are poles in the alternator, and therefore there are several sparks per alternation. In this case spark frequency $= \frac{rpm \times \text{studs}}{60}$. The energy in each spark varies according to the condenser P.D. at the moment of discharge. This condition results in some sparks being more intense than others, and as a consequence the wear on the studs is uneven with electrodes at 90°.

If a disc is run under these conditions for long the wear on the studs is such that some become shorter than others, and as a consequence a uniform length of gap cannot be maintained, owing to the necessity of providing clearance between all moving studs and the electrodes.

Also it will be noted that when the energy in the condenser is greatest the gap clearance is also greatest, this giving rise to a poor spark at these instants, when the spark really should be at its best.

To obviate this the fixed electrodes are pitched 45° instead of 90°, this ensuring that the stud which takes the least discharge when under one electrode receives the maximum when underneath the second electrode; the E.M.F. varying from zero to maximum during the interval of time taken for the disc to move forward 45°.

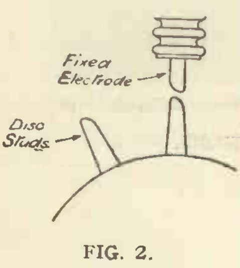
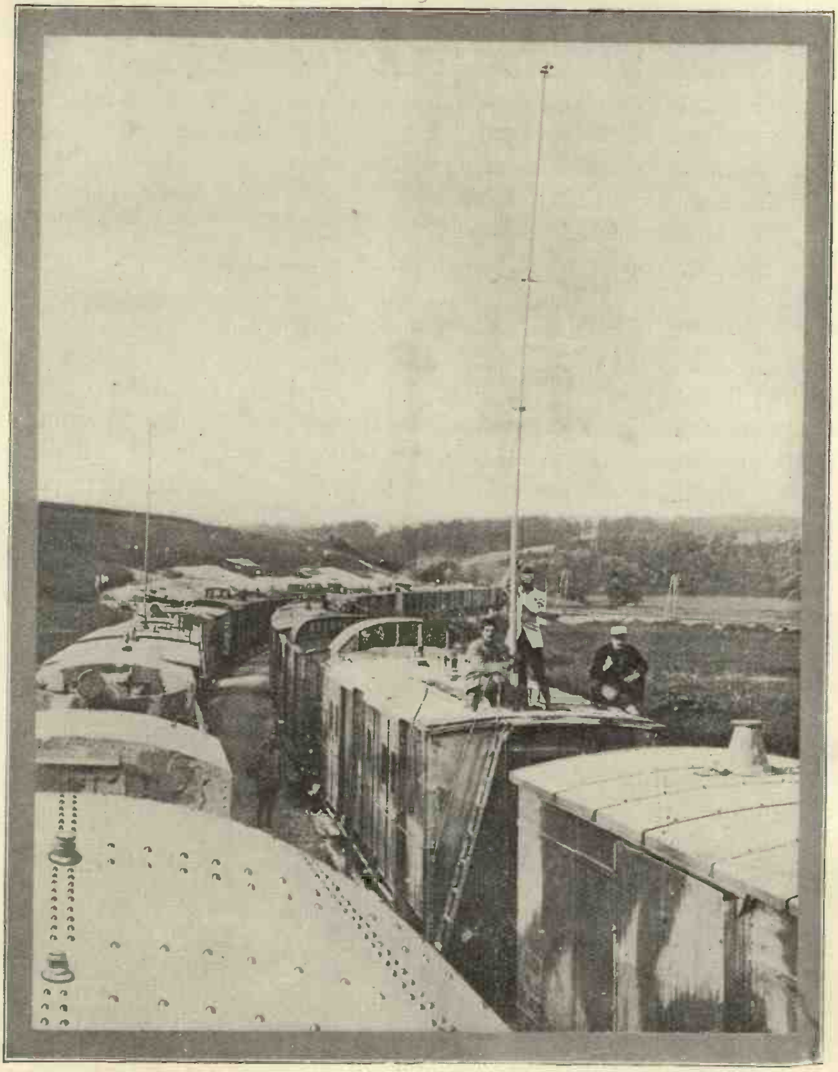


FIG. 2.

The only phase adjustment required with this type of disc is as between studs, and slight adjustments of this kind are made by rotating the disc-box either backwards or forwards over a small angle.



[French Official Photo.

FRENCH RAILWAY TRAIN WIRELESS INSTALLATIONS.

Wireless Telegraphy In the War

PICTURESQUE STORIES AWAITING THE EXIT OF THE CENSOR.

WHEN the angel of Peace sounds " all clear " and the censors of the belligerent nations gracefully retire from the scene, there will be many picturesque stories to tell upon subjects which by reason of their technical character would generally be dismissed as outside the average man's limit of interest. How the great wireless services were turned over entirely to the control of the belligerent nations owning the stations will deserve a place amongst these records, for it is doubtful whether there has been any class of commercial enterprise in which there has been a more complete surrender to the needs of the moment.

Simultaneous with the suspension of commercial wireless there have been vast expansions in military and naval radiotelegraphy. Definite figures, of course, we cannot give, but they are such as are calculated to cause complete surprise when ultimately published.

Britain, of course, with its vast mercantile marine has had to find some thousands of efficient operators, and the response made by intelligent young men throughout the whole of the United Kingdom has been particularly gratifying, especially when it is remembered how little official encouragement had been given to the amateur wireless man on this side of the Atlantic. The demand continues for those who, approaching military age and having a desire to serve their country in a position of individual responsibility, feel within them the native call to the sea.

America, although possessing initial advantages in the possession of thousands of bright fellows familiar with the principles and practice of wireless, and also having the experience of Great Britain and the Allies to work upon, has nevertheless already accomplished much more in this direction than was certainly ever anticipated by the bungling lieutenants of the Kaiser. We are informed officially from Washington, in the weekly bulletin issued by the State Departments, that by the middle of November last the expansion of the personnel in training in the radio services of the United States since the opening of the war—an interval of only seven months—had been more than 1,000 per cent ; and here, of course, the story does not end. At the end of November a school at Harvard University for the development of men enlisted in the radio service had more than 2,000 under training, and some

400 per month were graduating for duty with the fleets on merchant ships or at other stations.

Whilst all the radiotelegraphic services in the United States were put under the control of the Director of Naval Communications at the end of April last, that department has wisely continued certain routines found by experience to be of incalculable value in war as well as peace. The time signals—so useful for determining longitude—storm signals, weather reports and hydrographic bulletins, continue to be issued from the scheduled American stations as usual, much to the comfort of mariners, who, since the U-boats commenced their heartless campaign, have had strenuous and anxious times.

On the Atlantic coast of America there are three high-powered stations capable of transatlantic communication. The service, we are informed, is mainly directed from the high-powered station at Radio, Va., near Arlington, and from the station at Key West. The station at Sayville, Long Island, has also, of course, an important part. Every United States ship is in constant communication with the Navy Department at Washington by means of efficient apparatus.

On the Pacific coast there are four high-powered stations, whilst the station at Darien, Panama Canal, has a radius capable of including within its sphere of control the Panama Canal zone, the Caribbean, the Gulf of Mexico, and also certain Pacific waters. As might be expected, the service in the fleet closely co-ordinates with

[Photo: Sport and Genera

TRAINING OF WOMEN FOR WIRELESS APPARATUS WORK AT THE POLYTECHNIC, REGENT STREET, W. BRAZING SOME OF THE DELICATE PARTS OF THE INSTRUMENTS.

[*Photo: Sport and General*

TRAINING OF WOMEN FOR WIRELESS APPARATUS WORK AT THE POLYTECHNIC, REGENT STREET, W. ADJUSTING AND TUNING UP MARCONI INSTRUMENTS.

the service ashore. There is only one Government radio service in the United States which is not directly engaged upon warlike programmes, and that is conducted by a small series of stations belonging to the forest section of the American Board of Agriculture.

American Signal Corps Expansion.

According to Major J. Andrew White, Chief Signal Officer of the Junior American Guard, the organisation of the Signal Corps of the U.S. Army, which in pre-war days required but 46 officers and 1,212 men, is now expected to be increased largely. Within this extensive growth the radio companies find a proportionate expansion. The functions of these units, as outlined in the instructional course, are theoretically as follows:

In the first instance, radio companies are used by the commander of a division for the maintenance of communication with adjacent columns or with the divisional cavalry. When the character of the service, distance or the nature of the terrain prevent the laying of wire lines, then other special duties fall to its lot. The radio company also serves to connect divisional headquarters with the divisional trains, and, pending the construction of semi-permanent lines, with the radio station at the army corps headquarters in the rear. These radio facilities may also be used to intercept messages sent by the enemy or to interfere with the operation of his radio station. All who have been acquainted with wireless in the field know that the scheduled uses for a unit may possibly be expanded to include other highly useful and not uneventful "stunts." For this we have as witness our entertaining contributor "Perikon."

If American radio operators with all this scope fail to provide material for good after-the-war stories then we have overestimated the ability of our broad-minded and versatile cousins.

SENATORE MARCONI SPEAKS OF BRITAIN'S INDISPENSABLE POWER.

Whilst we are certain that Senatore Marconi with characteristic modesty will resent any suggestion on our part that his efforts in the Allied cause since the outbreak of war have justified his inclusion amongst those whom we like to refer to as "statesmen," the fact remains that this eminent scientist has accomplished much useful work in creating that unity of outlook and purpose so essential in bringing the present Herculean task to the desired conclusion. The disaffection amongst certain of the Italian troops, which was responsible for the "break-through" on the Friulian Plains, might very well have failed to eventuate, had the great Italian Patriot-Scientist and his co-workers been able to spare time and energies to dissipate the misconceptions which led up to it. The international character of Senatore Marconi's life work has brought him into intimate contact with all the races constituting the present Allies, and the very breadth of outlook which enabled him as a young man to make such epoch-making discoveries has given him an insight to the real, as

[*Photo: Sport & General.*

TRAINING OF WOMEN FOR WIRELESS APPARATUS WORK AT THE POLYTECHNIC, REGENT STREET, W. SOLDERING IS A FINE ART IN THESE INSTRUMENTS AND REQUIRES A STEADY HAND.

FIELD WIRELESS IN MESOPOTAMIA.

distinct from the merely reputed, character of the inhabitants of Western Europe and the United States.

Senatore Marconi, during all his missions in Europe and America, has never lost an opportunity for revealing one Ally to another in its true light. No task would have been more congenial, had he been located on the Isonzo, than that of convincing the army whose *moral* was being sapped by enemy suggestions regarding the perfidy of Great Britain that the calumnies spread abroad were entirely without foundation and that the agents engaged in their propagation were scoundrels and not philanthropists animated by humane purposes. He could have checked at the source much mischief which was not apparent to less observant persons until "too late."

Evidence of Senatore Marconi's thorough understanding of the Anglo-Saxon peoples, their intentions in this world war, and their ability to carry through what they have undertaken, despite many unforeseen happenings, was provided in the Italian Senate early in the New Year, when in a debate centring largely around the matter of food distribution he spoke clearly on what Great Britain and the United States had done and could do, and where any present weakness lay. "Our people," said Senatore Marconi, "must fully realise the great efforts made by Great Britain, and how indispensable her power has been in the prevention of the subjugation of Europe by Germany." Dealing also with America's unparalleled preparations he emphasised the importance of the intervention of the United States and the indebtedness of Italians to the American Government and people for their friendly sentiments. With these remarks were words of warning:—"Co-operation between the Allies will give us victory if they look ahead instead of simply making good mistakes." Whilst Senatore Marconi was speaking, British guns and aeroplanes were holding in check German activities intended to pave the way for fresh efforts towards Venice and French troops with characteristic dash were preparing a surprise which was to result in the recapture of an important Italian position and a bag of nearly 1,400 prisoners and much valuable war material. As the result of such speeches as those delivered by Senatore Marconi, and others similarly well informed, even the troops which were tricked by the enemy into leaving the firing line are returning and fighting with their old stubbornness and courage.

BRITAIN'S PEACE TERMS: U-BOAT OUTRAGES TO BE KEPT IN MIND.

We commend to our readers, particularly those who "go down to the sea in ships," the permanent possession, either in newspaper or pamphlet form, of Mr. Lloyd George's speech of January 5th, which, in such brilliant contrast to Germany's vague statements upon the objects and purposes of her "defensive" war, sets out in precise and unequivocal terms exactly what the Allies are fighting for. If, having before them such terms, the Germans consider it necessary to continue the contest, then they stand self-condemned, and we venture to suggest that, unless the German people are more partial to the present slaughter than their own statements would suggest, then the campaign can only be carried on through 1918 by a deliberate withholding of the facts from the German troops and masses by their political and military leaders. No nation or group of nations which hitherto has entered into armed conflict has ever offered to make such sacrifices in the cause of a just and lasting peace. At the same time no belligerent or group of belligerents was more confident of its ability if necessary to carry its military efforts to a successful conclusion.

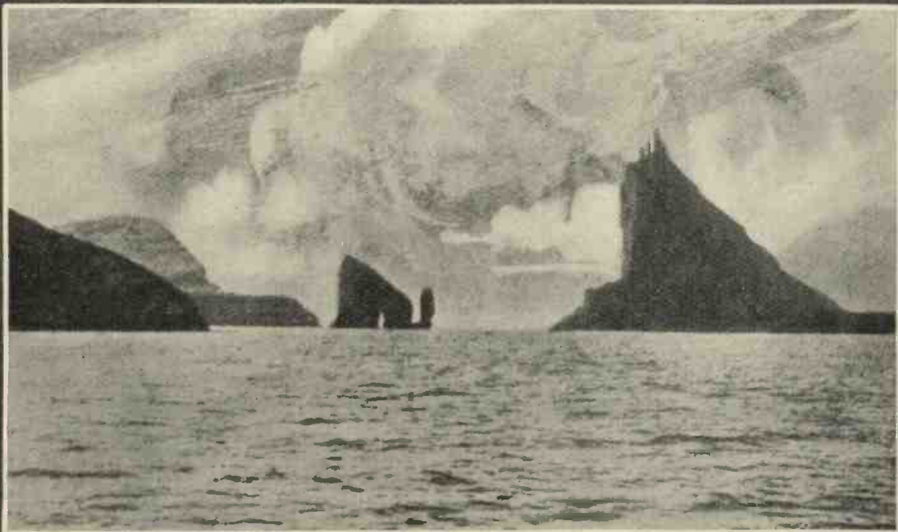
[French Official Photo.

INTERIOR VIEW OF A WIRELESS CAR ON THE MARNE FRONT.

We note with satisfaction—and even the German peoples must admit the justice of our claims—that at the Peace Conference, whenever and wherever it may take place, our seamen and the outrages they have suffered must not be forgotten. To allow to pass unpunished such crimes as have been committed on the high seas since the U-boats went forth on their nefarious missions against the mercantile marine would in itself place an insurmountable obstacle in the way of any proposal for the reduction of armaments to which we are agreed.

BRINGING NEAR THE FAR-AWAY ISLANDS

BY W. B. COLE



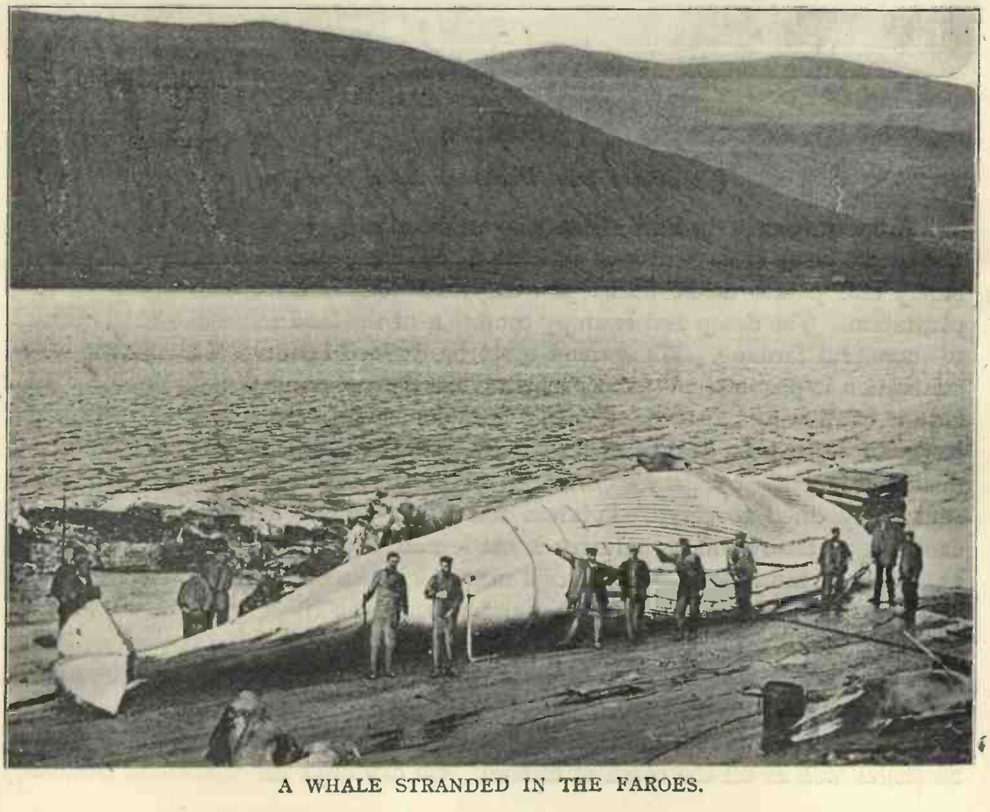
PART II

(*Continued from December issue, page* 591.)

AGRICULTURE in the Faröe Islands is carried on under rather primitive conditions, the people being conservative in their methods. The enclosures consist of pasture, barley and potato fields, whilst you may occasionally meet with a small turnip plantation. The damp and swampy condition of the land forms the chief obstacle to successful farming. The ground must be drained by numerous ditches before cultivation is possible. Vegetation mainly consists of meadow grass, and the local custom of allowing this to stand until it has done flowering forms one of the principal reasons for the poor quality of the hay, a further obstacle to its satisfactory production being the constant rain, which frequently drenches it before it has been sufficiently dried to carry. Potatoes sometimes become soft on account of the excessive wet. The main industry is cattle and sheep farming. The animals are not tethered, but roam at large, except in winter, when cattle and horses are housed. The large number of beasts and sheep produce such an effect upon the whole of the local vegetation that the Faröes must present a very different appearance to-day from that which met the eyes of their earliest inhabitants some twelve hundred years ago or so.

The Faröese owe much to their fisheries, fishing being carried out all along their coasts, as well as off the coast of Iceland. On dry days the whole cliff sides may be seen white with split cod in course of being salted and dried previous to shipment.

Whaling forms a special branch of industry in itself. The species of this sea mammal generally hunted here is the bottle-nosed or *Grinda-Quealur*. In Faröese parlance "Grind" means a gathering or multitude. Whale herds visit the islands in July and August. The boat which first perceives them makes with all speed to the nearest inhabited shore, and signals with coat or jersey fastened at the top of a mast. As soon as this warning appears, the villagers kindle a large fire of damp straw, and these beacons, each with its specified place, spread the news from island to island. False alarms are of rare occurrence. Boats put out from all the adjacent villages, and in a very brief space the sea is alive with craft eagerly hurrying to the drive. This forms the most ticklish part of the business. The boats are arranged in a semicircle to seaward of the herd, and then, with shouts and splashing of oars and stones, the terrified quarry are driven towards the nearest whale bay. To produce the necessary panic amongst the herd a curious implement is employed. A large rounded stone pierced at one end is fastened by a stout piece of whaleskin about 20 ft. long and denominated by the islanders a *Sokn*. This is swung round the head and dashed into the water, churning the surface of the water into foam to the accompaniment of a rare turmoil. Considerable skill is required for keeping the "school" (sometimes amounting to 2,000 whales) closely packed, whilst at the

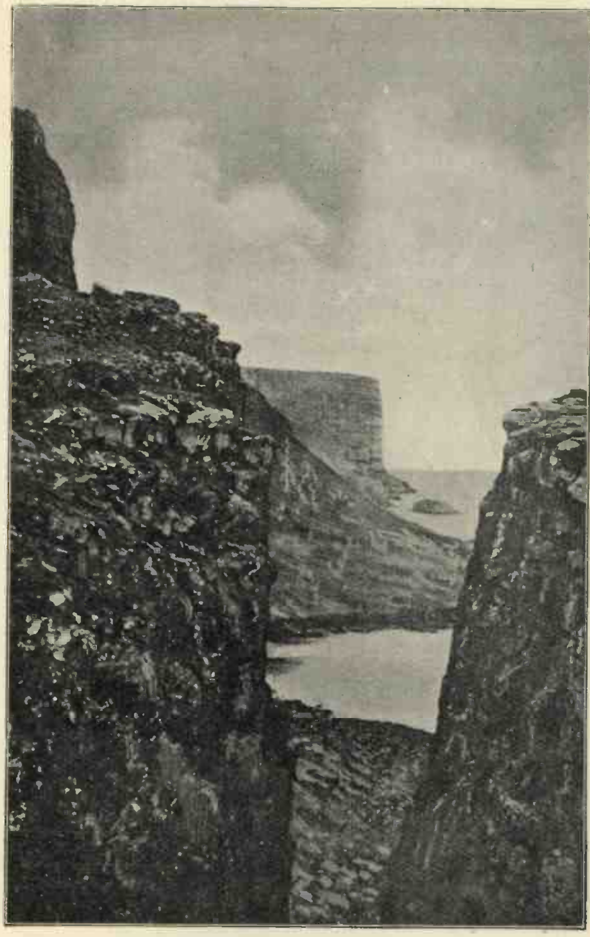


A WHALE STRANDED IN THE FAROES.

THE SPORT OF DRIVING THE WHALES ASHORE.

same time gradually driving them towards the bay. The veteran whalers pride themselves on achieving this object without causing a stampede. These whale bays are fringed by a sloping bottom, which shelves on to a sandy beach ; so that when the last rush comes the fish charge ahead and strand themselves. Once ashore they are attacked with knives and lances by the hunters there awaiting them. Large hooks, with a stout rope attached, are driven into the eyes, and with this apparatus men and women drag their prey up the beach. The whales are not of any large size, seldom attaining more than 30 ft. A hand's-breadth is measured backwards from the blow hole, and the *Grindaknivur* (a long whale knife) is plunged into the back, instantly severing the spinal cord. Such fish as are not driven ashore are killed by the lance of the harpooner in each boat's crew. The throwing of the harpoon is little used. The shape of the boats used in this fishery is strongly reminiscent of the old Viking ships. High stem and stern posts, resting well above the gunwale at each end, together with the fine lines on which the little vessels are constructed, bespeak their lineal descent from the ancient craft. A large whale will yield about 30 gallons of oil, chiefly located in the beast's head, and this amount is worth about £3. The flesh forms excellent eating, and when boiled—the usual method of cooking—it bears a strong resemblance to beef, though slightly darker in colour. The Faröese themselves enjoy the fat or blubber ; I tried it and found it too much for my super-sensitive palate. After the allotment of certain prizes for valour and skill exhibited during the hunt, the whole of the capture is valued on the spot and divided under strict rule.

So much for agriculturists and fishermen. But there are other industries here.



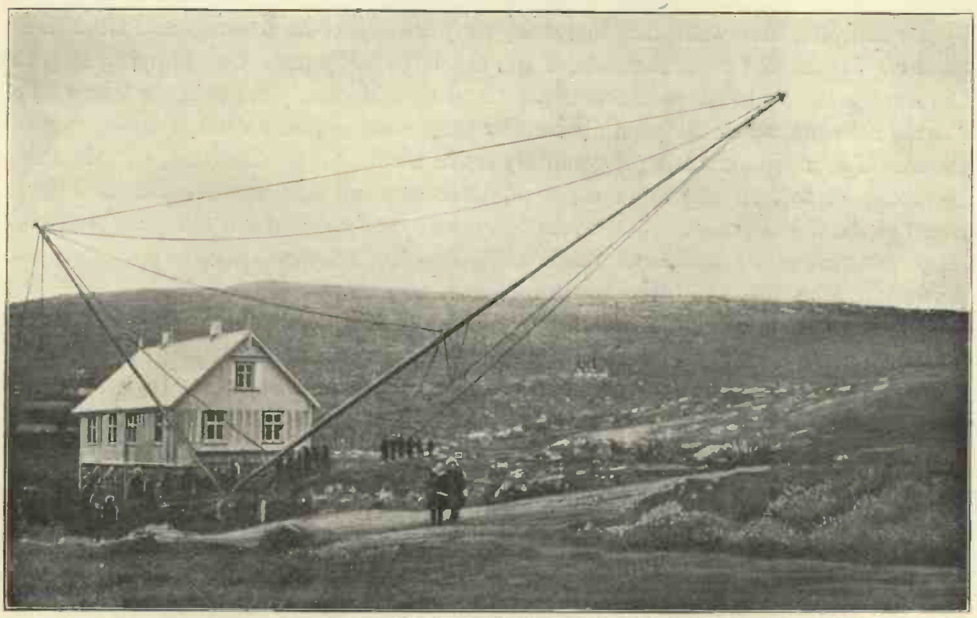
THE CRAGGY HOMES OF THE BIRDS IN THE FAROE ISLANDS.

Amongst these we may mention that of the bird-catchers. An extremely dangerous occupation is theirs, needing great strength of muscle and nerve, a steady brain and a sure foot. They usually work in single pairs, although sometimes two pairs are required. One man lets his comrade down the cliffs at the end of a rope, which frequently runs to 600 ft. Dangling at the rope's end, the fowler thrusts a large cod hook, lashed to the end of a long stick, into the burrows of the bird, which sometimes run a foot or so deep. The squeaking inmate is silenced by the wringing of his neck and then slung by a noose to the hunter's belt. Sometimes a fowling net is employed. This is a formidable weapon, with a handle 15 ft. in length, shod with a three-pronged fork of iron to assist the hunter in scaling the crags. The fowler poises himself upon a ledge just wide enough to leave him free to use his net. The scared birds fly all round, deafening him with their shrill, discordant cries and buffeting him with thousands of wings. A single slip would mean a horrible death on the jagged rocks hundreds of feet below; but these men's nerves seldom fail them. With deadly aim and deliberation, the huge net sweeps to and fro, seldom missing its victim and occasionally enmeshing two or even three birds at a single swoop. Their necks are soon twisted, and the birds form a festoon around the hunter's waist. A skilled operator may bag from five hundred to a thousand birds in a single day. The birds thus caught are mainly puffin and loom. They are either eaten fresh or salted for winter use, whilst their feathers also form a source of revenue.

It will easily be understood that touring troops of actors or music-hall artistes do not include the Faröes in their round! Dancing forms the chief amusement, although excellent amateur theatricals and occasional concerts vary the programme. In addition to the ordinary ball-room varieties the Faröese have their own special national dance. Men and women link hands indiscriminately, forming one long loop. Keeping time with their feet, they advance and retire towards and from their *vis-à-vis*, all singing in unison one of the old Faröese Sagas. One hopping step to the front and two to the side constitute the single " figure," and thus the whole loop is kept moving round the room, becoming twisted as it goes into a complication of forms. The unison-chanting is generally set in a minor key ; and this, joined to the stamping of feet in rhythmic time, produces a weird and semi-barbarous effect. Some of the Sagas possess as many as 75 verses ; and no sooner is one poem finished than someone starts another. Each Saga possesses its own special tune. Such a performance as this will often go on for hours together.

The language of the islanders is a dialect of Norse, peculiar to these regions, and with some admixture of Danish, the latter being probably due to the fact that modern Danish is spoken in the law courts, churches and schools. In view of the strong Scandinavian strain in English blood, I was not surprised to find much similarity between many of the Danish words and our own. For instance, " Bord," meaning table, has only to be heard once to remind one of its connection with that " blessed British institution," the boarding house ! " Stol," pronounced "stool," means chair ; " klippè " signifies to cut ; whilst " lille " is the same as our "small." Thus it is easy to acquire an extensive vocabulary, and whenever you find yourself at a loss for a word, if your first attempt be unsuccessful, a synonym will often hit the mark. Luckily for the Britisher it is unnecessary for him to learn Danish. Most of the people with whom I have come into business or social contact speak

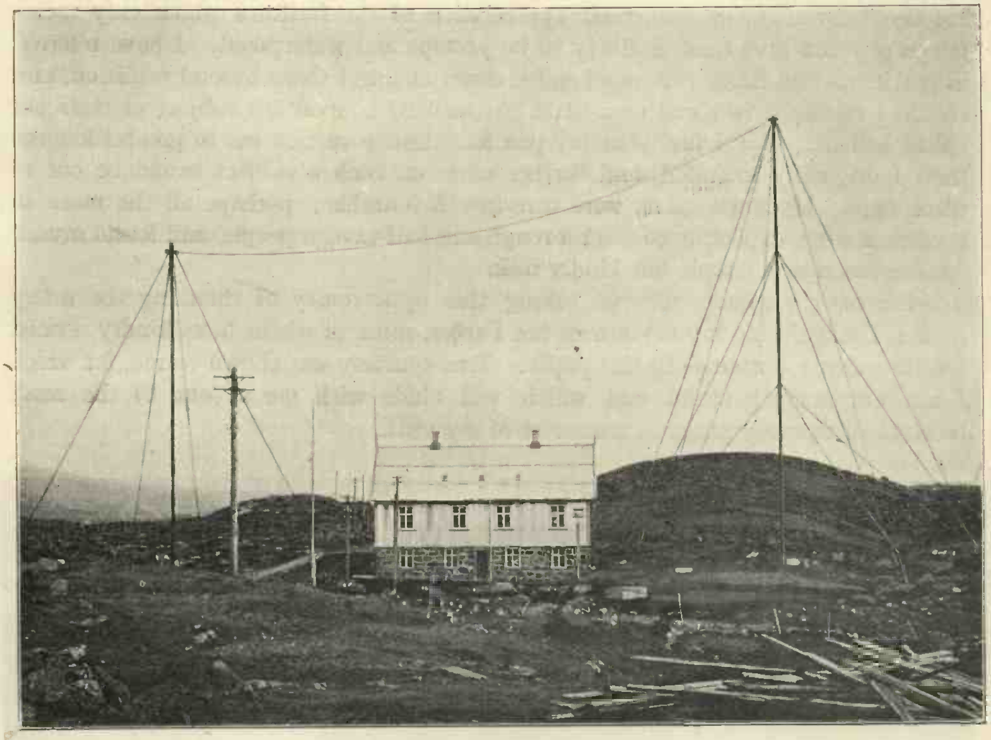
TVERAA WIRELESS STATION AND TELEPHONE EXCHANGE. NOTE THE PECULIARLY NORSE CHARACTER OF THE ARCHITECTURE AND DECORATION.



VIEW AT THORSHAVN, SHOWING THE ERECTION OF THE WIRELESS MAST BY FALLING DERRICK.

excellent English. Thorshavn even boasts a debating society wherein papers in English are often read and discussed in that language. The city is also blessed with a bank and a cable station. The latter connects with Iceland on the one hand and Lerwick, in the Shetlands, on the other. Through the centre of the town runs a stream which swells to a veritable torrent after much rain. 'Tis a not infrequent occurrence ! To " keep their heads above water " the Faröese build their houses of wood, superimposed on stone walls about 6 ft. high. The upper stories are reached by wooden stairs ; the basements, forming the general storehouse, including accommodation for peat. Their method of building roofs is somewhat peculiar. Instead of tiles they use a thatch of beech-tree bark, over which they place grass sods, which—once free from the attention of sheep—flourish well. This combination, they claim, ensures their homes remaining dry.

An excellent telephone system has during the last eleven years been in operation throughout all the principal islands, with the exception of Suderö, the most southerly of them. The submarine cable, which connected this island with its neighbour Sandö, broke so frequently, owing to its resting on sharp ledges, that it had to be abandoned. The frequent storms and currents caused it to be repeatedly cut to pieces. An additional source of trouble arises from the corrosion of the steel sheathing caused by its resting on coal deposits. This forms an excellent electrical couple, with the salt water as excitant. The Marconi Company was, therefore, asked to link up Thorshavn, the Central Exchange, with Tveraa, in Suderõ, and since February of last year the two stations have been in constant communication. This has already proved a great boon, for the stations communicate three times a day and exchange on the average about twenty telegrams. Had it not been for their employment communications would have to be effected by motor-boats, which take from five to seven hours to perform the voyage. With the present scarcity of petroleum from which we are suffering, this would involve a practically prohibitive telegraphic charge. The two stations are alike in equipment. The aerial, of umbrella form, is supported in the centre by a steel mast 100 ft. high, erected in a single piece by means of a 50 ft. falling derrick. This derrick now acts as a mast, supporting one of the four extension wires. Three telegraph poles stay out the remaining three. The prime-mover is a Gardner oil engine, coupled directly to a D.C. dynamo, which charges a battery of 35 accumulators once every ten days or so. The transmitting plant is of the ½-kw. type, with the converter and rotary spark-gap in the usual silent cabinet. The receiver consists of a crystal and magnetic detector mounted together in one case with the necessary tuning condenser and inductance. All communication between Thorshavn and Tveraa is done on a 500-metre wave with small coupling, thus ensuring complete immunity from interference by and to other stations using the usual 600 metres. A 300-metre wave is also fitted and later on 600 metres will be available for communication with ships. At Thorshavn the apparatus is lodged in the cable station. The earth system consists of galvanised iron plates, buried vertically in two semicircles with subterranean wires, radiating outward ; the plates are riveted together and wires radiating inward connect them with the transmitting plant in the house. At Tveraa the earth system consists simply of galvanised wires buried about six inches, radiating outwards in the shape of a fan. This station is housed in the



THORSHAVN WIRELESS STATION.

PANORAMIC VIEW OF THORSHAVN, SHOWING LOCALE OF W.T. STATION.

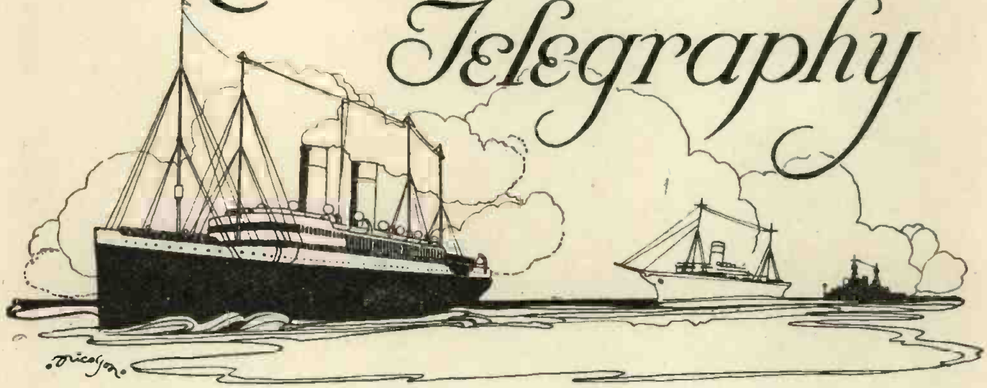
telephone exchange, which stands on the slope of a high hill, a position which possibly accounts for the comparatively high power and tall masts required by so short a distance as 47 miles.

I have dwelt at this length upon the general characteristics of these interesting islands because there is but little available in book form, and you must understand the conditions to realise the value of wireless to the inhabitants. An account of a visit by J. Russell-Jeaffreson, written seventeen years ago, is the latest with which I am acquainted. The average intelligence and education of the people seems to me decidedly high, so that their appreciation of the facilities which only radio-telegraphy can give them is likely to be prompt and widespread. I have referred in passing to the Sagas or songs handed down amongst them by oral tradition, and should have liked to dwell at a little greater length upon the subject of their old epical ballads. But I find that my pen has already carried me to greater lengths than I originally intended, and further notes on such a subject would be out of place here. My impressions were certainly favourable ; perhaps all the more so because I went, expecting to meet a rough and half-savage people, and found myself instead amongst a simple but kindly folk.

I cannot conclude without taking this opportunity of thanking the many friends I met during my sojourn in the Faröes, some of whom have kindly revised the statements contained in this paper. True courtesy was shown to me, for which I am extremely grateful and which will abide with me as one of the most precious of the very pleasant memories of my visit.

PANORAMIC VIEW OF TVERAA, SHOWING POSITION OF WIRELESS STATION.

Maritime Wireless Telegraphy



MERCANTILE ROLL OF HONOUR.

THE official Roll of Honour of the Mercantile Marine has a long leeway to make up, owing to obvious difficulties besetting the task of compilation, and has not, in fact, yet reached the period of intensified frightfulness announced by our barbaric enemy to commence exactly a year ago. The sixth list, recently published, only brings this sacred record up to the end of October, 1916. We are pleased to find only two names of wireless operators were registered during the six months which ended on the above-mentioned date as having lost their lives in service on merchant and fishing vessels, these being H. Nixon, of Hull, who is supposed to have met his death on July 11th, 1916, and A. J. Proughten, of East Finchley, who is supposed to have died on April 5th, 1916. Some details of Mr. Proughten's experiences were published in THE WIRELESS WORLD of May, 1916. History will show that the lives of these gallant fellows were not given in vain.

FEARED LOSS OF THE "AURORA."
WHALER USED FOR WIRELESS RESEARCH.

All wireless men will regret the news that the famous Polar exploration ship *Aurora* is posted as considerably overdue and feared lost. This vessel, it may be remembered, was fitted out as a relief ship to the Shackleton second expedition to the Antarctic, and, being equipped with wireless, its operator, although deterred from establishing the communication which it was hoped to effect, was able to conduct under the most adverse conditions some very useful research work in connection with electrical phenomena in Polar regions. Full details were given of this work in THE WIRELESS WORLD for June, 1916. At the moment of going to press we have been unable to obtain any details regarding the composition of the crew or its radio equipment, and it is conceivable that, as the craft was on a voyage from New Zealand to England, disaster might easily overtake the vessel without the prospect of timely assistance, even though SOS signals were sent out. Sir Douglas Mawson, the previous owner of the *Aurora*, is stated to have expressed the opinion that the vessel must have met with foul play or very exceptional handling by the elements, as she was one of the most sturdy and stable whalers ever built.

CANADIAN VICTORY LOAN PROCESSION AT MONTREAL.

One of the most novel features of the Canadian Victory Loan Parade, recently held in Montreal, was a float representing wireless operators at work. The exhibit, which was arranged by the Marconi Wireless Telegraph Company of Canada, comprised a complete transmitting and receiving set, and was manned entirely by operators who had suffered torpedoing at the hands of the Huns. Placards in French and English drew attention to the fact that wireless is playing its part in the war, and encouraged all in the vast crowds lining the streets to do their bit also by buying Victory Bonds. "We'll save lives at sea—you save money at home" read one notice, while another informed the people that every man on the float had been torpedoed, and asked if readers were helping to buy more ships by purchasing bonds. With the aid of some Leyden jars an "Emergency" coil was made to produce sparks, which were audible long before the float came into view, and the popularity of the Marconi wireless apparatus and the boys who are rendering such excellent service to the Empire was demonstrated by the loud cheers which greeted them as they passed in the procession. Copies of telegrams from Sir Thomas White, Minister of Finance, and Sir William Laurier, printed upon the regulation "Marconi" forms and sealed in the usual "Marconigram" envelopes, were showered upon the crowds and eagerly sought as souvenirs of one of the most gorgeous carnivals ever witnessed in Canada. The names of the operators who manned the float are given below :—

D. R. P, Coats, W. Garner, F. J. Browne. Operator McCormack, survivor of the

Lusitania, was to have appeared, but unfortunately the steamer in which he is now serving left Montreal earlier than had been expected.

A Vow for Each Fresh Loss.

It cannot be pretended that 1917 finished in a manner which was fitting for our dauntless men at sea. By a sequence of misfortunes to convoys and other formations the Royal Navy lost in all too brief an interval of time several very useful destroyers, patrol vessels and auxiliary ships. The greatest blow perhaps from a military point of view was the disappearance during foggy weather, during the night of December 22nd–23rd, of three destroyers off the Dutch coast, under conditions which have not been made public at the time of writing. These mishaps, which serve to emphasise the vastness and complexity of the task which our Navy has conducted for three and a half years in all weathers, should also remind every one of us, whether at sea or ashore, how essential it is to co-operate directly or indirectly in bringing our sailors' tireless efforts to a satisfactory conclusion. Every wireless operator might well make it a practice to place against each mishap to an Allied warship the vow that his duties will henceforth be conducted with intensified zeal. We can never form anything like an exact estimate of the lives and tonnage already saved from the enemy by the alacrity of our wireless men, but we are confident that when the war is over there will be no class of seagoer more justified in their consciousness of duty well done.

Convoy Disasters.

In the absence of further data we feel justified in crediting to " wireless " such differences as are favourable in the details concerning the convoy disaster in October last, when two British destroyers and nine merchantmen were sunk, and the two incidents in mid-December off the mouth of the Tyne when one British destroyer, five armed trawlers, one British and seven neutral merchantmen were sunk and a British destroyer damaged. In October, we were officially informed, the German ships escaped owing to the wireless apparatus on both the *Strongbow* and *Mary Rose* being shot away right at the beginning of the engagement, but in the latter case the fact that 88 Scandinavians and ten British survivors were rescued by four destroyers—strongly suggests that wireless signals were received on this occasion from the ill-fated vessels. As the whole episode, particularly the non-arrival in time of a force detailed to protect the Scandinavian convoy, is the subject of a Court of Enquiry nothing further can be said. We may, however, be excused for expressing our mystification at the manner in which the enemy obtained such detailed information regarding the movements of the convoy and the character of its escort. The enemy undoubtedly has still very clever agents working in this country.

The Old, Old Story: U-Boat Barbarity.

The sinking of the Ellerman liner *Hindalgo* repeats with almost pathetic precision the details of devilment and hardship so frequently revealed since the Germans, realising the hopelessness of their military position, threw aside the last vestige of humanity which had veiled their unparalleled brutality. With a precision so oft repeated as to be legitimately considered as calculated, the torpedo which gave the *Hindalgo* its initial list to port destroyed the wireless gear, smashed up the port lifeboat and swamped the starboard cutter. Thirty-five officers and men who took to the one remaining boat were left to witness the shelling which hastened the vessel's end and then to face great privations and suffering. Making a southerly course for land a moderate gale sprang up on the second day and continued throughout the third day, when the second cook was buried early in the morning, the donkeyman died in the afternoon and the fireman reached a dying condition. On the fourth day of exposure, that on which land was sighted, the cook, second steward, two able seamen and a fireman died. When the survivors reached shore and their condition was examined by a medical man no less than 20 were taken to a hospital. Several of these had fingers and toes amputated owing to the effects of exposure. With such facts before us there is no difficulty in understanding and sympathising with the resolutions of the Merchant Seamen's Guild regarding the attitude to be taken towards German ships and commerce after the war.

Logarithmic Notation

An Interesting Suggestion

THE following letter appeared in a recent issue of our contemporary, the *Electrical World,* and will probably interest many of our readers :

" To the Editor of *Electrical World.*

" SIR,—Would it not be generally advantageous to adopt a common system for indicating whether a logarithm is to base 10 or base e ? Some text-books give ' log x ' as being ' loge x,' and specify the base for other systems, as, for example, ' log x.' On the other hand, other books call ' log x ' the common log, or log 10, and specify ' loge x ' when the hyperbolic logarithm is meant. It appears to the writer that as such a beautifully simple system is in use to distinguish between the trigonometric functions—*i.e.*, ' sin x,' ' tan x,' etc., for circular functions, and ' sinh x,' ' tanh x,' or ' Sinh x,' ' Tanh x,' as used by some writers to indicate hyperbolic functions—it should be a fairly simple matter to distinguish between the two generally used systems of logarithms in some similar manner. For instance, ' log x ' or ' logt x ' would indicate ' log 10 x,' and ' logh x ' would indicate ' loge x,' or the ' hyperbolic logarithm of x.' The notation I suggest would be very convenient for typewriting, and I should imagine rather more convenient for printing than the system of indices now in use. It would further remove the confusion due to the different usages of various authors as noted above.

" F. M. GILLESPIE.

" Preston, Idaho."

Notes of the Month

UP-TO-DATE VENEZUELA: COMPREHENSIVE COURSE AT NEW NAVAL RADIO SCHOOL.

IT has long been apparent to those who have considered the fields still open for wireless expansion that no Continent is likely to derive greater immediate benefit from this unique agent of inter-communication than that of South America. Each fresh issue of the Wireless map of the world shows a growing accumulation in this particular area of the significant spots denoting transmitting stations, and wherever a new station appears there is an additional inducement to the maritime and sea forces moving up and down the coasts to install wireless on all craft of importance. Last summer the Venezuelan Republic took the important step of establishing a well-organised school at Puerto Cabello for the training of operators for service in the Venezuelan Army and Navy.

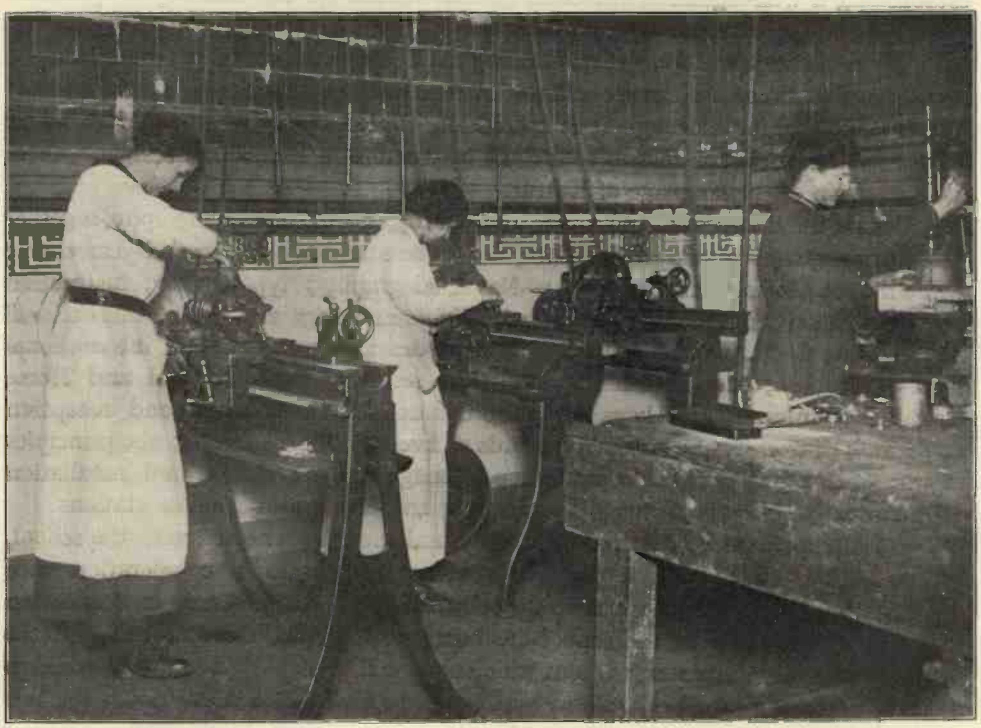
Copies of the Official Gazette containing the Decree concerning this establishment which have just reached Europe will not be read with enthusiasm by the subjects of Kaiser Wilhelm, for although it is specifically stated that the proposed two-year course for radio-telegraphists is to include instruction in French and English, there is no mention of the language of Kultur.

During the first year of the course all the subjects of general telegraphy, together with the languages already referred to, are to be studied. The second-year course will embrace the following subjects :—Naval telegraphy ; typewriting ; instruction in international semaphore signalling with lights and flags and in the international Morse Light Code, instruction in the laws, codes and regulations of international radio-telegraphy ; the international wireless service ; the Universal and Morse alphabets ; international keys and abbreviations ; transmission and reception at the rate of from twelve to twenty words of five letters per minute ; the principles of wireless telegraphy ; the construction, management, regulation and installation of radio-telegraphic apparatus ; the planning and erection of wireless stations.

This comprehensive course, together with all things connected with the school, are under the direction of a director-professor who works in co-operation with the engineer-director of the National dockyards. All the expenses in connection with the maintenance of the school are being paid by the Government, and the examinations for certificates, without which none will be employed in the Venezuelan military and naval wireless stations, are conducted by a Board, including the two officials already mentioned together with an Army and a Naval officer and two titular telegraphists. Photographs have already reached us of the inaugural class held on board the Venezuelan cruiser, *Mariscal Sucre*, at Puerto Cabello, under the direction of Professor Antonio E. Toro Key.

MORE WOMEN FOR WIRELESS.

In several recent issues we have had pleasure in drawing attention to the growing practical interest being displayed by women in various departments of wireless work. Now we have to record what promises to be a considerable extension of the employment of the fair sex in the construction and testing of apparatus. The pressing need for the services of well-educated women for Government work in connection with wireless apparatus was recently made apparent by advertisements issued to the newspapers through that all-embracing department, the Ministry of Munitions, and photographs are published in this issue showing what are presumably "recruits" to this interesting branch of war work, engaged on the lathes and driller and on other delicate and important work. The opponents of scientific education for girls and young women will now be advised to observe silence, for it is not unlikely that by the enrolment of many who have gained a useful knowledge of physics in the polytechnics and the more enlightened secondary schools much will be accomplished towards giving our aerial forces the equipment so essential to their effective employment in the great, and we hope final, struggle for victory.



[*Photo: Sport and General.*

TRAINING OF WOMEN FOR WIRELESS APPARATUS WORK AT THE POLYTECHNIC, REGENT STREET, W. AT WORK ON THE LATHES AND DRILLER.

Another Japanese High-Powered Station.

The strict censorship which appears to be common to the naval operations of the several Allied countries operates with particular severity against Japan, for, seeing that our Oriental Allies have no military forces in the field at the moment, there is but little to indicate to the man in the street that this gallant nation is doing anything of moment in the world war. The general effacement of non-warlike news by that dealing with the terrible world upheaval also tends to hide from view everything taking place in the land of the chrysanthemum. There is evidence, however, that Japan is not standing still, and that although the cables may be relatively silent regarding her doings she will have much to show, when peace is declared, of which she may reasonably be proud. In our issue of July we gave some details of the powerful station erected at Funabashi as part of the scheme of intercommunication between Japan and the United States of America. This station was actually in commercial operation when the entry of America necessitated the suspension of activities. Now we learn that the Japanese Government has plans, which are expected to materialise shortly, for the construction of another powerful station at Sushu in the Island of Formosa, which station, according to report, will be as large and as well equipped as Funabashi, and will therefore justly claim to be amongst the most powerful in the world. This station, it is understood, will be open to public use. Next month the Japanese are holding at Tokio an exhibition of all-Japanese electrical machinery, including, of course, the now inevitable display of wireless telegraph apparatus.

Iberian Countries' Steady Progress.

Nearer home, Spain and Portugal run neck and neck in their application of wireless to their various needs. Following the official order published in the *Gaceta de Madrid* in October last, requiring every merchant vessel of 500 tons and upwards to carry wireless whilst engaged in coasting trade, the several Spanish shipping companies are busy preparing to comply with the order. In view of the recent re-arrangement of the so-called barred zone and the disgraceful habit which the German pirates have developed of sinking neutral boats without warning and apologising afterwards for their calculated mistake, the decision of the Spanish Government is likely to result in a considerable saving of men and material, apart from the ever-present value of wireless as a means of bringing first-aid in stormy weather. Portugal, too, having satisfied herself by the test of experience that "wireless" is indispensable to the proper development of her colonial possessions, has recently set apart £75,000 out of a loan of £1,000,000 for wireless telegraph stations in Angola.

Correspondence

EDITORIAL NOTE.—In view of the recently published articles by Dr. de Groot, the following letters will be found of interest:—

The Editor, THE WIRELESS WORLD.

SIR,—I have just read with great interest the articles by M. Cornelis J. de Groot on the "Matter and Elimination of Strays" which have appeared in your recent numbers, and think that you may perhaps find the following notes not altogether devoid of interest.

During the three to four years that I have been an operator, I have devoted some time to a comparison of the strength, frequency and type of stray, and the meteorological conditions prevailing at the time of observation. On a voyage from England to Japan, via Cape Town and Singapore, covering the months of May to November, I made regular observations, thus collecting much data. This I have compared with the above-mentioned articles, seeing that for a portion of the voyage I was in the zone dealt with by M. de Groot, and I find the two to be in close agreement. I would, however, like to mention one or two points I have observed in addition to facts stated in the articles, more particularly in reference to the classification of strays as to electrical nature and source.

I have noticed that there is a certain type of stray which, as regards sound and frequency of recurrence, would appear to be allied to the Type 1 (Loud and sudden clicks) of M. de Groot, but whether they originate in lightning discharges is not certain, for they have been observed in various quarters of the globe and under different meteorological conditions. This much, however, is quite certain, that they are the sure precursors of rain. Sometimes they were observed twenty-four or forty-eight hours before the coming of the rain, whilst at other times only a space of a few hours intervened between the time of their being recorded and the actual fall, and when the sky was cloudless without any apparent indication of rain. Again, they have been noted in the North Atlantic in mid-winter when the sky has been totally overcast for several days prior to their advent. They would therefore appear to be associated with rain or rain-bearing clouds.

All operators of any experience are familiar with the sizzle or hissing X's which precede a white squall. A similar type of stray is to be observed during a lightning storm when the centre of the disturbance is in the immediate vicinity of the receiving aerial, but, unlike the white squall type, this particular class appears to be governed by the successive lightning flashes. Commencing weak, it grows in strength until it will obliterate even the strongest signals, and it is terminated suddenly by a flash of lightning and click in the telephones of Type 1. The length of time of duration varies greatly from one or two minutes to ten or fifteen or even more minutes. This suggests the setting up of a state of electrical stress between the aerial and the clouds or some other body or part of the atmosphere.

Strays of Type 3 (the most frequent and most troublesome type) I have observed both in cloudy and clear, in dry and wet weather, and near land and in mid-ocean. They appear to have their origin in some source entirely different and apart from either of the other two classes. Probably they are due to the action of some body or bodies—*e.g.*, the sun—outside our own atmosphere and yet sufficiently powerful to create disturbances in the ether.

In direct contrast to the almost ceaseless rattle in the telephones, which is the general rule in the tropics, is the entire absence of all classes of strays that I observed on voyage during the winter months in the Arctic. Throughout the period of total darkness no strays of any kind were recorded, even when there were aurora displays in the heavens. The advent of spring, together with the return of the sun aud rain, was accompanied by strays of the " Rain Type " I first mentioned, and of Type 3, although up to the month of June (at which period there was twenty-four hours of sunlight per day) the intensity of what disturbances were noted was far below that which is common in the tropics.

As M. de Groot points out and emphasises, the superiority of the musical note is very clearly demonstrated in " stray " disturbances. In this matter I should like to mention that the synchronous spark of the " Marconi 5-kw. Special Set " possesses very great atmospheric piercing properties.—Yours etc.,

(Signed) Harry Robinson,
Operator.

Sir,—With regard to X's, observations covering a number of years have led me to the conviction that, as a general rule, a variation in the number and strength of X's will be followed within a few hours by a variation in weather conditions, such variations depending upon the locality, season of the year, and the type of X's recorded. I have found this rule to hold good for all parts of the world. Successfully to interpret the " signs " and predict the kind of weather it is necessary to study the various classes of X's with relation to the various weather conditions causing them ; to consider the locality, whether land or sea, mountainous or flat, wooded or bare, whether tropical, sub-tropical or temperate, and to consider the season of the year and the weather usually met with at that time in the particular locality. With experience, and taking all these things into consideration, a fairly accurate prediction can generally be made as to approaching disturbances, their nature, intensity and probable time of arrival. Similarly while the " dirty weather " is in full swing, its termination can generally be foretold by a few hours, by the diminution of X's. Another interesting point I have observed is the relation between X's weather and distant signal strength. On a night when increasing X's denote coming dirty weather, signals from distant stations will be below normal, often considerably so, and if well away from land, no signals will be heard all night on many occasions. Sometimes this reduction below normal is observed from one broad general direction only, whilst signals from the opposite direction are normal. I have invariably found that the direction of worst radio communication is the direction from which the predicted disturbance comes. From this I deduce that radio signals on passing through an atmospheric disturbance are reduced in strength, particularly if the disturbance is intensely electrical. In fact, I might almost say that the reduction is in proportion to the extent of the purely electrical part of the disturbance.

Conversely, when X's begin to diminish and the centre of the disturbance has passed—the time when (in the North Atlantic, for example) a gale has just backed to the N.W. and is blowing itself out, though still blowing strong, and the barometer begins to rise—signal strength rises in the direction from which the disturbance came, and falls in the direction taken by the departing disturbance. Very frequently signal strength rises *above* normal in the first-stated direction—rises so that "freaks" often occur. This is particularly the case in the North Atlantic in winter, and it may be said that the longest distances and best results will *almost always* be obtained just immediately after the centre of a disturbance has passed, and these results will be obtained from, and in, the broad general direction from which the disturbance has come.

In this connection I find part of the article entitled "Features of Long Distance Stations of American Marconi Co.," in the 1917 Year Book, most interesting. I refer to page 740, where it is recorded that a discrepancy was observed between the true directivity and the apparent directivity of the waves received from other long-distance stations. The writer says that when signal strengths were normal, the apparent directions lay close to the true direction, and when below normal there were deviations of sometimes large extent. He also notes that Arlington's apparent direction was farthest from true on the night that a tropical storm warning was being broadcasted.

Now, do not these deviations of direction and weatherings of signal strength point to atmospheric disturbances as the direct cause? All the above observations seem to indicate it. Also, considering that note about Arlington, the "tropical storms" referred to are well known to be intensely electrical in character, and, as stated, caused the greatest deviation in directivity. From my own experience I find that the more highly electrical a disturbance the further below normal does signal strength go when the signals pass through the zone of disturbance.

In support of my suggestion that atmospheric disturbances of more or less electrical character cause the weakening of signals and the deviation from true direction, may I hazard the opinion that the following is the explanation?

It is known that conductors and electrically charged mediums are opaque to electro-magnetic waves. Then, waves travelling from A to B encounter a zone of more or less highly electrified atmosphere—an atmospheric disturbance, more or less electrical in character. This zone will be opaque to the waves, so they must needs bend round it, or be diffracted, and will thus arrive at B from a new angle, and be reduced in strength. It follows that the nearer the receiving station B is to the disturbance, the greater or more noticeable will be the effects. The effect would be similar if a high mountain were between A and B and near B. To my mind, all observations appear to bear out this explanation. It would be interesting to observe with a radiogoniometer what effect a mountain, screening a transmitting station, has on the direction of the received waves at different distances from the mountain.

Before concluding I should like to express my hearty appreciation of Mr. Bertram Hoyle's article, "An Outline of the Design of a Wireless Station," which has been appearing recently in the WIRELESS WORLD. I have just lately read the last part of it, and I must say I enjoyed the whole article immensely; it just filled a gap nicely, and I would like to see it published in book form. I am also greatly interested in the article on "The Three-Electrode Valve" and find it very instructive. Truly your most excellent magazine is ever improving, and you have my best wishes for its continued and growing success.—Yours, etc.,

(Signed) A. DINSDALE.

Equivalent Resistances Calculation

By P. BAILLIE, L.Sc.

We already have considered in these columns the case where a condenser is shunted by an inductance, and a quick method of calculation has been given

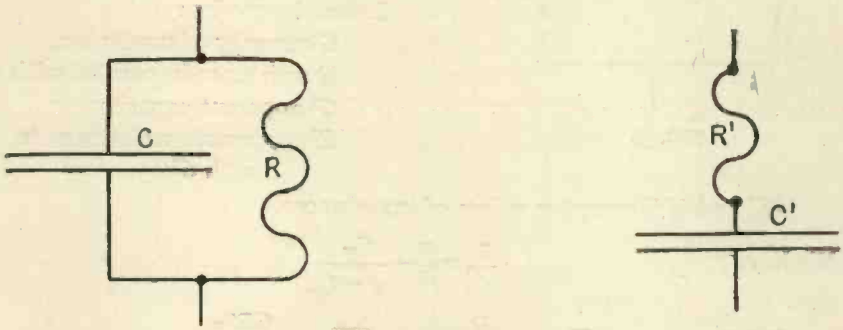


FIG. 1.

about this subject. Another method will now be given which refers to another case frequently met with.

It is a common practice to place in parallel in a wireless circuit a condenser and a resistance or an inductance and a resistance.

For instance, this happened when connecting a detector, a 'phone, or an indicator (excepting an electrostatic voltmeter which has only capacity) across the armatures of a condenser. Dielectric conductivity or leakage between plates also gives the same effect.

Shunting a condenser with a resistance increases the apparent capacity of this condenser ; and the amount of this increase is depending upon the frequency of the oscillations which are travelling through the circuit.

When the circuit oscillates with its natural period the shunting resistance causes an alteration of this period. This is to be considered in a great many cases—for instance, in wavemeters or in some receiving or measuring devices using waves of little or no damping. Moreover, it may be noted that shunting a condenser by a resistance causes a diminution in the apparent resistance of the circuit. And this is a means in use for reducing the resistance of certain circuits.

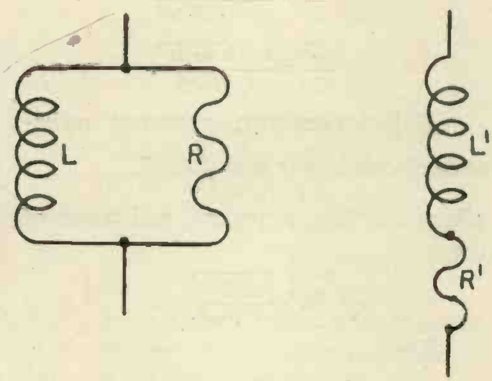


FIG. 2.

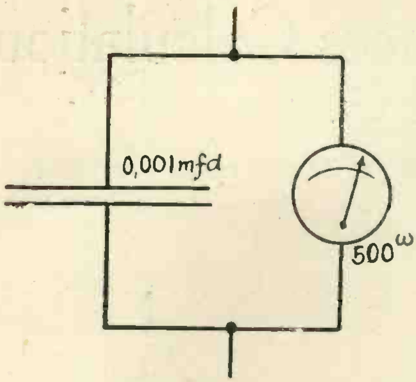


FIG. 3.

A similar effect is produced when shunting an inductance by a resistance. The apparent inductance and resistance are diminished. This is a further way of reducing the resistance of a circuit.

Quantitative study is easily done by considering complex impedances. Let us recall it briefly.

Let us denote by :

C capacity of condenser.

R resistance in parallel with C.

C^1 apparent capacity.

R^1 apparent resistance in series with C^1.

$[Z]$ and $[Z^1]$ complex values of impedances.

We have
$$\frac{1}{[Z]}=\frac{1}{R}-\frac{C\omega}{\sqrt{-1}}$$

hence
$$[Z]=\frac{R}{1+C^2R^2\omega^2}-\sqrt{-1}\cdot\frac{CR^2\omega}{1+C^2R^2\omega^2}$$

and the two sets are equivalent when

$$[Z^1]=R^1-\frac{\sqrt{-1}}{C^1\omega}$$

$$[Z]=[Z^1]$$

hence
$$R^1=\frac{R}{1+C^2\omega^2R^2}$$

$$\frac{1}{C^1\omega}=\frac{C\omega R^2}{1+C^2\omega^2R^2}.$$

This can be written :

$$\frac{R^1}{R}=\frac{1}{1+C^2R^2\omega^2}$$

$$\frac{C^1}{C}=\frac{1+C^2\omega^2R^2}{C^2\omega^2R^2}.$$

Before shunting, apparent resistance of condenser was $\frac{1}{C\omega}=R_c$

after shunting apparent resistance of the set is :

$$\sqrt{R_1{}^2+\frac{1}{C_1{}^2\omega^2}}=\rho.$$

Then

$$\frac{\rho}{R_c}=\frac{1}{1+\left(\frac{R_c}{R}\right)^2}$$

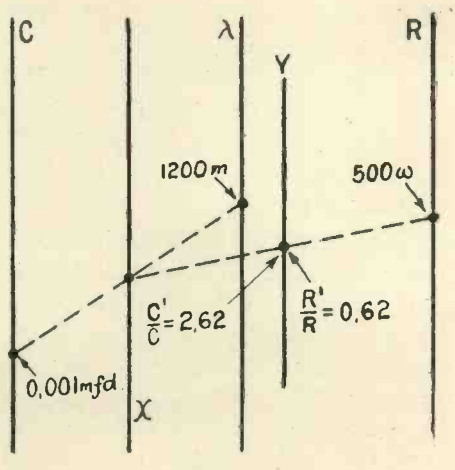
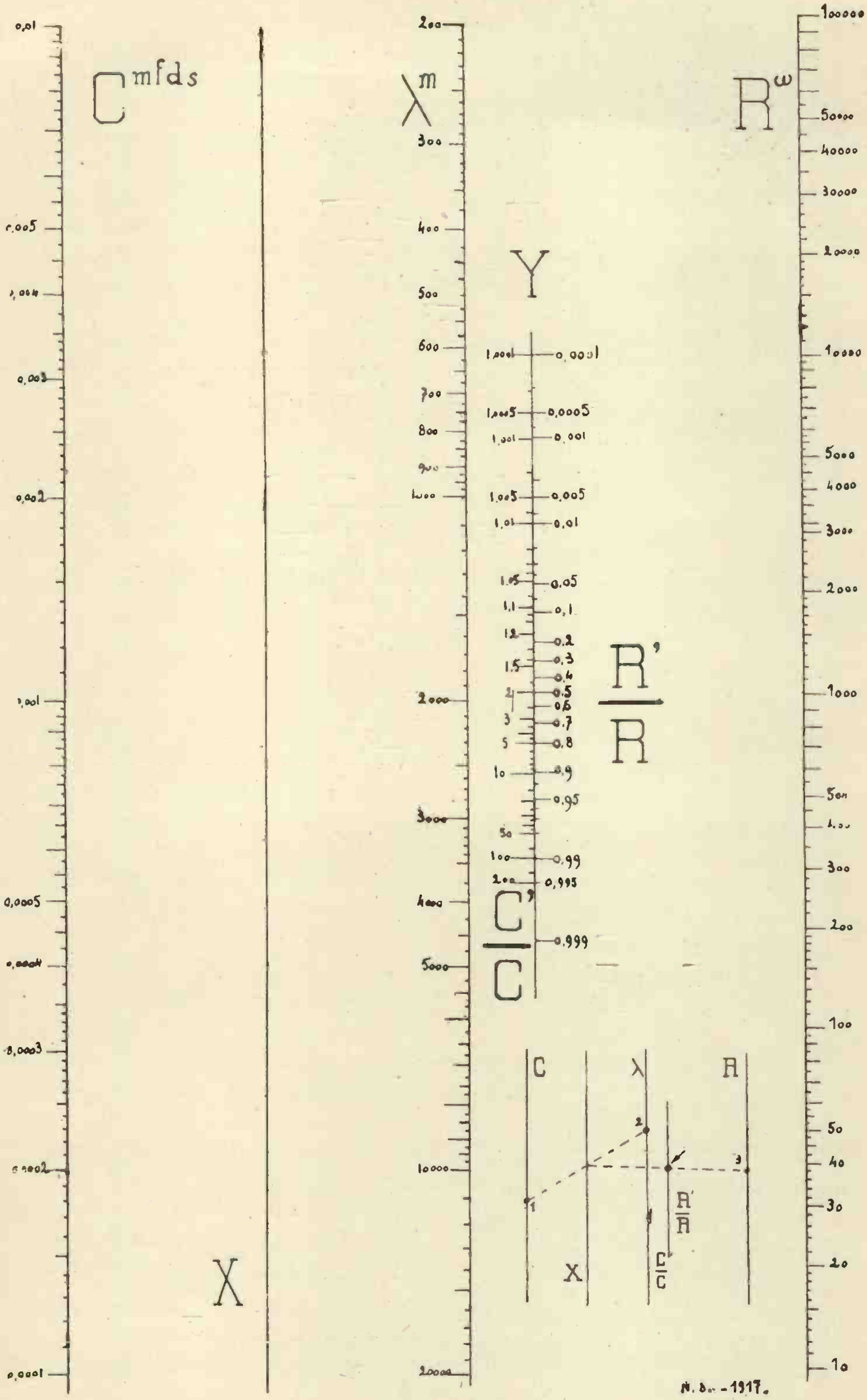


FIG. 4.


C mfds
λ m
R ω
Y
X
R'
R
C'
C
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0,005
0,003
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10
50
100
200
C
λ
R
X
N. B. - 1917.

NOMOGRAM 5.

Consider now the case of a resistance, R, shunting an inductance, L.

Let us denote by :

L^1 apparent inductance after shunting.

R^1 apparent resistance in series with L^1.

We similarly have $$\frac{1}{[Z]}=\frac{1}{R}+\frac{1}{\sqrt{-1}\,.\,L\omega}$$

hence $$[Z]=\frac{RL^2\omega^2}{R^2+L^2\omega^2}+\frac{\sqrt{-1}\,.\,R^2L\omega}{R^2+L^2\omega^2}$$

$$[Z^1]=R^1+\sqrt{-1}\,.\,L^1\omega$$

and the two sets are equivalent when $[Z]=[Z^1]$

hence $$R^1=\frac{RL^2\omega^2}{R^2+L^2\omega^2} \qquad L^1=\frac{R^2L}{R^2+L^2\omega^2}.$$

This can be written :

$$\frac{R^1}{R}=\frac{1}{1+\frac{R^2}{L^2\omega^2}} \qquad \frac{L^1}{L}=\frac{\frac{R^2}{L^2\omega^2}}{1+\frac{R^2}{L^2\omega^2}}.$$

Before shunting, apparent resistance of inductance, L, was $R_L=L\omega$; after shunting apparent resistance of the set is

$$\rho=\sqrt{R_1^2+L_1^2\omega^2}.$$

Then $$\frac{\rho}{R_L}=\frac{\left(\frac{R_L}{R}\right)^2}{1+\left(\frac{R_L}{R}\right)^2}.$$

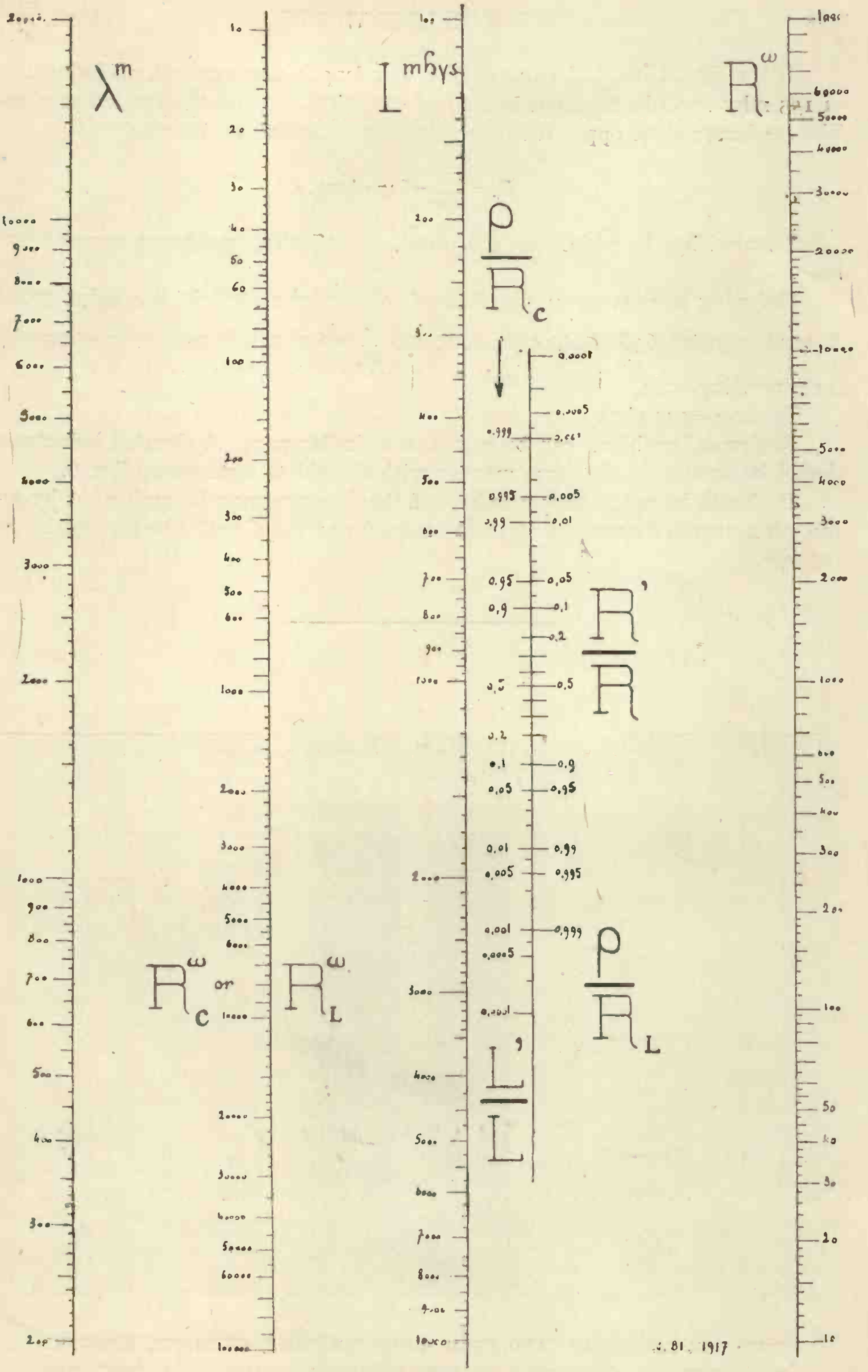
As already stated, the natural wavelength of an oscillating circuit is altered when shunting a condenser or an inductance. The variation can be calculated, though to do so is somewhat tedious. In the common case where the equivalent resistance R^1 is small compared with inductance, the effect on the wavelength of this extra damping can be neglected. Then the ratio of wavelengths is approximately $\frac{\lambda^1}{\lambda}=\sqrt{\frac{C^1}{C}}$.

All these formulæ are solved by the accompanying nomograms, Fig. 5 and Fig. 6.

These are based on a graphical method of calculation, several applications of which have already been published in this magazine. We merely shall explain their use.

Let us consider an example ; for instance, consider the shunted condenser, Fig. 3. We then shall use nomogram, Fig. 5.

Draw a straight line (Fig. 4) from point 0.001 mfd. of the C scale to point 1,200 m. of the λ scale. It meets scale X at A. Join A to point 500 ohms of R scale by a straight line. It meets scale Y at B. Read on the right-hand scale value of $\frac{R^1}{R}=0.62$, and on the left-hand scale value of $\frac{C^1}{C}=2.62$. The set condenser-telephone is then equivalent to a condenser of capacity $C^1=0.0026$ mfd. having in series a resistance $R^1=309$ ohms.



NOMOGRAM 6.

If the circuit has to be tuned on a wavelength 1,200 metres, an inductance of 155 mhys. will be required instead of 400 mhys. as with the condenser alone. The condenser alone opposed to the current an effective resistance :

$$R_c = \frac{1}{C\omega} = 637 \text{ ohms.}$$

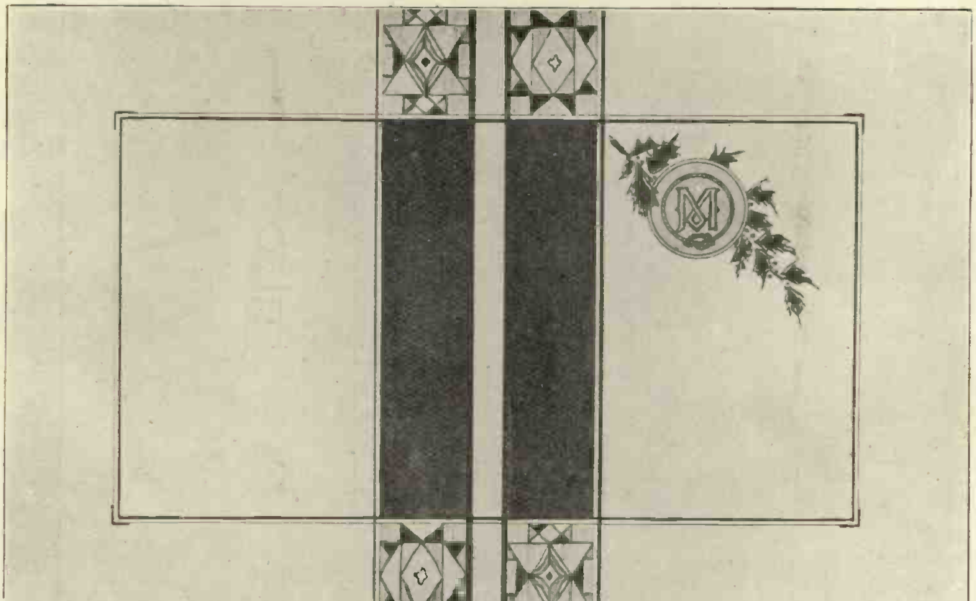
Shunted by the resistance 500 ohms, the effective resistance opposed will be ρ.

Referring to nomogram, Fig. 6, and joining by a straight line point 500 of R scale to point 636 of R_c scale, the ratio $\frac{\rho}{R_c} = 0.38$ will be read at meeting with corresponding scale.

Hence $\rho = 242$ ohms.

Reciprocal problems can be solved in a similar way. A shunted inductance should be treated in the same manner with the aid of nomogram, Fig. 6.

It should be noted that numbers of the R scales may be multiplied by 10, 100, etc., provided numbers of the λ scales (or of the C scale) be divided by 10, 100, etc.



COVER OF CHRISTMAS CARD FROM RUHLEBEN CAMP, GERMANY, DESIGNED BY INTERNED OPERATORS. FOR CHRISTMAS CARD, SEE PAGE 732

Among the Operators

SUNK BY MINE.

WE regret to have to record the death of Mr. Charles Bernard Francis Morgan, 18½ years of age, of Brighton, who was lost when his ship was mined on October 10th, 1917. Mr. Morgan was educated at the Preparatory School and the Xaverian Colleges at Mayfield and Brighton, and trained for a wireless operator at the British School of Telegraphy, London, where he gained his P.M.G. certificate. On joining the Marconi Company he proceeded to sea almost immediately in October, 1916. His sixth voyage terminated fatally with the sinking of the vessel.

OPERATOR C. B. MORGAN.

Our heartfelt sympathy goes out to his parents and relatives in their sad bereavement.

THE HALIFAX DISASTER.

The great and terrible explosion which occurred at Halifax, Nova Scotia, when a munition ship collided with a Belgian relief ship, and which shook the civilised world with grief and sympathy at the appalling loss of life, and devastation, following in its wake, is of too recent date to require any attempt at description here. Through this un-thought-of agency of death it is our very sad duty to chronicle the deaths of four Marconi operators serving on different ships near the scene of the catastrophe.

Messrs. Arthur Greenwood Mitchell, of Lidget Green, Bradford; Reginald Charles Lovell Pitcher, of Maidenhead; Arthur Edward Charles Mann, of Gorton, Manchester; and John Francis Lawless Armitage, of Higher Broughton, Manchester, were the victims of whom we speak.

Mr. Mitchell, who was 22 years old, was educated at the Yorkshire Board Schools at Woodroyd, Princeville, and Marshfield respectively, and on leaving school entered the service of the Electricity Department, Town Hall, Bradford, afterwards joining the Marconi Company as learner in April, 1915. On account of his previous knowledge of telegraphy, he quickly qualified, and proceeded to sea in July, 1915, serving on three vessels previous to the one on which he last sailed and made the supreme sacrifice.

OPERATOR A. G. MITCHELL.

Mr. Pitcher, aged 22 years, received his education at the Maidenhead Modern School and the Polytechnic, Regent Street, W., and was trained in wireless telegraphy at the London Telegraph Training College. In November, 1915, he joined the Marconi Company, and sailed on his first voyage the following month. The last vessel, on which he was making a fourth consecutive trip, was

OPERATOR A. E. C. MANN.

the fourth ship on which he had served his country in her need.

Mr. Mann, born in February, 1899, was educated at the Ardwick Central School, Manchester, and afterwards employed as shorthand typist in the office of the Chief Goods Manager, L. & Y. Railway, Victoria Station, Manchester. He received his wireless training at the City School of Wireless Telegraphy, Manchester, and joined the Marconi Company on June 12th last, shortly afterwards making his first trip. On his next voyage he met with disaster, and his name is now included in the imperishable roll of honour.

Mr. Armitage, aged 18¾ years, was educated at St. Patrick's School, Manchester, and trained in wireless at the City School of Wireless Telegraphy, Manchester, whilst employed as a salesman by the American Shoe Company, Deansgate, Manchester. He joined the Marconi Company in November last, proceeded to sea a few days later, and was yet another of those brave sons of England who was called to give his life for his country's cause. Our expressions of condolence with the parents and relatives of these young men are shared, we are sure, by all our readers, and we trust some degree of comfort may be derived from the knowledge that they were killed whilst at their posts of duty.

OPERATOR R. C. L. PITCHER.

ACCIDENTALLY DROWNED.

Extremely sad is the case of Mr. John Edward Gaywood, who, although he had reached port on a ship which had been badly damaged by a torpedo, lost his life by accident on December 6th last.

OPERATOR J. F. L. ARMITAGE

It appeared that the deceased was returning to his cabin about eight p.m., bringing with him an American oil lamp, used for heating his cabin. On his way he had to pass a hole in the bridge made by the explosion when the vessel had been torpedoed. The hole was protected by a rope, and during the night nothing was seen of Mr. Gaywood. Next morning the lamp was found near the hole, but the rope was missing. Apparently he had fallen through in the darkness. Search was instituted, and in the afternoon his body was found by the ship's diver.

An inquest was held, and a verdict of "accidentally drowned" returned. Trained in the Marconi School, young Mr. Gaywood was only 21 years of age, and had been in the Marconi service for 2½ years. He had served on several ships, and was held in high regard by all who knew him.


OPERATOR J. E. GAYWOOD.

The funeral took place at Hornchurch, the body being brought from Fishguard by the second officer, Mr. Howard. The oak coffin was covered with the ship's red ensign, which had been wrapped round his body on its being brought ashore, the flag being later presented to the parents. The captain and crew were represented by Mr. Howard (second officer), who was accompanied by Mrs. Howard, while the Marconi Company were represented by Mr. Whitmore (inspector). The service was conducted by the Rev. A. C. Kibble, C.F. There were numerous floral tributes, including those from the officers and crew of his ship, the members and staff of Messrs. Temperley & Company (ship's owner), and the Marconi International Marine Communication Company, Ltd.


OPERATOR
C. H. J. SOMERSCALES.

DEATH FROM ILLNESS.

We regret to report the death of Operator Charles Herbert James Somerscales, who was taken ill on board his ship, and removed to Plymouth Naval Hospital. He died on December 22nd last at the age of 17¾ years from malaria, brain fever supervening.

Mr. Somerscales was educated at the Erith County School, employed as lad writer for a time at the Royal Arsenal, Woolwich, and trained in wireless telegraphy at the British School of Telegraphy. He entered the service of the Marconi Company in April, 1917. We deeply sympathise with his parents and relatives in their great bereavement.

Share Market Report

LONDON, *January 15th*, 1918.

BUSINESS has been very quiet in the share market during the past month. There has been small investment buying, and the prices of all issues are well maintained. Marconi Ordinary, £3 1s. 10½d.; Marconi Preference, £2 13s. 9d.; Marconi International Marine, £2 11s. 3d.; Canadian Marconi, 11s.; American Marconi, £1 5s. 3d.; Spanish and General, 9s.

Instructional Article

NEW SERIES (No. 11).

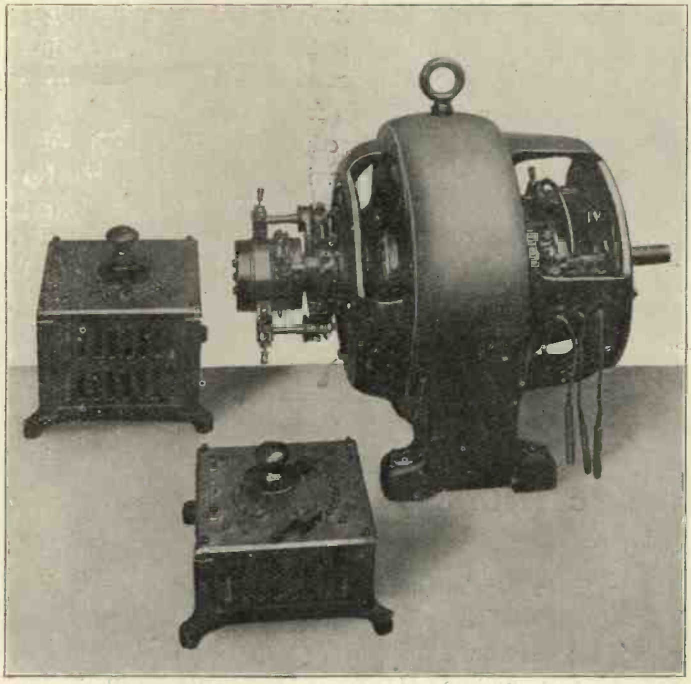
EDITORIAL NOTE.—In the opening number of the new volume we commenced a new series of valuable instructional articles dealing with Alternating Current Working. These articles, of which the present is the eleventh, are being specially prepared by a wireless expert for wireless students, and will be found 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.

ROTARY CONVERTERS.

56. Direct Current Motors.—A rotary converter is a machine by which continuous current is transformed into alternate current or alternate current into continuous current. The first process is the usual function of the machine, but for the purposes of wireless telegraphy the process is inverted, the direct current being transformed into alternate current.

It has been seen that when a coil of wire is rotated in a magnetic field an E.M.F. is induced in the coil. Conversely if a direct current is passed into the coil a magnetic field will be erected round the coil which will cause the coil to revolve. In the case of the alternator the current is reversed in direction each half period. It is obvious that passing a direct current into the coil will cause it to revolve only half a revolution. In order, therefore, to produce a complete revolution of the coil the current will have to be reversed at each half period.

This is attained by adding a commutator to the shaft in place of the slip-rings previously used in connection with the alternator.



1½ K.W. ROTARY CONVERTER.

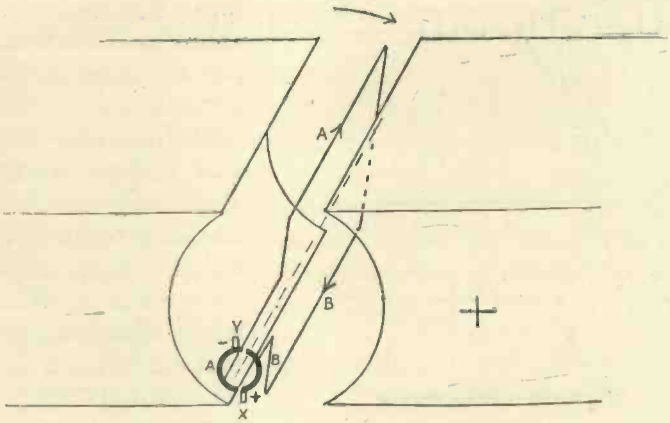


FIG. 54.

In Fig. 54 is shown a single coil, the ends of which are connected to two half rings. Consider firstly the production of a current when the coil is rotated in a magnetic field. As the coil is rotated from the position shown in Fig. 54 to that shown in Fig. 55 the current flowing through the coil and in the external circuit when the brushes are connected together will have increased from zero to a maximum and decreased to zero again. The current leaves the coil by the brush X, and enters by the brush Y, X being therefore the positive brush. Now as the coil passes the zero position, that is when the coil is at right angles to the magnetic field, the commutator, A, under the negative brush, Y, passes under and makes contact with the brush X and the commutator B passes under and makes contact with the brush Y. After the coil passes the zero position the current flowing in it is in the opposite direction, as shown in Fig. 56, but, since the commutators have passed under the opposite brush, the current will still leave the coil by the brush X, the current in the external circuit being, therefore, in the same direction. We thus have the current in the external circuit rising to a maximum and decreasing to a minimum, then rising to a maximum and decreasing to a minimum again, but in the same direction as shown in Fig. 57.

It must be noticed that in the figures shown the currents are induced ones. Therefore if a current is passed into the coil the direction of rotation will be opposite to that shown in the figures.

It is therefore seen that if a continuous current is passed into the coil the coil will revolve. This is the principle of a direct-current motor, and is made use of in rotary converters.

If now an armature is wound with coils of wire placed in a magnetic field and the coils are connected to a commutator the armature will revolve when a direct current is passed

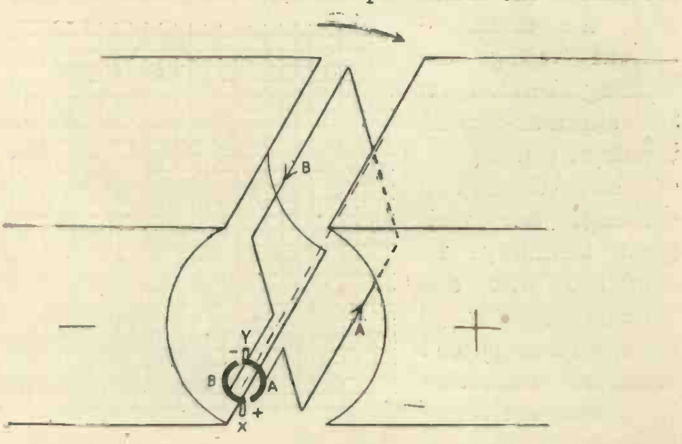


FIG. 55.

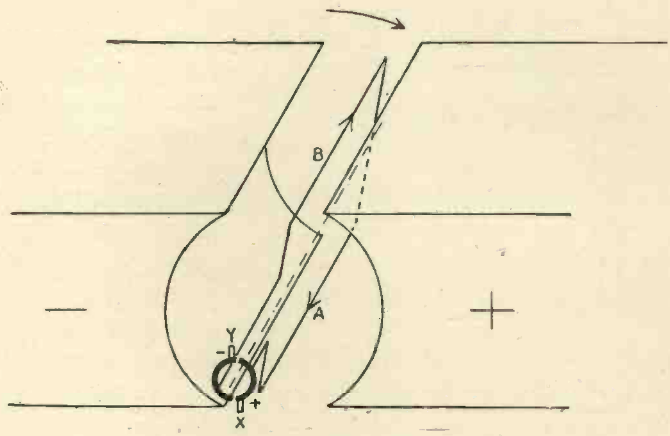


FIG. 56.

into the coils. If another suitable winding is added to the armature and connected to slip rings and rotated in the same magnetic field an alternating current will be produced by the second winding, which alternating current can be utilised in an external circuit. We thus have an armature with a direct-current winding and an alternate current winding rotating in the same magnetic field. Since the alternate-current and direct-current windings are separate, the voltage of the alternating-current side is independent of that of the direct-current side.

Let the two armatures be wound with the same number of turns in exactly the same way, and the direct-current winding be supplied with 100 volts and taking 100 ampères to drive it as a motor. Now since the alternate-current winding is similar to the direct-current and revolves in the same magnetic field he pressure at the slip rings of the alternate-current winding will be 100 volts maximum—that is, the virtual voltage will be

$$\frac{100}{\sqrt{2}}=70{\cdot}7 \text{ volts.}$$

It will be seen, however, that this is only the case when the two armature windings are identical, which case will be referred to again. If the two windings are different, then the only factors common to both the alternating-current and direct-current sides are: (1) the strength of the magnetic field, (2) the speed of rotation of the armature, the alternate-current voltage depending, therefore, on the alternate-current armature winding.

Now these two windings can with great advantage be combined into one winding. In Fig. 58 is shown a single coil armature connected to a two-part commutator. If now the

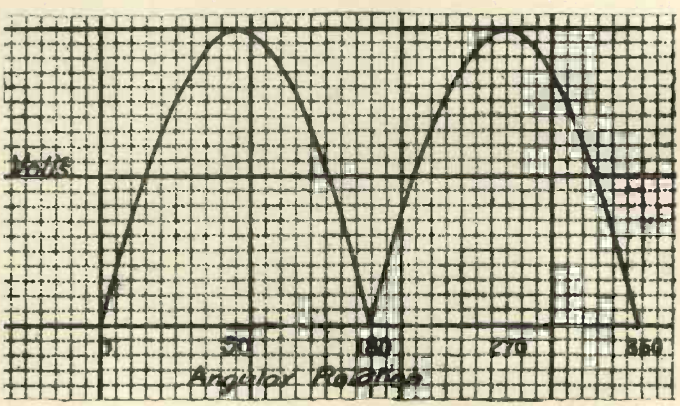


FIG. 57.

armature winding is tapped at two equidistant points and taken to two slip rings we then have the one armature winding acting as the direct current-motor winding and the alternate-current generator winding.

It will be seen that by tapping the winding at two equidistant points and connecting the ends to two slip rings single-phase current is produced, but if three equidistant points are tapped and taken to three slip-rings three-phase current is available, with, of course, an alteration in the voltage and current supplied.

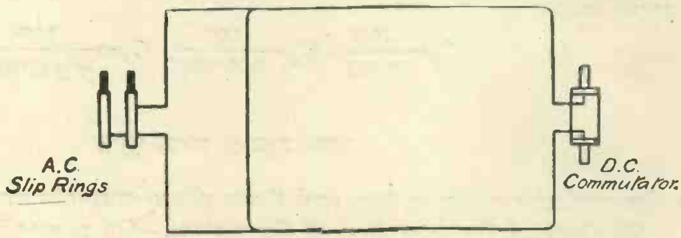


FIG. 58.

57. Voltage Ratio of Converter.—It has already been seen that if a voltage of 100 volts is applied to the primary or direct current side of a converter the voltage of the alternate-current or secondary side will be 100 volts maximum, or 70·7 virtual volts, if the alternate-current winding is a single-phase one. The voltage obtainable from single or more phases can also be calculated from a formula.

In a single-phase winding the tappings are taken off at points 180 degrees apart. For a two-phase four-ring armature the tappings are taken off at 180 degrees apart, and for a three-phase three-ring armature 120 degrees apart. Let the distance between the tappings on the slip-ring equal the pole-pitch (the pole-pitch being the distance between the centres of two magnet poles) divided by a constant, or distance between tappings $=\frac{\text{pole pitch}}{K}$.

Then K for single, two and three phase respectively $=1, 1 \times \frac{2}{3}$, and it can be shown that the virtual value of the alternate current voltage is

$$V_{virtual}=\frac{\text{continuous voltage}}{\sqrt{2}}\times \sin\frac{90}{K}$$

where K has the above values.

It will then be found that, if 100 be the continuous voltage, the alternate current voltage will be

70·7, 70·7, 61·2 volts,

for single, two and three phase-converters respectively.

58. Current available from Converter.—In order to arrive at an approximate figure for the current obtainable from a single, two and three phase converter let the converter losses be negligible and the current and voltage be in phase—that is, the machine has unity power factor.

Let the continuous voltage be V and the current be C ampères. Then we have $VC=V_1C_1=2\ V_2C_2$, where V_1, C_1, V_2, C_2, is the voltage and current for single and two phase converter respectively. It can be shown that the power of a three-phase circuit is equal to $\sqrt{3}\ V_3C_3$, so that $VC=\sqrt{3}\ V_3C_3$ and since $V_1=\cdot707$ volts, $V_2=\cdot707$ volts, $V_3=\cdot612$ volts, we have, letting the continuous current be 100

$$C_1=\frac{100}{0\cdot707},\ C_2=\frac{100}{2\times\cdot707},\ C_3=\frac{100}{\sqrt{3}\times\cdot612}$$

or

100, 141·4, 70·7, 94·3

as the continuous single, two and three phase currents available.

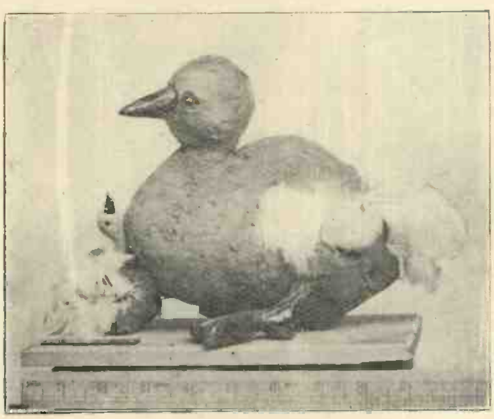
59. General Consideration of Converters.—On page 782 is shown a 1½ kw. rotary converter with a starting resistance and shunt regulator. Both these resistances are connected in the direct-current side of the machine, assuming the converter is to be run off a direct-current circuit and thus used for the supply of alternating current.

If the shunt resistance, connected in the field of the motor, is **increased** or **decreased** the current in the shunt winding is decreased or increased and consequently the field is weakened or strengthened. This will cause the speed of the armature to be **increased or decreased** respectively. Now it has been shown that the ratio of the voltage of the alternate current and direct current side is fixed when a common winding is used, and, therefore, no alteration in speed of the armature can alter the voltage available.

Since, however, the shunt regulator controls the speed, any alteration in its resistance will affect the **frequency** of the **supply**, and is used between small limits to bring the frequency of the machine the same as the frequency of the primary circuit, that is to obtain **resonance.**

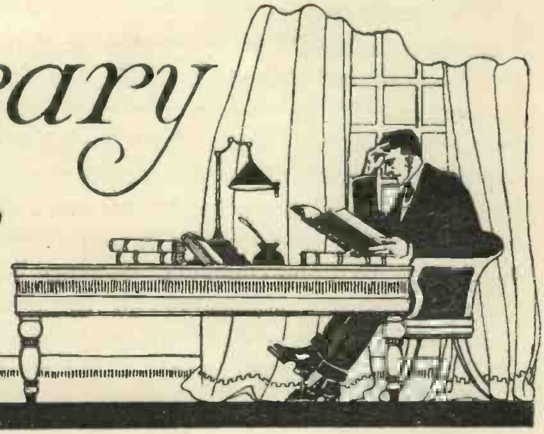
(To be continued.)

A "Wireless" Potato



THE remarkable potato, a photograph of which is reproduced herewith, was grown on the Marconi allotments at Chelmsford. The weight of this vegetable bird is 2 lb. 10 oz., and on being sold by public auction at Chelmsford realised over £21 in aid of the Y.M.C.A. Hut Fund. No surprise was experienced at the works on the production of this creature, as many other wonderful devices have come from the same quarter.

The Library Table



PITMAN'S DICTIONARY OF COMMERCIAL CORRESPONDENCE IN ENGLISH, FRENCH, GERMAN, SPANISH, PORTUGUESE, AND RUSSIAN. New Edition. London: Sir Isaac Pitman & Sons, Ltd. 7s. 6d. net.

WE learn from the preface that the aim of this book is to enable students of commercial correspondence to overcome the difficulties encountered by all those whose task it is to express themselves in a foreign tongue in the shortest possible time. With this object in view commercial expressions have been supplied in the languages dealt with, which would be sought in vain in ordinary dictionaries. This alone should make the work exceedingly valuable to the business man.

The method adopted in this dictionary is to take each word in English in alphabetical order and then to give its equivalent in each of the languages. It is good so far as it goes, but, of course, is useless if the reader desires to ascertain the English meaning of a foreign commercial phrase. In Appendix I., we find the foreign equivalents of days of the week, months, seasons, cardinal numbers, ordinal numbers, and miscellaneous terms, together with a short article on commercial letters in their various national forms. This section is very useful to an Englishman who wishes to send a form letter in a foreign language, and numerous examples are given. Appendix II. contains tables of Russian declensions and conjugations.

The work has apparently been most carefully carried out, but would seem to need companion volumes in the various languages, if the best use is to be made of it. Thus to an Englishman having correspondence with a Spanish agent, the Spanish equivalent of this book would be just as useful as the English version.

We would draw attention to the relatively low price at which this book is published. It is a large volume, containing no less than 718 pages, and is certainly excellent value for the money.

* * * * * *

TELEGRAPH PRACTICE. By John Lee, M.A. London: Longmans, Green & Co. 2s. 6d. net.

To those who have some acquaintance with the inside working of the telephone and telegraph systems of the world, this expertly written book, " a study of com-" parative method," by the Postmaster of Belfast and late Deputy Chief Inspector of Telephone and Telegraph Traffic, G.P.O., London, is intensely interesting and instructive. To the average man who simply hands in and stamps his telegraph form, bothering no further about it so long as the service is performed, it is an education, as he is informed of the numerous processes, telegraphic and otherwise, through which it passes in the interim. The functions of the different systems and instruments employed by various telegraph administrations of the world are lucidly described and compared, reference being made to modern systems, such as the Creed, Murray Multiplex, and Western Electric. *Telegraph Practice* should be included not only on the bookshelf of the telegraph man universally, but on that of all who use the services of the telephone and telegraph.

* * * * * *

CONTINUOUS-CURRENT MOTORS AND CONTROL APPARATUS. By W. Perren Maycock, M.I.E.E. London: Whittaker & Co. 6s. net.

Mr. Maycock's works are distinguished from those of many other technical writers by a refreshing disregard of the conventional methods of text-book writing. They are, in brief, written with the idea, not of showing how much the author knows, but what the reader should know. Those who possess this writer's well-known book on *Alternating Current Work*, in which a difficult subject is handled with next to no mathematical treatment, will understand what we mean. The book before us, which is well up to the author's usual standard, deals with " continuous-current motors and control apparatus " in a clear, up-to-date, and very thorough manner. The object of the work is well stated in the Preface, and we cannot do better than quote the following paragraph: " This particular book is intended for the owner " who has (or desires to have) continuous-current motors fitted on his premises or " in his works, for the consulting engineer who will advise him, for the contractor " and supervising engineer who will carry out the installation, for the man who will " subsequently have charge of the machine, for the civil or mechanical engineer " who desires some knowledge of the subject, and—last, but not least—for the " student."

Chapter I. deals with the elementary theory underlying the action of motors and the construction and connections of a modern machine; Chapter II. with the starting of motors that have only to be started and stopped; Chapter III. with apparatus for starting, varying the speed, and reversing motors; Chapter IV. with a fuller treatment of the theory of motors; Chapter V. with the resistance elements and more complicated types of control apparatus; Chapter VI. with efficiencies and in Chapter VII. there is a sorting out in classification of the different kinds of control. There are three valuable appendices, the first showing how to calculate the resistance steps for use in starting a motor, the second dealing with the use of logarithms, and the third with the connection of a motor to a higher or lower voltage than that for which it is rated.

On opening the book the reader is immediately struck by the fullness with which it is illustrated. We are glad to see that early and relatively unimportant historical matter has been omitted, so that the student may come immediately to modern

and useful material. On a number of occasions, we have been requested by readers to furnish them with the name of a good book dealing with automatic starters and we cannot do better than refer them to the volume before us. It will not be going too far to say that every wireless operator who is interested in something more than the mere handling of a standard ship installation, and all men who are engaged on land station work, will obtain great benefit by studying this volume. The general reader will be interested to find descriptions of such modern applications of the electric motor as the Tilling-Stevens petrol-electric bus, the small electric trolleys familiar to travellers at Euston and other railway termini, and coal-cutting machinery. Altogether this is an excellent work, and well produced.

One Hundred Years—Each Way

An Interesting Speculation

RECALLING to mind the fact that it is just one hundred years since six young engineers met in a Fleet Street coffee tavern, and thereby laid the foundations of the Institution of Civil Engineers, the *Daily Telegraph* puts forward the following entertaining speculation :

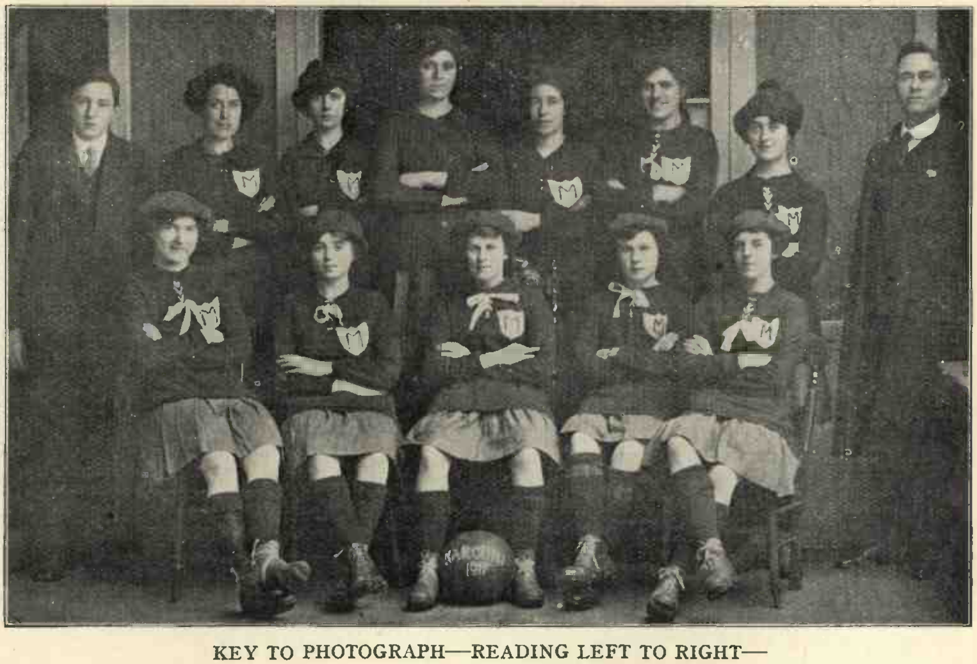
" If one could only show the engineer who planned the pyramids the engineering " marvels of to-day, which, we wonder, would astonish him most—a wireless message " from America, a first-class locomotive, an aeroplane, the cantilevers of the Forth " Bridge, a Dreadnought, a submarine or the Twopenny Tube ? "

The absence of the gentleman to whom the queries are addressed certainly relieves him of an embarrassing task, and we certainly, being more or less in the position of the Chairman of a local Bench who finds himself confronted by a lawbreaker from amongst the bosom of his family, " decline to adjudicate " in such a matter. We can, however, support the author of this poser in his following assertion . . . " yet a century ahead our descendants will probably be astonished " that the brains of to-day were baffled by difficulties to which they know the simple " answers."

The science and practice of wireless telegraphy is not without its unsolved problems, but when one looks back and realises that seventeen years ago the opportunity had not been afforded to the newspaper Press and to many of our most distinguished scientists to *ridicule* the report that wireless signals had been definitely received across the Atlantic, we are justified surely in the belief that all our present difficulties will melt like hoar frost in the sunlight, and that long before another century has elapsed the wireless engineers of the generations to follow will be engaged upon the development of discoveries which even the most visionary amongst us dare not entertain as being within the realms of possibility. At that time an Institute of Radio Engineers may not only have palatial buildings in the vicinity of the Houses of Parliament but may actually be looked upon by our legislators as worthy of encouragement.

Personal Notes

THE interesting photograph on this page shows the Ladies' Football Club belonging to the Marconi works at Chelmsford. The club was formed on March 27th, 1917, for the purpose of playing a game for the British Red Cross Society, and on that occasion they did so well that it was decided to continue to run, with charity as their object. Three matches only were played during the season of 1916–1917, the first one being lost, the second a draw, and the third ending in a win of four goals to three. At the commencement of the present season, it was naturally found that money was required in order to successfully carry out the object in view, with the result that a concert was given on their behalf, resulting in a profit of £12 1s. 3d. Great success has attended the ladies in their efforts so far—both as footballers and as helpers in various charitable objects—and every week most eulogistic comments can be observed in the Press.



KEY TO PHOTOGRAPH—READING LEFT TO RIGHT—

V. Bryant (*Assistant*), Misses Marshall, Cawley, Everett (*Treasurer*), Lyster, Kerley (*Captain*) and Attridge. W. S. Bloomfield (*Secretary and Trainer*), Misses Banham, Green, Johnson, Hurrell and Francis.

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GRAVE OF THE LATE MR. G. W. PAALMAN AT NAGASAKI.

The accompanying photograph shows the late Mr. G. W. Paalman, a telegraphist in the employ of the Société Anonyme Internationale Télégraphie Sans Fil, whose death occurred at Nagasaki, Japan, on September 21st last. Mr. Paalman, who was of Dutch nationality, joined the wireless service on February 1st, 1913, and had seen service on a number of ships. At the time of his decease he was acting as wireless telegraphist on the s.s. *Oranje*. Death occurred from acute catarrhal entercolitis and jaundice. The funeral took place at Nagasaki, and was attended by the late telegraphist's colleagues, and officials from the ship. Above, we give a photograph of the grave.

THE LATE MR. G. W. PAALMAN.

THE SEAPLANE—WIRELESS MAST ACCIDENT.

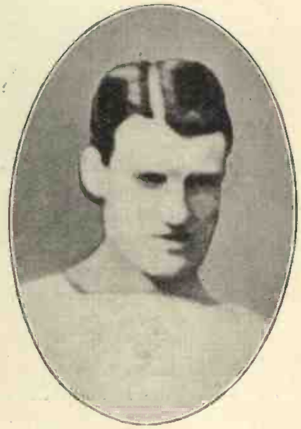
Test-Lieutenant (Acting Flight-Commander) G. de Ville, whose photograph we give, as detailed in our last issue had the misfortune to collide with a wireless

ACTING FLIGHT-COMMANDER G. DE VILLE.

mast after emerging from a low-lying cloud at a height of 300 feet. He was saved by the gallantry of Seaman Rath and two comrades who, between them, lowered his unconscious body to safety. Rath, whose portrait was given in our January issue, has received the Albert Medal in gold, and his comrades, Knoulton and Abbot, who followed Rath up the wireless mast and carried the rope with which Lieutenant de Ville was lowered to the ground, received the. Albert Medal. We are now able to publish a photograph of Deck-hand Abbott.

LOST AT SEA.

We are sorry to hear of the death of 1st Class Air Mechanic G. W. Bickle, wireless operator, who was lost at sea in November last while engaged on seaplane patrol. Deep sympathy is felt for the young man's parents, who reside at Ealing.



DECK-HAND ABBOTT.

DEATH THROUGH COLLISION.

We regret to learn from the *Lincoln and Stamford Mercury* of a fatal accident while flying in Hampshire to Second Lieutenant John Edwin Ransome, of the Royal Flying Corps. The young officer enlisted in February, 1915, in the Motor Transport Section, and after a short training went to France, where later he transferred to the Wireless Signalling Company. After serving in France for 2½ years, he was recommended for a commission, and had only just obtained his pilot's certificate when he met his death, owing to colliding with another airman at a height of a thousand feet. The accident took place on December 12th last.

AIR MECHANIC G. W. BICKLE.

A YORKSHIRE D.S.C.

Congratulations to Lieutenant-Commander W. V. Hoyle, of the Royal Naval Reserve (Wireless Section), who has been awarded the Distinguished Service Cross. He has been

a sign of excellence in clothes

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three times "mentioned" in despatches, and five times wounded. Lieutenant-Commander Hoyle is the son of the late Mr. G. R. Hoyle, of Copley Hall, Halifax.

A Cable Pioneer.

It is with regret that we learn from the *Electrician* of the untimely death from typhoid fever of Mr. Ruben Marchant Sayers, A.M.I.C.E., M.I.E.E., who has been associated for some while with Dr. Erskine Murray as partner in the firm of Messrs. Clark, Forde, Taylor, and Erskine Murray. Mr. Sayers joined the firm in 1897 as assistant engineer, and took part in a great deal of important work in connection with the laying of various cables. He became a partner in 1910.

Lieut. L. G. Hosking, M.C.

The more senior operators in the Marconi Service will be interested to learn of the award to Lieutenant L. G. Hosking of the Military Cross, for services rendered at the front. Mr. Hosking joined the Marconi Company some years before the war, and saw considerable service at the Clifden High-Power Station. On the outbreak of hostilities he joined the forces, and was not long in gaining his commission. We offer to him our hearty congratulations.

Sad Accident.

We regret to announce the death of Sidney Harcourt Mansfield, a messenger in the service of the Wireless Press. The boy, who was 15 last birthday, was riding a tricycle in the City, when the machine skidded and overturned. Mansfield was thrown underneath a two-horse van, which passed over him. Unfortunately, he was very severely injured, and was removed with the greatest possible speed to the hospital, where he passed away on the following day. At the inquest a verdict of accidental death was returned, no blame being attached to anybody. Deep sympathy is felt with the parents of the lad in their terrible bereavement.

A New Post.

Captain E. Powell, of Maesteg, Wales, who has recently been appointed assistant commander of a wireless school, joined the Royal Flying Corps in January, 1915. He went to France in February, 1915, as a wireless operator, and went through a number of famous battles, including the great battle of Ypres. In October, 1915, he was promoted Second Lieutenant on the field, and obtained his captaincy in June, 1916.

Died in Hospital.

We regret to learn the death of Walter Maddison, who was employed by the Relay Automatic Telephone Company, Limited, of Marconi House. Mr. Maddison entered the services of the company on June 2nd, 1914, in connection with their Brixton works. On October 13th, 1917, he left to take up a commission in the Royal Flying Corps, and about a month later was taken ill and moved to the hospital, where he died of internal trouble on November 24th.

Questions & Answers

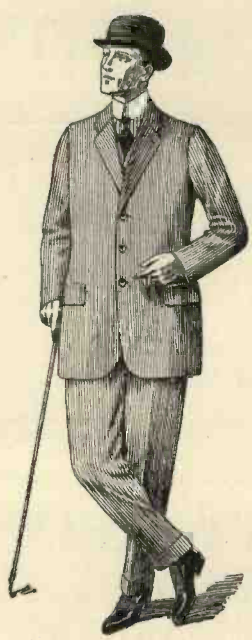
Note.—*This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless telegraphy. There are no coupons to fill in and no fees of any kind. At the same time readers would greatly 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.*

"Constant Reader" (Aberdeenshire).—At present you are too young to be accepted either by the Marconi Company for their free training scheme or by the military and naval authorities for wireless work with the Forces. Free training is given in Scotland at the Royal Technical College, Glasgow, and the Nautical College, Leith. The other schools you mention have no connection with the Marconi Company's scheme. In reply to question 4 we are afraid it would not be advisable at your age to come to London in a clerical position, as the relatively small salary would scarcely be sufficient to keep you anywhere but at home. If you were accepted for a position in the Company's Office you would be allowed to study wireless in the Company's own school. We are very glad to hear that you were so successful in the geography examination and that you find our articles useful.

A. D. (Dingwall, Scotland).—We were interested to receive your letter regarding the peculiarities of the silicon detector, and but for the conditions that now prevail we should publish your letter in full. That portion of it which refers to atmospherics is printed on another page for the benefit of other readers. The first portion of the letter we will deal with here. All crystal detectors possess a certain capacity value, which may have an appreciable effect upon the tuning of the circuit, particularly where large inductance and small condensers are used. The reduction of jamming to which you refer may possibly be caused by the sharper tuning with the more sensitive detector, together with a slight de-tuning caused by the capacity of the crystal itself. We are conscious, however, that the above is not a full explanation of what is described, and we have experienced something similar ourselves. We have put your letter aside for further investigation and it is possible that in a month's time we may be able to give you a little more information on the subject. Please, therefore, watch this column in future issues.

H. M. S. (Grimsby).—(1) *Practical Wireless Telegraphy*, by Elmer Bucher, can be obtained from our publishers, price on application. (2) In view of the knowledge you have it would not take long for you to obtain the Postmaster-General's Certificate—not more than a month at the outside. We cannot give you any advice as to what to do after the war, as no one can tell what conditions and requirements will then be. This also applies to questions (3) and (4). (5) Yes, it is quite possible to take a P.M.G. Certificate whilst serving in the R.N.V.R. After obtaining permission from your Superior Officer you should apply to the Secretary, General Post Office, who will inform you of the nearest centre where you can be examined and the probable date of the examination. Not knowing the extent of your knowledge, we, of course, cannot say how long it would take you, but if you have had practical experience of the apparatus for some while, and are fairly well up in theory, it is possible that you might be able to pass right away. Thank you for your good wishes, which we reciprocate.

L. J. W. (Shepherd's Bush).—(1) If you are otherwise suitable there is no reason why you should not be accepted by the Marconi Company immediately and your training completed in their school. If you wish to enter the wireless service we would strongly recommend you to avail yourself right away of the present opportunity. If you are over 16½ and under 18 you should apply immediately to the Traffic Manager, Marconi International Marine Communication Co., Ltd., Marconi House, Strand, W.C.2. (2) This depends upon the extent of your knowledge and the results of certain tests which would be put to you. (3) We cannot answer this question without knowing the extent of your present knowledge. (4) Any knowledge of mathematics is useful in wireless.



J. J. (Aberayron).—It is easier to obtain a position as a wireless telegraphist than as a wireless engineer. Members of the latter service are required to have spent a certain amount of time on practical engineering work, either in apprenticeship or in a recognised engineering college. Wireless telegraphists on the other hand need have nothing more than a good general education on starting their course of wireless training.

F. E. (Blackpool) asks if we will send him an explanation of the "Multi-Segment Commutator," with diagram if possible, as he is going in for an examination.

Answer.—This is too large a matter to be dealt with in this column, and, further, it is not directly a wireless matter. We should advise our correspondent to obtain a good book on *Electricity and Magnetism*, such as that by Sylvanus P. Thompson, where all such subjects are explained very clearly. Finally, we might add that our correspondent has ignored Rule No. 5 printed at the head of this page.

W. E. P. (Belfast).—(1) No; we think it would be necessary for the man to be trained in the United States Naval Apparatus. To receive this training it will be necessary for him to enter the U.S. Navy and be appointed for wireless duty. Any knowledge of wireless which a man might possess would, of course, make his chances of being selected so much the better. (2) The wireless apparatus used in the U.S. Navy is a composite system, many of the Marconi patents being utilised. (3) Apply to the nearest Royal Naval recruiting office. Our correspondent concludes his letter by asking for replies in the January issue, if possible. We would like to point out to him that his letter was received here over a week after that issue had gone to press. In these times, with so many difficulties in printing, our magazine has to go to press much earlier than usual.

G. C. S. T. (Cheltenham).—To become a wireless engineer in the Marconi Company it is necessary to undergo a course of training in electrical engineering at an approved college or technical school. For a list of approved institutions apply to the Chief Engineer, Marconi's Wireless Telegraph Co., Ltd., Marconi House, Strand, W.C.2.

"AUDION" (Zanzibar) asks more questions than we usually allow, but, in view of the fact that he is on active service in a distant part of the globe, we will make an exception in his case.

Question (1) refers to the two copper gauze brushes which bear on the steel disc of the 3 kw. Marconi discharger. Without these contacts our correspondent says a good clear note cannot be obtained, and with some wave adjustments the spark is very poor and confused when the contacts are not bearing.

Answer.—We do not understand why this should be and would suggest that some other cause be sought for the falling off in quality of the spark. The object of these brushes is merely to protect the bearings which otherwise might become pitted by any leakage to earth. As it is, if there should be any leakage from the disc the current will pass, not through the bearings, but through the copper brushes to frame.

Question (2). The circuit shown in your sketch is, no doubt, a good one for your ship and aerial, but would not necessarily be equally good on all other aerials. If you will examine it carefully you will see that the effect of the second connection is to convert the aerial tuning inductance into an auto-jigger. Question (3) No. Question (4). The normal range of the 3 kw. set depends upon the size and form of the aerial to which it is connected and whether it is fitted to a ship or land station. Question (5) asks whether a quenched spark gap will give results equal to a rotary if the latter were out of action owing to a breakdown, and how many gaps in series would be required for normal working with the 3 kw. Marconi set 350 cycles.

Answer.—To get the best results with a quenched gap discharger it is necessary that the circuit should be specially designed for the purpose, and it is not a question of simple substitution of one form of discharger for another. Under present conditions we cannot give particulars of how the circuit should be altered to suit the quenched gap. (6) (*a*) $40 per month, (*b*) £9 per month respectively. In comparing these figures with others the difference between the purchasing power of money in this country and in the United States and Australia should be taken into account. We much appreciate your kind remarks regarding our magazine. It is always interesting to hear from correspondents in distant parts of the Empire.

"SEESTU" (Aberdeen).—The reason why the instructors at the various schools do not wear naval uniform is simply that they do not belong to H.M. Navy. Instructors in the Marconi Company's Schools do not usually wear uniform whilst they are employed ashore.

E. S. R. (Toronto).—We are not answering your questions under the *nom-de-plume* of "Audion," as by a coincidence another correspondent has already chosen that name. (1) A ship fitted with a Canadian Marconi installation (or with any other, for that matter) is bound by the following clause in the International Radio Convention: "Coast stations and ship stations are bound to exchange radiotelegrams reciprocally without regard to the radiotelegraph system adopted by such stations. Each ship station is bound to exchange radiotelegrams with any other ship station without distinction as to radiotelegraphic system adopted by such stations. (2) Yes, in peace time it would be possible to obtain a private licence under certain conditions. (3) This is answered in (1). (4) This is also answered by (1).

H. W. (B.E.F.).—Formulæ alone would not be of much use to you. The information you require is given in a useful article dealing with the "Inductance, Capacity and Natural Frequency of Aerials," by Professor G. W. O. Howe, D.Sc., M.I.E.E., which appears in the 1917 YEAR-BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, where you will also find in the section on "Useful Formulæ and Equations" a number of formulæ which will suit your purpose.

"REVERSED" (Allahabad).—We think the occurrence you mention is very rare and without a knowledge of the circumstances we cannot explain it.

G. B. W. (Skipton).—(1) Possibly the operators to whom you refer are in the Royal Naval Volunteer Reserve and not in the Marconi Company. (2) No, certainly not. The authorised Marconi badge is the letter "M" surrounded by a laurel wreath. The fact that the holder possesses a Postmaster-General's Certificate is no authority for adding a crown or anything else.

G. H. L. (H.M.T.).—(1) According to the circuit you show in your drawing, your tuning lamp is wrongly connected, and, as arranged, short circuits the whole of the receiver. It should be connected between the *lower* plate of the arrester and the earth bolt, or, better still, between the top plate of the arrester and the earth terminal of the jigger, if this lead is not too long. (2) It is advisable to disconnect the crystal when transmitting, by throwing out the crystal switch. This prevents it being rendered insensitive by the strong transmitting current. (3) Yes, it is necessary to connect a short wave condenser to the spare earth arrester. If it is connected to the top plate of the main arrester, there is no difference in transmitting efficiency, but a closed oscillating circuit is formed in the aerial and absorbs a considerable amount of energy during reception, thus rendering signals weaker.

Private A. N. R. (B.E.F.).—A great deal of wireless telegraphy can be learnt by correspondence, but not sufficient to pass the Postmaster-General's examination. The reason for this is that actual manipulation of the apparatus can only be taught at a place where the installation is installed. These courses are very good for getting a general groundwork of theory, and we would suggest that our correspondent applies to one of the schools advertising correspondence classes in our pages.

Enquireless (Bolton).—The pay of wireless operators in H.M. Forces depends upon the rank they hold. For further particulars we would refer our correspondent to the articles which appeared in THE WIRELESS WORLD for October and November, 1916. In the R.F.C. the observers usually work the wireless apparatus in the aeroplanes, and on the ground the wireless work is done by air mechanics and N.C.O.'s. There are, of course, also wireless equipment officers. Particulars regarding terms and periods of service can be obtained from a local recruiting office.

F. J. C. (Sittingbourne).—We would also refer this correspondent to the article in the October, 1916, WIRELESS WORLD on wireless in H.M. Forces, where the subject is very fully dealt with.

X. Y. Z. (Manor Park).—The rotary converter acts both as a motor and an alternator. If you study the diagram and explanation in *The Handbook of Technical Instruction for Wireless Telegraphists* you should be able easily to follow the main principle. Current in the armature is, of course, alternating. You say you cannot understand the explanation your instructor gives, but, as you do not quote h s explanation, we cannot help you on this point. If you understand the principle of the direct current dynamo you will understand that an alternating current generated in the armature is turned into direct current by the commutator. If, then, this direct current is passed intc another dynamo through the commutator, the armature of the second dynamo will commence to rotate and the current will become again alternating. If slip rings are then connected to the opposite end of the armature of the second dynamo alternating current can be tapped off. This is, roughly, the principle on which the converter works.

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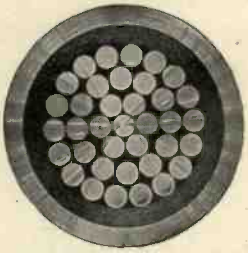

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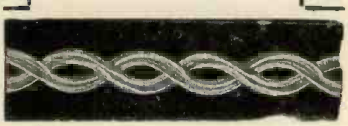

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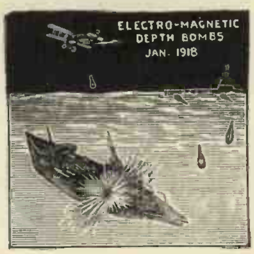

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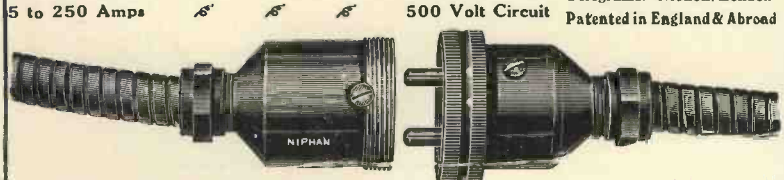

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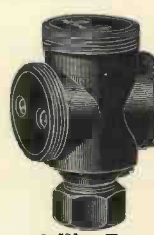

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