The WIRELESS WORLD

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Twenty-six Days on a German Submarine.

By M. J. McGrath.

DOUBTLESS there have been many unpleasant sensations at sea during the last four years; to a merchant service sailor there are few, if any, more unpleasant than the crash of a torpedo and the sickening lurch of his stricken ship.

It was the sound of such an explosion that woke me violently on the morning of May 2nd, 1918.

It was an experience to which I had already become accustomed—the dull thud of the explosion, the lurch of the halted vessel, the smell of burnt powder, the slow rolling of a helpless ship, in the first agony of her struggle with the all claiming sea.

I rushed from my sleeping cabin towards the Wireless Room, over sloping decks where the grey smoke clouds wreathed like a fog, only to find my apparatus hopelessly beyond repair.

I reported to the bridge, sunk all papers relative to the private working of the ship and then, since nothing else could be done, prepared to take my place in the boats. My junior had already gone and with the pilot and the skipper I left the ship.

The vessel had heeled over to starboard and it was almost possible to walk down the port side to the boats, one of which, almost crowded with men, lay off at a distance of about ten feet from the side. We managed to get into this boat, the painter was cut and we pushed off. I was crouched down in the bows and had a chance of watching the men around me. One or two of the Engine Room hands were badly scalded, nearly all were soaked with water, and every face bore a tense, strained expression, the look of one who waits with misgiving for destiny to unfold itself.

Expressions swiftly changed, in some cases to looks of horror, in others of despair, indifference or anger, as the submarine coming to the surface about half a mile away, opened fire on the sinking ship.

After a few rounds had been fired the

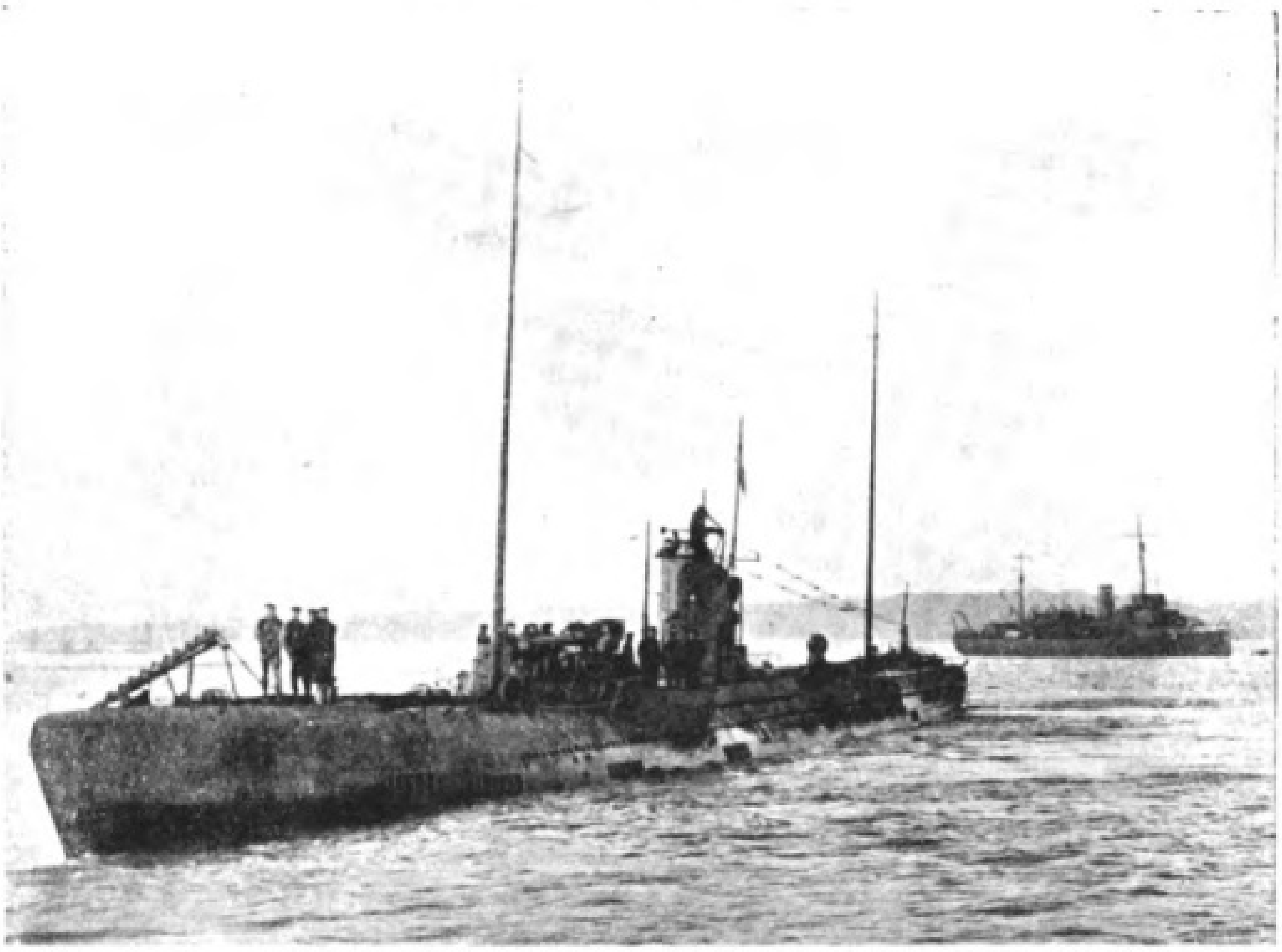


Photo: *A German Submarine with Wireless Masts in Position.* Giles' Photo Agency

magazine blew up and the vessel took fire. It was a picture never likely to be forgotten by those who watched; two small boats crowded with drenched, half-wakened, half-frightened men tossing on a dull grey sea; the long dark body of the submarine with her two guns flashing, and in the near background, framed in fire, the black hull of our ship, slowly sinking, looking like some animate thing which struggled for life in the grip of the sea.

In the silence that followed the hiss and crackle as the burning topmasts sunk beneath the water we turned and saw to our dismay that the U-Boat was heading in our direction, bearing down on us at a rapid rate.

She came through the waters with what seemed to us astonishing rapidity, the sea foaming and seething around her as she cut the water like a knife, the frame of her conning tower looking more like an armoured motor car than anything else in the world. I did not realise how well I was to become acquainted with that conning tower in the near future.

As she drew nearer we could distinguish the figures of the men upon her decks, the crews at their guns, and the officers on the tower-head, and I noticed with no great solace to my peace of mind about a dozen men covering us with rifles. They signed to us to lower our sail which we immediately did and with a swift turn the U-Boat laid us neatly alongside her.

Her crew were dressed in high boots and coats of what seemed to be rubber and at first sight it was difficult to distinguish between officers and men, the only difference, in fact, being in the caps, the men wearing the peculiar-shaped flat

Photo: *A U-Boat Crew Surrendering to a British Officer.* Giles' Photo Agency
Inset: The Author of this Article, Mr. M. J. McGrath.

caps of the German sailor, and the officers the peaked cap and gold crest of the "Kaiserliche Marine."

An officer, naturally enough speaking in perfect English, called for the captain; slowly but without any change of expression the skipper, a man of some sixty years of age climbed aboard. The second call came for the "chief wireless man," and in a sort of daze, I also clambered on to her wave-washed decks. Eventually one of our gunners joined us, we were hustled below, the hatches banged down and we heard the swish of the water as we got under weigh.

I find it a matter of great difficulty correctly to describe my feelings at this particular period on first coming aboard the U86.

We were taken to a small cabin amidships, questioned, searched and marched away.

As I marched aft under the gentle guidance of a genial gentleman with a large magazine revolver, past rows of faces which to my distorted fancy seemed to be lit up with diabolical grins, my feelings were those of one who is going through a nightmare of a particularly vivid and frightful nature, and through it all ran a vague, quite impersonal wonder as to the manner in which I was to be killed. I was marched into the after chamber, where seated on a torpedo I was the subject of general and not unkindly attention from different members of the crew.

During twenty-six nights, when it was possible to sleep, I slept on a mattress of sorts on that torpedo. I took my food on it, sat on it, lay and dreamt on it, got up and sat down again on it, and then started the whole programme over again.

Experiences on board were many and

varied. One might say that life on a submarine is crowded with innumerable happy little events which pass the hours which otherwise might become monotonous. It was hard to be down there a prisoner among the dirt and filth, sometimes not hearing a word of English for days. It was hard to be there with a beard getting longer and longer every day and the grime on your clothes and your body becoming thicker and thicker daily with never a wash or a shave. But you never got the chance to be miserable for long. An English or American destroyer would come along and drop depth charges on you for an hour or so, or a flock of aircraft, travelling at lightning speed would suddenly appear from nowhere and swoop down upon you and then a general scatter certainly took place.

No, I must admit that one of the inestimable advantages of submarine life is that one does not have much time to brood.

There was, however, an occasion which I shall always remember when during 50 hours we lay at the bottom, while above us the destroyers and chasers passed incessantly each one dropping its quota of good wishes and departing. Towards midnight of the second night, only one electric light was left burning in the whole ship; so low had the accumulators become that only this one light could be spared to see by. Most of the crew were clustered around this light, it was the least gloomy part of the vessel, waiting with varying expressions for either the enemy above to go away, or for Death to come down, on the swift wings of a bomb, down to the very sea bottom to claim his own.

Later the bombardment lifted and in slow jerks we raised ourselves through the sea, to the accompaniment of sixty throbbing hearts that doubted and hoped alternately, as the submarine stopped, then once again started with ever increasing effort in her climb up through the water to the surface above and to Life.

Still it is really useless attempting to describe the innumerable occasions on which we were either hunted or hunting. What is the good of speaking about one's feelings at the times when, at the sighting of any of our aircraft, we made that sickening swoop down through the very heart of the sea, when the air grew hot and heavy and the terrific pressure beat against the ear drums and the eyes seemed to be on the point of bursting from their sockets.

To talk of one's impressions, the rattle of the mine chains, of the whizz of the depth charges from your own destroyers, of the moan of the decoy ships' shells is certainly a difficult matter, but there is another side which is harder still to speak of. I refer to the times when in a silence-stricken ship, amongst men who stood immovable at their posts at the tubes, you crouched listening for the sudden spat-out word of command and during the eternal seconds that followed while the torpedo sped on its way and you waited for the splitting crash of the explosion, you muttered a sort of prayer that the torpedo might miss the ship that was sailing so bravely through the dark night, that the lives of the men who were sleeping unconscious of harm might be spared.

Yes, the life was hard, the conditions bad, the food vile, the danger and misery incessant, but worst of all was the realization of your captivity almost in sight of your own home.

God, it was terrible to see the sun rise day after day over the English coast, sometimes to watch it sink below the purple line where the Irish hills meet the sky, to watch the gulls swoop and circle over a sun-kissed sea and to think that you might never see the English

Photo: *U.117 with her formidable gun.* Giles' Photo Agency

coast, never again look on the Irish hills or watch the gulls at play, but that possibly all that waited for you was Death—Death in a thousand terrible forms and at the best, maybe, a quick end and an iron tomb on the slime of the ocean's bed.

So the days went on until at last the day came when we steamed up the Kiel Canal, that Canal where the ships of the English Navy were to follow in so few months, and finally laid up alongside the German depot ship in the harbour at Emden.

I do not propose to take the reader further with our German tour or to paint any pictures of that plague spot, Brandenburg Camp, but will leave him here, having carried out, I hope, in some little degree my original intention of trying to give some idea of the experience of a merchant service man taken prisoner by a U-boat.

Just a few more words in conclusion. It is apparently a general illusion that all German submarine men are murderers and barbarians. I consider it my duty to state that after my experience of them I cannot speak too highly of the German Navy men, with, of course, certain exceptions. The German military element I found exactly the reverse. Another point, with reference to the people at home who have not yet realised the work done by the Merchant Service during the war, let me offer one suggestion. When you compare the respective merits of the Navy and the Merchant Service, don't forget to give due consideration to all points and then when you have thought it all over, just tack this on to the end, namely, that the man who hunts has got a better job than the man who is hunted.

Believe me, I have found it out.

GREENLEAF WHITTIER PICKARD

Personalities in the Wireless World

THIS month we introduce our readers to Mr. Greenleaf Whittier Pickard, whose name is familiar to all who have followed the development of wireless receiving apparatus. Born in 1877 at Portland, Maine, Mr. Pickard received his early education at Westbrook Seminary and the Lawrence Scientific School, passing thence to Harvard and to the Massachusetts Institute of Technology. At the age of 22 he began " radio " work at Blue Hill Observatory, Milton, Mass., where under a grant from the Smithsonian Institution he engaged in an investigation of long aerials for wireless telegraphy. In 1901 he associated with Mr. Harry Shoemaker in one of the early American Radio Companies and in 1902 joined the engineering staff of the American Telephone and Telegraph Company. Mr. Pickard remained with that firm until 1906, having developed meanwhile a system of radio-telephony. Since 1906 he has been consulting engineer to the Wireless Speciality Apparatus Company.

Besides having practised as a patent expert Mr. Pickard is an inventor and has taken out some hundred patents in the United States and other countries. In the course of extensive researches on crystal detectors he discovered the rectifying properties of a silicon-copper contact, and the popular Perikon detector.

In 1909 he conducted some quantitative experiments on the subject of the effects of light and darkness on wireless transmission. Using a zincite-bornite contact as detector he measured during day and night the relative intensity of signals received from the Marconi station at Glace Bay. These values, obtained by the means of a telephone with a variable shunt, he plotted against time and the resultant curve showed that with the particular apparatus employed the ratio of the current in the telephone about midnight to that during daytime was approximately 30 : 1. The same curve strikingly confirms Mr. Marconi' statements concerning the unfavourable effect of dawn on wireless signalling, for the relative intensity of the signals dropped from 6 to 2 between 3.40 a.m. and 4 a.m., rising rapidly to 6 again at about 5.15 a.m.

Mr. Pickard is a Fellow of the American Institute of Electrical Engineers and a member of the American Chemical Society, the Society of Chemical Industry and the Institute of Radio Engineers, being elected the President of the last for the year 1913. Perhaps the most interesting fact about this gentleman, from the point of view of the literary world, is that he is a grand-nephew of the poet Whittier. Is there any connection, we wonder, between this and the fact that he has made his home in Massachusetts, the acknowledged nursery of literary culture in the United States?

Wireless Maps.

By J. St. Vincent Pletts.

THE achievements of wireless telegraphy during the war have been many and great, and amongst them must be reckoned the part it played in bringing the Zeppelins to a fiery end, and destroying the high hopes built upon them by the Germans. The first step in combating this menace was the accurate location of approaching Zeppelins, and, as they were bound to make large use of wireless telegraphy for their own navigation, it was obvious that direction-finding stations on a wide base could supply the necessary information. No sooner, however, were the requisite stations erected than a subsidiary problem presented itself, namely, how to set out on the map the various directions found, so as to give an accurate intersection, without loss of time in calculating the great-circle course taken by the wireless waves.

I had the good fortune of discussing this matter with my able friend, Captain P. J. Edmunds, and we agreed that it was essential that the map should be orthodromic, that is to say that all great-circle courses should be straight lines, and desirable that it should be azimuthal, that is to say that all directions from a point as near as possible to all the stations should be true. We saw that these conditions would be fulfilled by a projection from the centre of the earth upon a plane tangential at the selected point, and he therefore had this projection drawn by the Royal Geographical Society, and thus the first wireless map was born. In this map a protractor, which differed only slightly from true angles, was drawn around each direction-finding station, so that it was only necessary to draw straight lines for the directions found by each station to get an intersection giving the true position of the sending station. As the map contains much other information which is still secret I cannot reproduce it here, but I hope that, when the time comes, Captain Edmunds will publish it, together with the mechanical adjuncts he used for minimising the labour of plotting the readings.

Some months later the Admiralty, in spite of their earlier scepticism, printed this map and called it a Gnomonic Chart of the North Sea. About a year later a friend of mine, who had been engaged on similar work in France, was home on leave and called to tell me that he had met a Professor of Cartography who had informed him that we ought to be using the zenithal instead of the gnomonic projection. I again discussed the matter with Captain Edmunds, and, though neither of us knew what either zenithal or gnomonic meant, we both did know that the projection in use was the right one for the purpose.

For my part I could not let the matter rest there, and determined to find out what a point vertically overhead, as well as what the style of a sun-dial, could possibly have to do with a map projection. The result of this determination was to plunge me immediately into the most awful morass of confused and inaccurate terminology which I have ever found in connection with any scientific subject. I found, for example, that zenithal was used as a synonym of azimuthal, not because it meant anything, but because, forsooth, the latter word is a little difficult to pronounce at first; and that gnomonic was used for orthodromic because there is a B in both—at any rate I have not been able to discover a better reason. Thus our azimuthal orthodromic map was actually, in the Professor's own language, a zenithal gnomonic projection. This confusion was no doubt partly due to the fact that up to this time, as far as I have been able to ascertain, this projection had only been drawn with the plane tangential either at the equator or at one of the poles, which, of course, would not be azimuthal for the North Sea. Quite recently, however, Dr. Eccles has published* an orthodromic map which is azimuthal with respect to Greenwich, and it is indeed largely at his suggestion that I am now publishing this brief account of some of the work I have done on the subject.

The first thing to notice about what are generally called "map projections" is that they are not maps and are very seldom projections, and that the excellent name "graticule" has therefore been given to the mesh of lines of latitude and longitude upon which a map is drawn. Now it seems to me that the construction of graticules has hitherto been approached from three different points of view. First, they have been regarded as purely geometrical projections of the sphere upon a plane. Second, they have been approached from the point of view of the draughtsman, whose principal concern is to get a graticule which he can draw with ruler and compass. Third, they have been constructed for the benefit of the user, and therefore exhibit some special property These considerations, or combinations of them, seem to have given rise to all, or nearly all, the existing graticules, and though I have, by adopting a new or wider point of view, succeeded in producing a number of new graticules, I only propose now to deal with those which exhibit some special property of value to the user, as he seems to me to have been somewhat neglected. Perhaps some day I shall find time to treat the whole subject more fully.

The useful properties of graticules may be divided into two broad classes according to whether they are properties of the whole area or only properties with respect to a point. The properties of the whole area are loxodromism, orthodromism, orthomorphism and orthoagrism. Loxodromism, or the property which makes all true compass courses straight lines, is only possessed by Mercator's Chart, or a projection or skew thereof, so that the graticule is completely determined. Orthodromism, or the property which makes all great circles straight lines, is only possessed by a projection from the centre of the sphere, or a projection or skew thereof, and requires, as we have seen, the selection of the tangent point to completely determine the graticule. Orthomorphism, or the property which gives correct local shapes and implies an orthogonal graticule, may be possessed by many different types of graticule, and is by itself indeterminate. The projection of the sphere from the point at the opposite end of the diameter which passes through the tangent point, generally called the stereographic projection, and Mercator's Chart, which is not a projection, are both orthomorphic graticules. Orthoagrism, or the property which gives correct areas, is also quite indeterminate by itself, and, unlike orthomorphism, it is unspoilt by orthogonal projection or skewing. Orthoagric graticules are usually called equal-area, but I prefer to give them a name analo-

* Maps for Radiotelegraphy and Aeronautics, by W. H. Eccles, published in The Year Book of Wireless Telegraphy and Telephony, 1919.

gous to those of the other properties of the whole area.

Mercator's Chart is well known and largely used by mariners, but I do not think anything like full use is made of orthodromic charts. The calculation of great circle courses is not a very simple matter, whereas it is easy, whenever a position is determined, to draw a straight line between it and the destination on the orthodromic chart, and to plot this line back on to Mercator's Chart, from which the varying compass bearings can be directly taken. Orthomorphism and orthoagrism are of no interest from the point of view of wireless, so I will pass on at once to those properties which are of special interest.

The properties with respect to a point are (*a*) true distances to or from a point, which is generally called equidistant, but which, in spite of the present use of the word, I am going to call zenithal, (*b*) true directions from a point, which is called azimuthal, and (*c*) true directions to a point, which is called retro-azimuthal. None of these completely determine the graticule, and all can therefore be combined with other indeterminate properties, while all projections are of course already azimuthal for the tangent point. From which it follows that the azimuthal orthomorphic graticule is identical with the stereographic projection already mentioned, so that the same map is reached through two entirely different channels. With regard to my use of the word zenithal, it has the advantages of being of similar origin to the word azimuthal, and of already having an analogous meaning in astronomy, where the zenithal distance of a star is the complement of its altitude, so that it seems to be the natural word for the purpose, while no apology is necessary for abandoning the misuse of the word equidistant. As far as I am aware the only retroazimuthal map hitherto drawn has straight parallel meridians, and was drawn by the Egyptian Government Survey to show the faithful, wherever they might be, the direction of Mecca. But it is the graticules determined by the inter-combinations of these three properties with respect to a point which produce what may be properly called wireless maps.

A symbolical classification of these three properties with respect to a point and all their inter-combinations is given in Fig. 1, where the double circle indicates that the graticule is completely determined by the selection of the points. Thus we arrive at six types of wireless maps, viz.:—

1. The zenithal-azimuthal graticule, which gives true distances and directions from a selected point, and which is, I believe, the only one of the six which has hitherto been drawn, or even contemplated. Such a map would be useful for a fixed station doing long distance reception from all directions. It would of course be possible to draw a graticule which gave true distances from one point and true directions from another point, but there does not appear to be any use for it.

2. The zenithal-retroazimuthal graticule, which gives true distances and directions to a selected point, and which would be of great use if it were possible to determine distances as accurately as directions by wireless telegraphy, for it would enable a ship or an aeroplane to plot its position direct from the readings obtained from a single station. In Fig. 2 I have drawn such a graticule for the whole world with respect to Clifden. In order to prevent overlapping and to get it all in the right way round, I have reversed the portions outside the poles (which are represented by semi-circles), and therefore the directions, which are given clockwise in degrees from the north, have to be taken from the upper reversed half of the peripheral protractor for these portions of the map, and it is

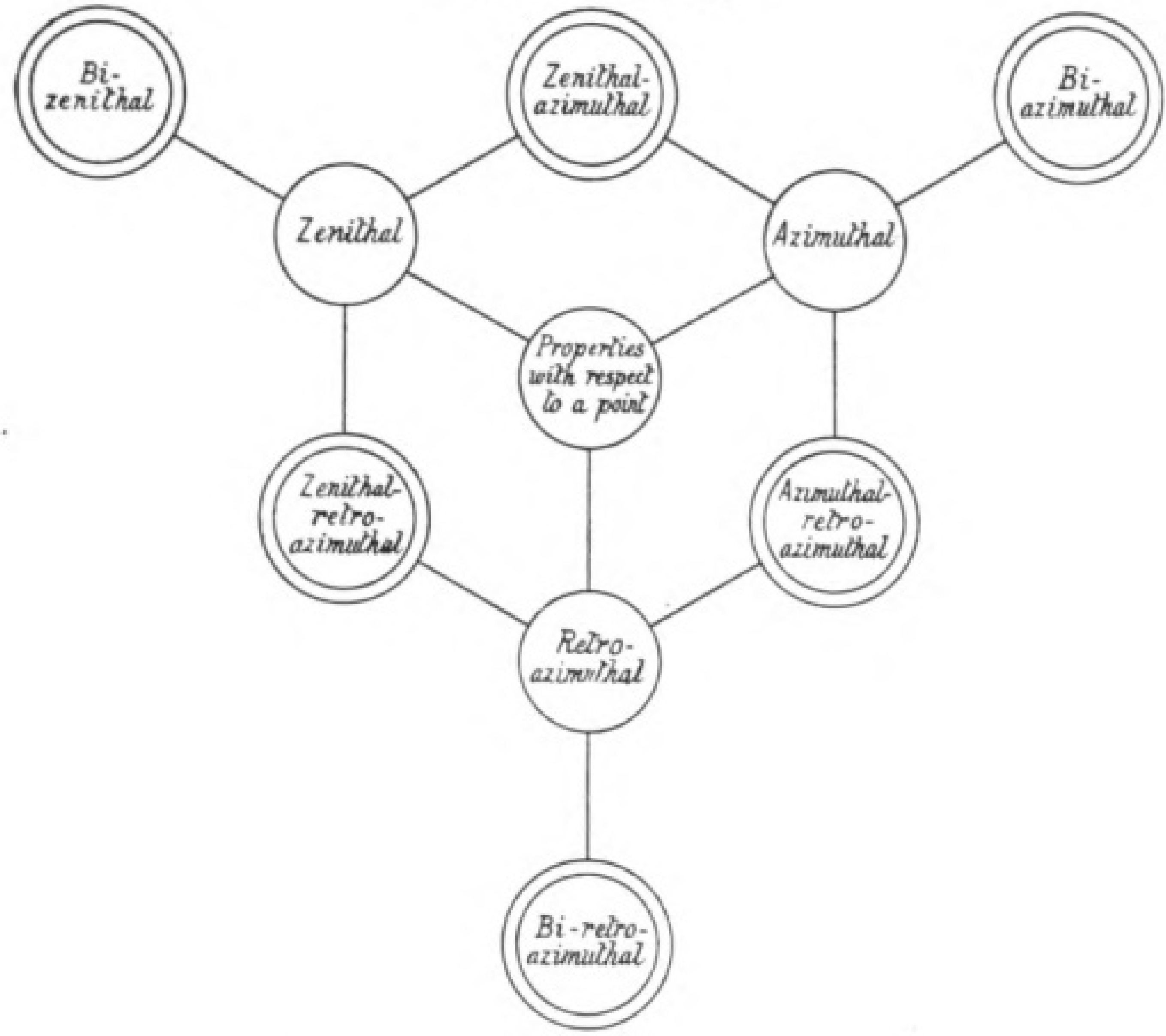


Fig. 1.

best to turn the map upside down when referring to them. It is an interesting fact, brought out very clearly by this map, that Clifden is not between 2,500 and 9,900 miles (*i.e.*, the distances of the poles) east or west, nor of course south, of any place in the world. A practical zenithal-retroazimuthal chart for the purpose of navigation in the Atlantic would of course consist of only the central portion of this map on a much larger scale. Again it would be possible, but of no use, to draw a graticule which gave true distances to one point and true directions to another point.

3. The bi-zenithal graticule, which gives true distances from two selected points, and which would be of great value if distances could be determined more accurately, as it would enable the position of a moving station to be determined by readings obtained either at or from two fixed stations.

4. The azimuthal-retroazimuthal graticule, which gives true directions from one and to another selected point, and which does not appear to be of any special value.

5. The bi-azimuthal graticule, which gives true directions from two selected points, and which would be of great value for the purpose of determining the position of moving stations from two fixed direction-finding stations, for the intersection of straight lines drawn at their true angles gives the position.

6. The bi-retroazimuthal graticule, which gives true directions to two selected points, and which is, in the

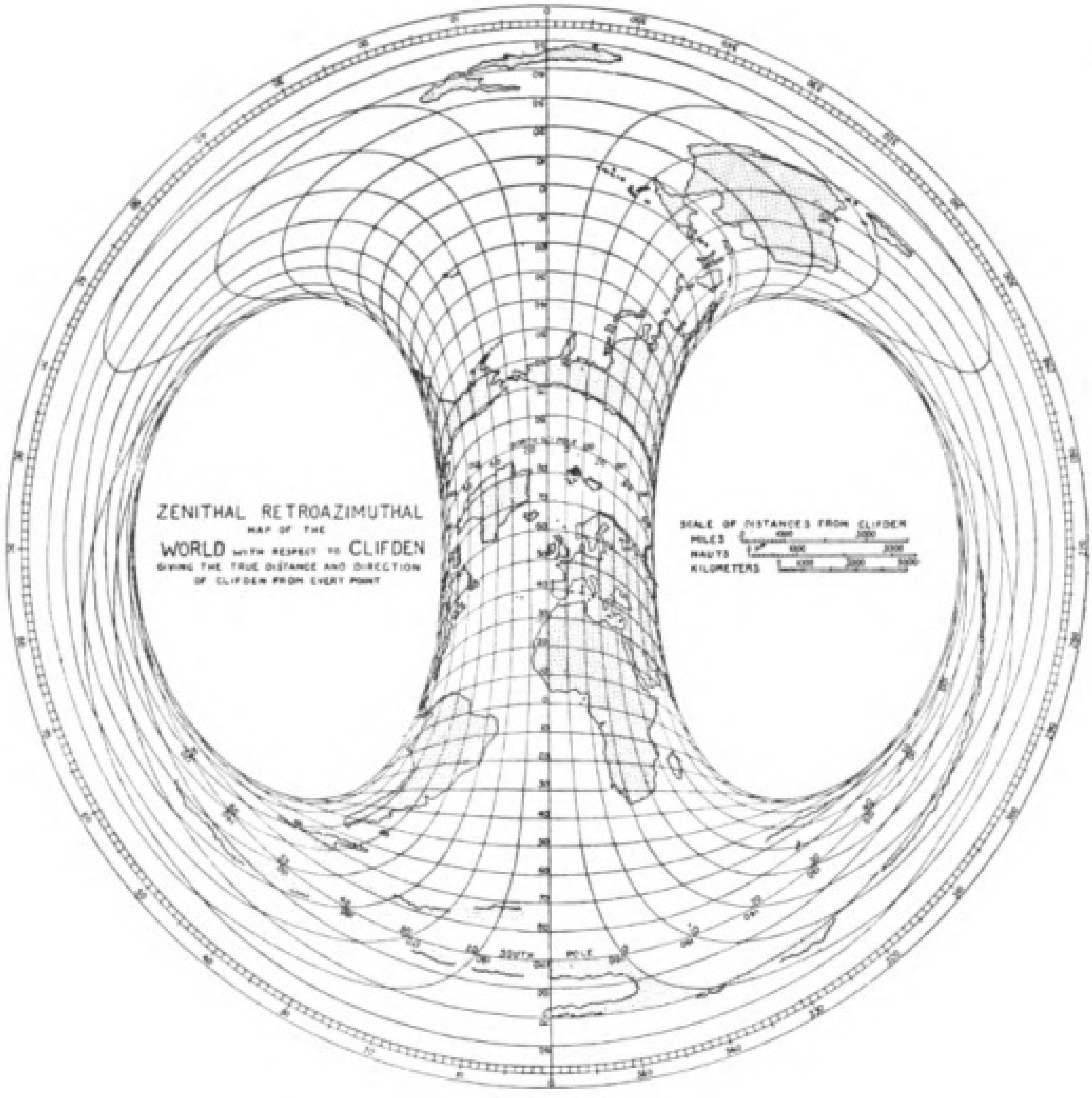


Fig. 2.

present state of development of wireless telegraphy, the most valuable for the purpose of navigation. In Fig. 3 I have drawn such a map for a part of the Atlantic with respect to Clifden and Glace Bay. A ship with direction-finding apparatus has only to draw straight lines at their true angles through these two stations, which are provided with protractors for the purpose, to determine its position by their intersection. Then, as already explained, the position can be put on to an orthodromic chart and joined by a straight line to the destination, and this straight line can be plotted on Mercator's Chart to give the course, without any calculation at all, and with very little loss of time. The area in the vicinity of the great circle joining the selected points cannot be shown on this graticule, but it would be of little use if it could be shown, for accurate intersections cannot be obtained with such obtuse angles.

This exhausts the six inter-combinations of the three properties with respect to a point, but arising out of the zenithal property are any number of indirect zenithal properties which can take its place in any of these combinations. For

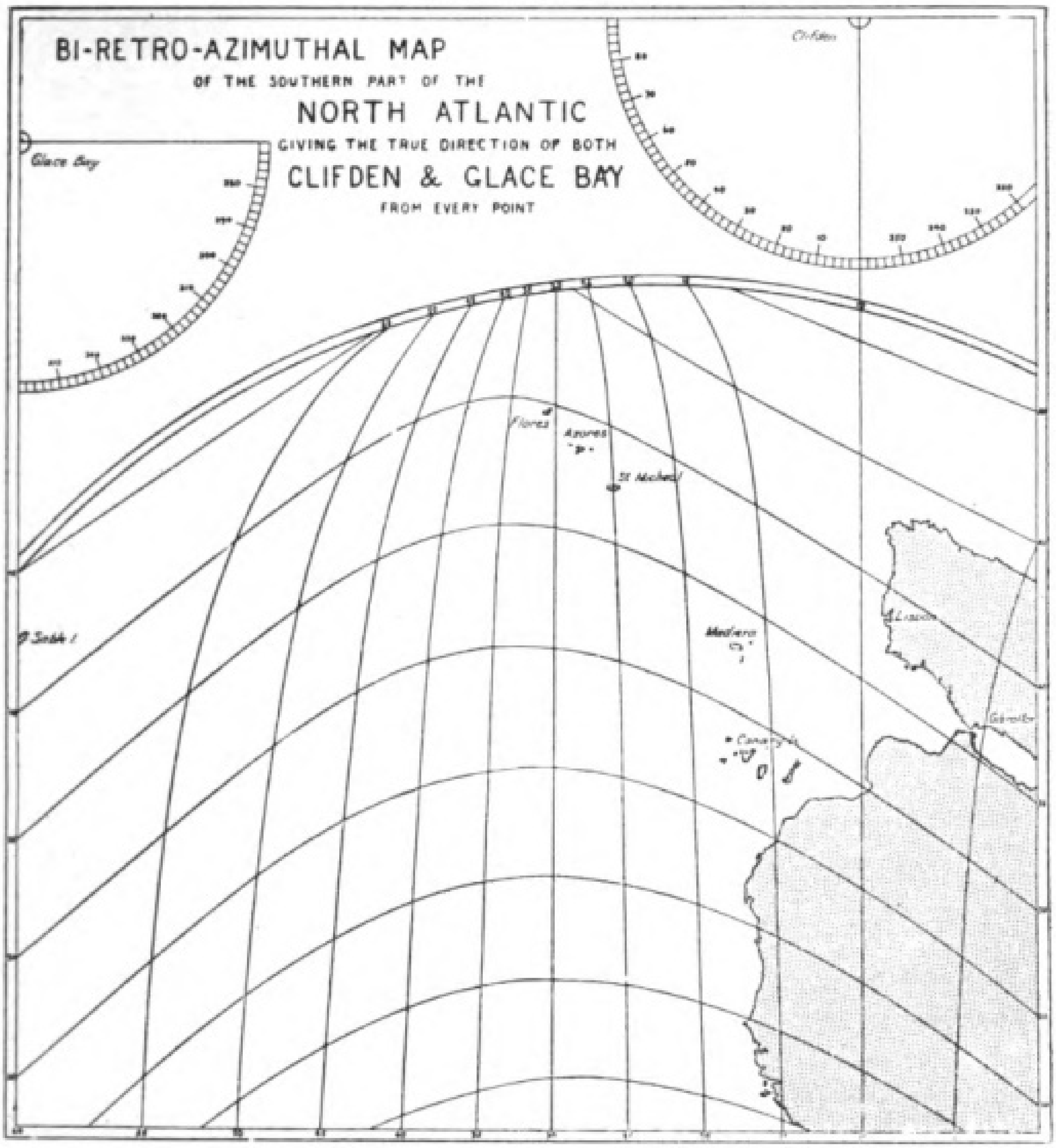


Fig. 3.

example, the distances measured on the map from the selected point, instead of being proportional to the true distances measured on the sphere, may be proportional to the readings of any instrument by which the distances can be determined, or to the power required at the transmitting station to produce waves of a certain amplitude at those distances, or to any property which varies with the distance, such as the height of the intervening mountain due to the curvature of the earth.

Similarly the azimuthal properties may be replaced by any property which varies with the direction, the most obvious being the magnetic instead of the true directions, though such graticules could only be of use for a short time. It would even be possible to represent distances by angles and directions by lengths, and, though this would make it possible to represent directions to and from the same point on one map, it is doubtful if such graticules would ever be of any use.

Digest of Wireless Literature

A BRIEF TECHNICAL DESCRIPTION OF THE NEW SAN DIEGO, PEARL HARBOR, and CAVITE HIGH POWER NAVAL RADIO STATIONS

By Leonard F. Fuller (Chief Electrical Engineer, Federal Telegraph Company). Proceeding of the Institute of Radio Engineers.

AS mentioned in Capt. Bullard's article, 11,000-volt, 3-phase, 60-cycle power will be delivered to the new San Diego high power radio station. The power equipment is being manufactured by the General Electric Company and will consist of the usual oil switches, switchboards, and motor-generators used in power work.

The motor-generators, which are in duplicate, will be 2-unit 4-bearing sets, consisting of 300 horse-power, 1,200 revolutions per minute, 2,200-volt, 3-phase, 60-cycle, squirrel cage induction motors, direct connected to 200-kilowatt, 1,200 revolutions per minute, 950-volt, compound wound, direct current generator with 2-kilowatt, 125-volt, over-hung exciters.

The temperature rises of the motors will be 40°C. for continuous full load operation and not over 55°C. for a continuous series of duty cycles of 1.5 hours on and 1 hour off at 125 per cent. of load.

The generator temperature rises will be 40°C. for continuous full load operation and not over 55°C. for a continuous series of duty cycles of 1.5 hours on and 1 hour off at 250 kilowatt output. The sets as a whole can withstand a 100 per cent. overload for short periods.

Duplicate 14-kilowatt, 125-volt, direct current, motor-generators with a complete set of spare parts will be installed also, for furnishing power for plant auxiliaries.

The Federal-Poulsen arc converter will be of the oil-immersed water-cooled type capable of furnishing 150 amperes radiation continuously, and 170 amperes for periods of 1.5 hours on and 1.5 hours off. The temperature rises will be 40°C. and 50°C. respectively for all current-carrying or electrical parts.

At Pearl Harbor, power will be supplied, as Captain Bullard states, at 2,200 volts, 3-phase, 60 cycles. This plant is similar to that at San Diego but of higher power. The large motor generators are provided in duplicate with a complete set of spare parts including spare armatures. They are 2-unit, 4-bearing sets, manufactured by the General Electric Company, consisting of 750 horse-power, 900 revolutions per minute, 2,200-volt, 3-phase, 60-cycle, wound rotor, induction motors, direct connected to 500 kilowatt, 900 revolutions per minute, 1,430-volt, compound wound, direct current generators with 3-kilowatt, 125-volt compound wound, over-hung exciters.

The temperature rises of both motors and generators will be 50°C. on a continuous series of duty cycles of 2 hours on and 1 hour off. High voltage direct current switchboards and control apparatus of a type used in electric railway work will be provided.

The Federal-Poulsen arc converter will be of the oil-immersed, water-cooled type, capable of furnishing 200 amperes radiation continuously and 250 amperes for periods of 1.5 hours on and 1.5 hours off with temperature rises of 40°C. and 50°C. as specified for San Diego.

On account of the oil immersion and water cooling of all coils and arc converter windings, this type of apparatus is extremely rugged and reliable. The arc transforms or converts the 1,500-volt direct current power into radio frequency energy without the use of rotating parts or radio frequency magnetic circuits.

The antenna loading coil will be of litzendraht cable supported entirely by porcelain. This cable will be 1.75 in. (4.45 cm.) in diameter, and the loading coil diameter will be 14 feet (4.26 m.).

The wave changer will be of the rotary type capable of throwing the plant on to any one of five wavelengths when operating at full power. This feature holds for San Diego and Cavite as well as Pearl Harbor and in all three the usual antenna grounding switches, transfer switches, etc., will be provided.

The generating equipment at Cavite will be identical with that at Pearl Harbor except that the power supply will be 220-volt direct current and no over-hung exciter will be used. The 500-kilowatt, 1,500-volt generator excitation will be supplied from the 220-volt direct current buses. At both Pearl Harbor and Cavite, special insulation and fittings for tropical conditions will be provided.

The arcs at Pearl Harbor and Cavite radio set at Cavite will be in every way identical with that at Pearl Harbor.

The arcs at Pearl Harbor and Cavite will be approximately 9 ft. 2.5 in. (2.81 m.) by 7 ft. 4 in. (2.23 m.) wide by 12 ft. (3.66 m.) long and will each weigh approximately 60 tons (54,000 kg.) under operating conditions. The San Diego arc is somewhat smaller and will weigh 21 tons (19,000 kg.) under operating conditions. The larger arcs will present an outside appearance very similar to certain types of vertical shaft hydro-electric generators.

"UBER ROHRENSENDER." *By A. Meissner. Elektrotechnische Zeitschrift.* 13.2.19, *p.* 65.

IN the introductory part, the author expresses the opinion that the development of the transmitting valve has definitely settled the question of damped versus undamped oscillations, in favour of the latter. This is justified by the simplicity of the apparatus, the absolute constancy of wavelength and the wide range of waves which can be obtained. Indeed, it is a well-known fact that a valve can be made to generate oscillations of frequencies ranging from a few hundred millions (wavelength about one metre) down to a few thousands or even hundreds.

In view of these qualities, the valve, besides its use for wireless transmission, forms also an ideal source for measuring purposes.

The author next sketches the history of development of the generating valve, in so far as the Telefunken Company is concerned. The first attempts of this Company to use the valve as a generator date back to March, 1913. Originally a Lieben tube (with a low vacuum and specially prepared cathode) was employed. At 400 volts in the anode circuit an energy of 10-12 watts could be generated. With this tube, telephonic communication was established between Berlin and Nauen on 21.6.1913. A view of the apparatus is shown on Fig. 1. In practice, however, the type of the low-vacuum tube had very soon to be abandoned in so far as transmission was concerned, owing to its very short life, even at the low amount of energy mentioned above.

On the other hand, for heterodyne reception (the idea of which was expressed by Fessenden a very long time ago), the apparatus proved to be quite satisfactory, as the energy required for this purpose is very small.

These first experiments with the Lieben tube showed that in order to

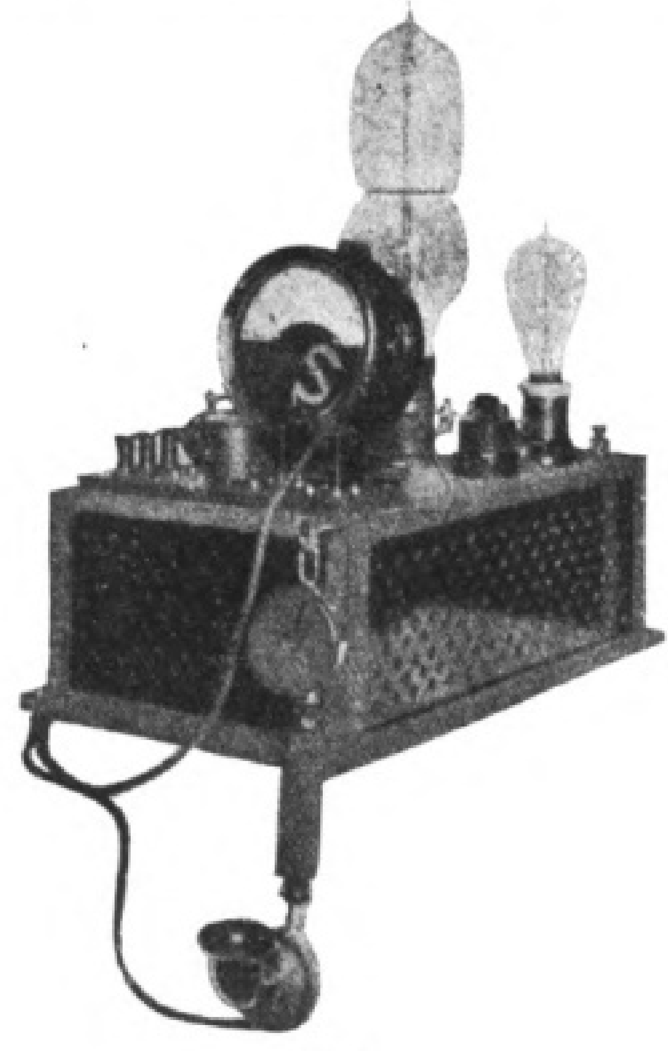


Fig. 1.

obtain a transmitting valve with a considerable output, high vacuum had to be employed. As the Telefunken Company depended on other firms for the evacuation of their tubes, the experimental stage took a comparatively long time. Only after the installation of their own evacuation-plant had been finished (May, 1914), quicker progress could be made, and in the beginning of 1915 the first practical valve transmitter (10 watts, 800 volts) was completed.

At this time, Langmuir's patents for the Kenotron and Pliotron reached Germany and were put at the disposal of the Telefunken Company. Langmuir's methods were adopted, and after overcoming certain constructional difficulties in connection with the grid and filament, a tube was constructed which could generate about 1 k.w. Fig. 2

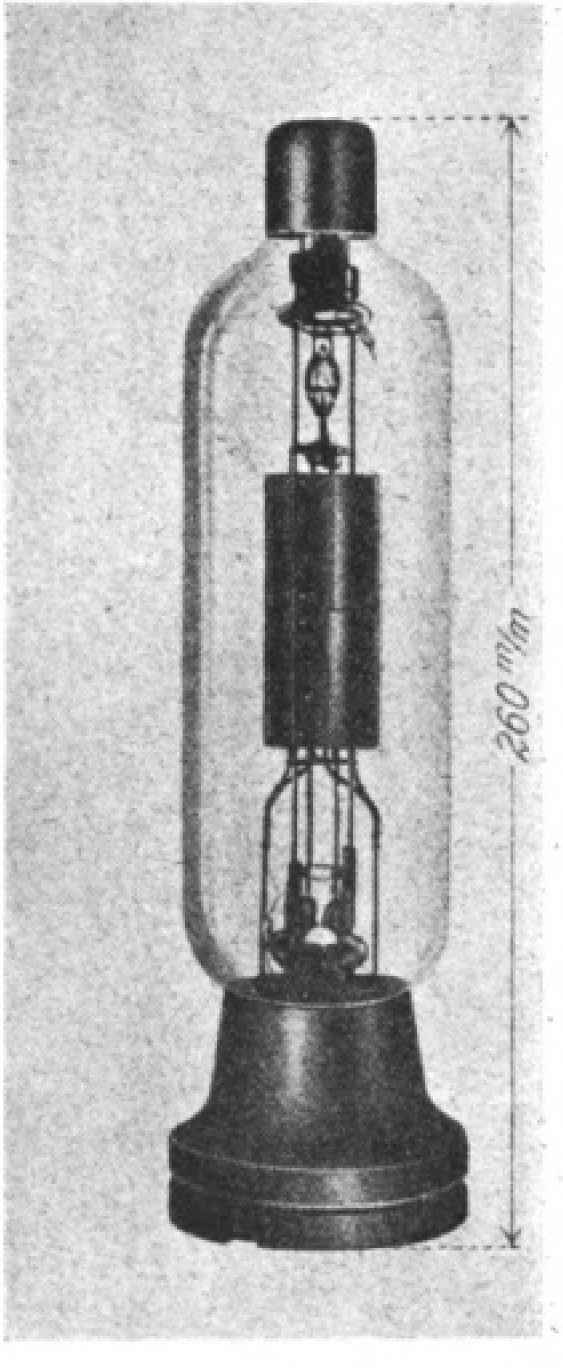


Fig. 2.

shows a generator for 200 watts. The anode is made of tantalum, and the V-shaped filament is attached at the top.

The advent of the improved construction has made it possible to employ several valves in parallel as well as to simplify the connection in the transmitting circuits.

A further difficulty has been met with

ir. the design of an adequate H.T. source for the anode circuit, as H.T.D.C. machines were found unsatisfactory. After several tests, an A.C. source with a special type of rectifier designed by the Akkumulatoren-Fabrik A.G. was adopted.

The author states that with this arrangement the A.C. from a 500-cycle machine can be converted into a D.C. with a loss of 4 per cent. only. This type of rectifier is employed only for small amounts of energy, while for larger amounts the mercury rectifiers of the A.E.G. have been found more suitable. The very small energy (10 watts) which could be obtained from the transmitter built in 1915 was the reason why valves were introduced into the German military stations, only very late, in the Spring of 1917, and even then only for heterodyne reception. The use of valve transmitters and of receiving arrangements involving the reaction principle was commenced still later—a short time before the Armistice.

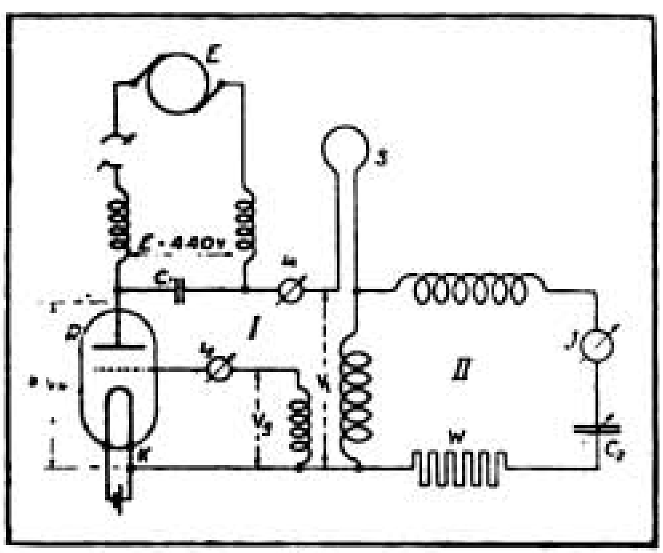


Fig. 3.

The author next proceeds to give an account of the phenomena which take place in the circuits of a generating valve. Without entering into a discussion of the numerous arrangements of the circuits (such a discussion will be given by the author's colleague—Dr. Vos) the auth›r limits himself to the

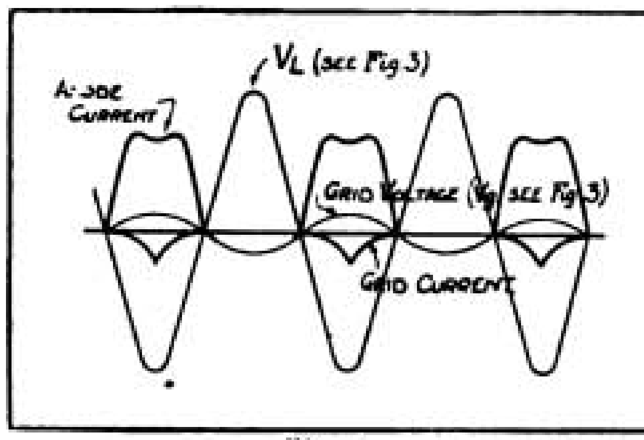


Fig. 4.

study of the characteristic circuits shown ir Fig. 3.

Experiments show that whatever the arrangement, there is always a *certain* coupling between the grid and plate circuits which gives the best results, and that the phase relations between the various currents and voltage is such as shown in Fig. 4.

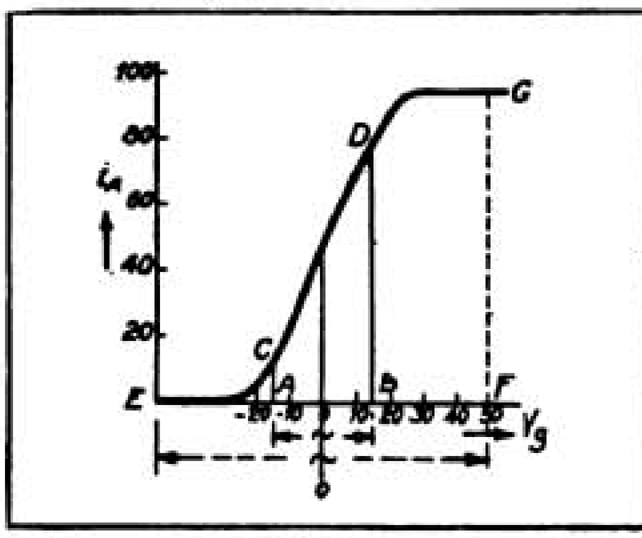


Fig. 5.

From the static characteristic of a valve (see Fig. 5) it is clear that if the grid voltage varies between sufficiently small limits, the law of variation will be exactly reproduced in the anode circuit, so that, for instance, if the voltage impressed on the grid follows a sine law,

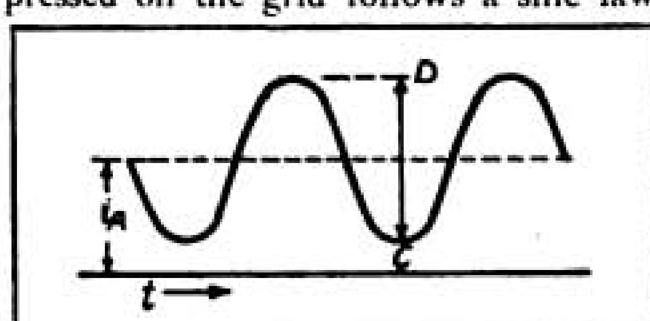


Fig. 6.

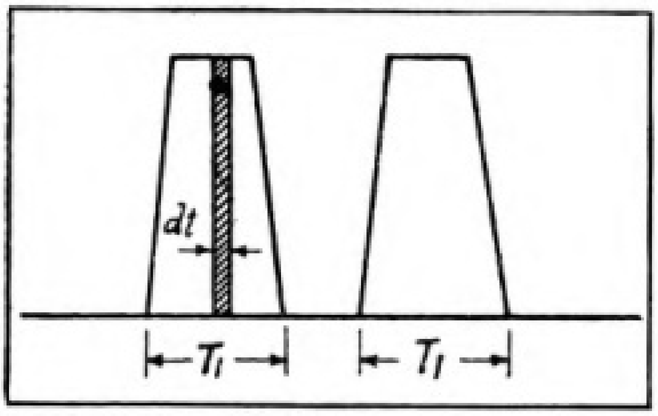


Fig. 7.

the current in the anode circuit will be given by the graph of Fig. 6, where the curve is a sine function of the time. If, however, the grid voltage varies between wide limits, the graph of the anode current will be represented by Fig. 7. This latter case is the one which occurs in a generating valve and has, therefore, to be specially investigated.

It is evident, that during the interval T_1 (Fig. 7) when current flows through the valve, we must have:

$$E = V_R + V_L \quad \text{..........} \quad (1)$$

(for the notation see Fig. 3).

Now, since L belongs to circuit II in which a sinusoidal current is flowing, V_L must also be sinusoidal. Therefore by measuring directly the effective value of V_L, we can calculate its value at any moment and determine by means

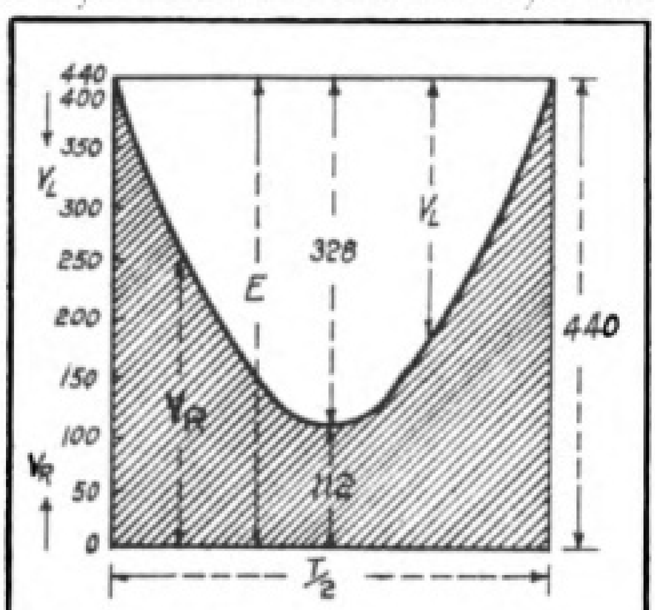


Fig. 8.

of equation (1) the momentary values of V_R. This is done graphically on Fig. 8 for a case when $E = 440$ vol. and V_L *eff* $= 232$ v.

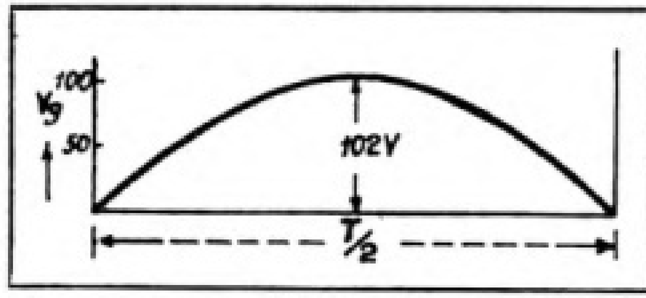


Fig. 9.

Again, since V_g is induced by circuit II, it must also be sinusoidal, and its value at any moment can be determined from its effective value, which can be found by direct measurement. For the case under consideration V_g *eff* $= 72.5$ v., and the graph is shown on Fig. 9. Let us now draw the static characteristics of our valve at different anode voltages as shown on Fig. 10.

By taking at any moment the value of the grid voltage (from Fig. 9) as the abscissa on Fig. 10, we can find the value of the anode current at that moment. For this purpose we have only to construct the ordinate corresponding to our abscissa, remembering at the same time that out of the several curves given on the figure that has to be chosen which corresponds to the value of V_R (as determined from Fig. 8) at the considered moment. By this method we can easily find, for instance, that at the moment when the grid voltage is 102 volts, the anode current will be 121 milliamps.

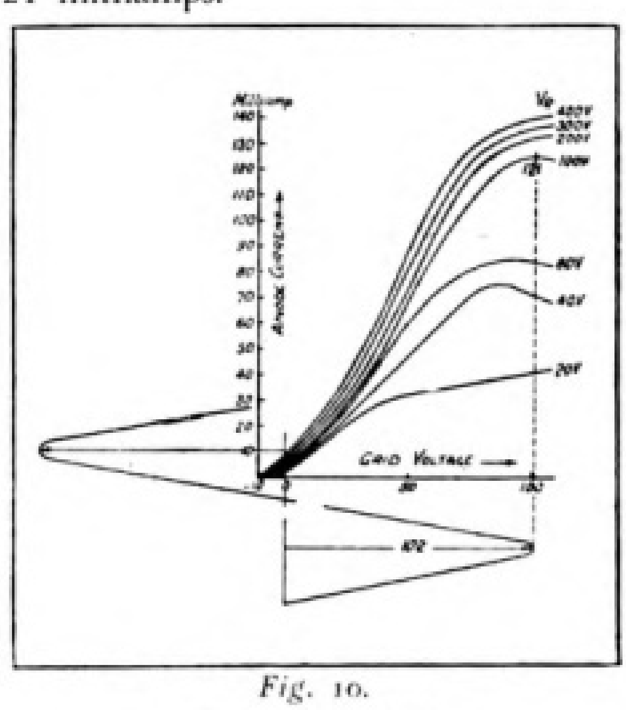


Fig. 10.

(*To be concluded.*)

The Telegraph Communications Board.

THE FORMATION OF AN IMPORTANT NEW COMMITTEE

WE understand that the question of long distance telegraph communication is now engaging the serious attention of the War Cabinet and as a consequence a "Telegraph Communications Board" has been appointed with Lord Milner as Chairman. The appointment of this Committee will be widely welcomed, particularly in view of the recent traffic delays which have shown how urgent is the question of revision of the existing arrangements for communication between the Mother Country, the Colonies, and foreign countries. The first official intimation of the appointment of this Board was given by the Postmaster-General in a parliamentary answer to Sir Henry Norman, who enquired whether the Government was aware of the steps taken by the French and American Governments in the erection of state-owned high-power wireless telegraph stations in France and America.

Viscount Milner.
Photo: G. Vandyk.

Hitherto while no fewer than five home departments have been directly concerned in the matter of wireless telegraphy the Post Office has been the only department to act for the State. The result has been a long drawn out correspondence with the other offices very commonly culminating in nothing being done. Under the new plan each of the Government departments concerned will be represented on the Board, and thus matters will be thrashed out in a far quicker and more satisfactory manner than hitherto. Although there is not the slightest doubt that the new Board will do much to improve the arrangements for long-distance telegraphy, its attitude towards wireless will need to be carefully watched by the public, or there may be the danger of an attempt similar to that which signally failed in the United States to place wireless telegraphy entirely in the hands of the Government, with the consequent prohibition of amateur working and the suppression of the private investigator.

We have so far no advice of the constitution of the Board beyond that Lord Milner is to be Chairman, and Sir Henry Norman Vice-Chairman, but we presume that most, if not all, of the members of the "Wireless Board" to which we made reference in our April issue will be members of the larger committee.

Stray Waves.

WIRELESS TELEPHONY AND AIRCRAFT.

DURING the past month or two the press—notably the daily press—has paid a great deal of attention to the subject of wireless telephony as applied to aircraft, the general tendency being to credit the Royal Air Force with having invented and perfected this means of communication during the war. Now, firstly, wireless telephony is not an invention but a natural development of wireless telegraphy. Its accomplishment did not involve the discovery of new fundamental principles or the invention of any new apparatus. Speech had been transmitted over great distances by wireless long before the outbreak of war and the various ways in which perfectly well-known pieces of apparatus were *connected* in order to obtain this result are the work of a number of experimenters who were quite unconnected with the R.F.C. or R.A.F. Secondly, circuits for wireless telephone sets both for reception and transmission were designed by the Marconi Company in the earlier days of the war and were entirely due to the efforts of that Company's experts. Naturally, improvements and refinements have been made possible by four years' experience of aircraft sets under fighting conditions, such as an increased degree of portability and better methods of fitting, but these are not the invention of or the perfecting of wireless telephony. The small weight and bulk of the aeroplane sets and the ability of the operator to hear messages in spite of the deafening noise of the engines are chiefly due to a modification of the Fleming valve and its circuits as worked out by a Marconi engineer. Given the wireless transmission of speech as *un fait accompli* the installation of the apparatus on ship, train, aeroplane or tank becomes a problem involving nothing more than mere adaptation to special conditions and requirements.

EARLY WIRELESS TELEGRAPHY.

In our March issue we re-printed from *The Electrical Review* a letter from Mr. Marconi in which he denied that when he first came to this country he received from the Post Office " the use of a considerable sum of public money " in connection with his early experiments in wireless telegraphy, as stated by Mr. A. A. Campbell Swinton. We now reproduce Mr. Swinton's reply published in *The Electrical Review* for March 7th—

" My object in writing to you on this subject on January 25th was to defend the late Sir William Preece against what seemed to me the very unfair suggestion that had been made in your columns that Mr. Marconi, when he first arrived in this country, failed to meet with sympathy in official circles, and I am glad to see that Mr. Marconi entirely agrees with my correction in this respect.

" I notice, however, that Mr. Marconi goes on to find fault with my statement that the assistance which he received from the Post Office ' included the use of a considerable sum of public money.'

" With regard to this, of course, I

have never suggested at any time that actual payments were made by the Post Office to Mr. Marconi, but in order to remove entirely this idea which, though never put forward by me, appears to have existed, I may state that I have a recent letter from Sir John Gavey in which he writes: 'To my knowledge no monetary transactions of any kind took place nor were any payments made by the Post Office to Mr. Marconi during the period we were working in association.'

"This, however, does not in any wise affect what I did state in my letter to you which was that the Post Office gave to Mr. Marconi 'much technical assistance including the use of a considerable sum of public money which was expended in developing wireless telegraphy by numerous experiments carried out with the help of Post Office officials, including Mr. (now Sir John) Gavey.' Of course opinions may differ as to what sum of money may be described as considerable, but that substantial sums of public money were expended and considerable technical assistance given by the Post Office to Mr. Marconi in the manner I have stated is borne out by a printed official report by Sir John Gavey written in 1903, which I have before me, in which an account is given of the experiments 'instituted by the British Post Office' for the purpose of investigating Mr. Marconi's method, beginning in May, 1897, and in which it is specifically stated that 'the apparatus used at this time was partly Marconi's own gear and partly modified and re-designed appliances made in the Post Office workshops or purchased by the Department.' The report proceeds to give detail of 'the masts of rather over 100 feet total height,' and of induction coils and other apparatus and materials which the Post Office provided, and in some cases specially purchased for the purpose. Further Sir John Gavey in his recent letter to me, writing of 'such Post Office funds as were expended on Mr. Marconi's wireless experiments,' states that these were utilised 'to meet the cost of materials, labour, and travelling expenses of Post Office engineers in carrying out distant experiments, notably those across the Bristol Channel, where three temporary wireless stations were erected, manned, and subsequently removed by the Post Office staff.'

A. A. CAMPBELL SWINTON."

London, S.W. *March 3rd*, 1919.

A WIRELESS INSTALLATION DE LUXE.

Interesting details of the way in which President Wilson kept in touch with Washington and Paris during his recent voyages are given in *The Electrical Review* (Chicago). His messages were first sent by wireless from the *George Washington*, on which he travelled, to the U.S.S. *Pennsylvania*, which then communicated direct to America over any distance up to 2,500 miles, or with the French station at Lyons.

The *Pennsylvania's* apparatus includes a 30 kw. arc set for transmission with waves of 3,600 metres, a 10 kw. spark set for working coastal low-power stations, a short range valve transmitting set, and a short range wireless telephone apparatus, the latter two being used for communication with the *George Washington*. There are six receiving cabins, in which messages were intercepted from Annapolis (16,900 metres), New Brunswick (13,000 metres), Lyons (15,500 metres), Tuckerton (4,000 metres) and from various smaller stations on wavelengths of 600 metres and 1,000 metres. Of the four transmitters carried, only one employs the spark method, the long-distance work being done by an arc.

INCENDIARISM BY ELECTRO-MAGNETIC WAVES.

A recent issue of *L'Industrie Electrique* contains an interesting account of a communication made to a recent meeting of the Academy of Sciences regarding the possibility of fires being caused by the action of aether-waves. As a result of the war wireless stations have increased in both number and power and M. Georges A. Le Roy undertook some practical investigations with a view to finding out whether certain conflagrations which could not be traced to the more ordinary causes might be attributed to wireless waves.

This is by no means a new question but one which crops up periodically, and we are able to state that it was investigated by Marconi's Wireless Telegraph Company as far back as fifteen years ago. Whilst this Company was erecting the wireless station at the Fastnet it was thought prudent to try beforehand whether the radiated electro-magnetic energy would actuate the fog-signal cartridge which was close by, and deliberate attempts to set fire to the gun-cotton by the agency of wireless proved unavailing even when pursued under conditions much more favourable than would obtain in practice.

On another occasion the Marconi Company carried out similar experiments in connection with the installation of wireless apparatus on board oil-tank ships, their results indicating no danger from induced sparking in respect to inflammable vapour in the open air. However, as a measure of precaution on these ships they screen with wire gauze all parts of their gear where sparking is likely to occur.

It would appear that up to the present the guilt of the aether-waves is not proven inasmuch as the induced sparks are cold and lack the energy required to produce combustion. The experiments described to the Academy of Sciences tended to show that if a concourse of unfortunate circumstances conspired to reproduce Hertz's detector spark-gap—such as a break in an iron hoop binding a bale of raw cotton—then there is a probability that an induced spark might cause a fire. On the other hand it can be urged that raw cotton, being particularly liable to ignite spontaneously, furnishes a poor subject for a test case. There is certainly room for further investigation of the question.

AN IMPORTANT DECISION OF THE I.E.E.

It has been decided by the Council of the Institution of Electrical Engineers to appoint committees whose aim shall be to assist in the propagation of knowledge of recent work and progress in electrical engineering. We are glad to be able to report that the committee dealing with wireless telegraphy has already commenced its labours. The action taken by the Council should have beneficial and far-reaching effects, particularly as regards wireless telegraphy.

The following is a complete list of the members of the Wireless Sectional Meetings Committee (for Radiotelegraphy and High-Frequency Engineering) of the Institution: The President (*ex-officio*), Major E. A. Barker, M.C., R.E., Mr. Charles Bright, F.R.S.E., Dr. W. Eccles, Prof. B. W. O. Howe, Admiral Sir H. B. Jackson, F.R.S., Mr. W. Judd, Sir Oliver Lodge, Prof. E. W. Marchant, Dr. G. Marconi, Major J. Erskine Murray, R.A.F., Mr. J. Sayers, Major T. Vincent Smith, R.A.F., Mr. A. A. Campbell Swinton, F.R.S., Mr. J E. Taylor, Capt. J. K. I. Thurn, R.N. (nominated by e Admiralty), Lieut.-Col. A. D. Warrington-Morris, O.B.E., R.A.F. (nominated by the Air Ministry), and Lieut.-Col. W. Ll. Evans, C.M.G., D.S.O., R.E. (nominated by the War Office).

"Forward Wireless" in Battle

The Last Phase before the Armistice

By C. A. Oliver, Wireless Officer, 25th Division.

Continued from April Number, page 26.

THE result of this change in direction was to bring up the strength of signals three-fold, both of the signals received and those transmitted by the station.

The town of Landrecies fell to the British the following morning and from this time onwards the advance was more than twice as rapid as it had been hitherto. The enemy, however, still found time to blow up bridges, railways and roads and did all in his power to hold up the advance of the oncoming victorious hosts.

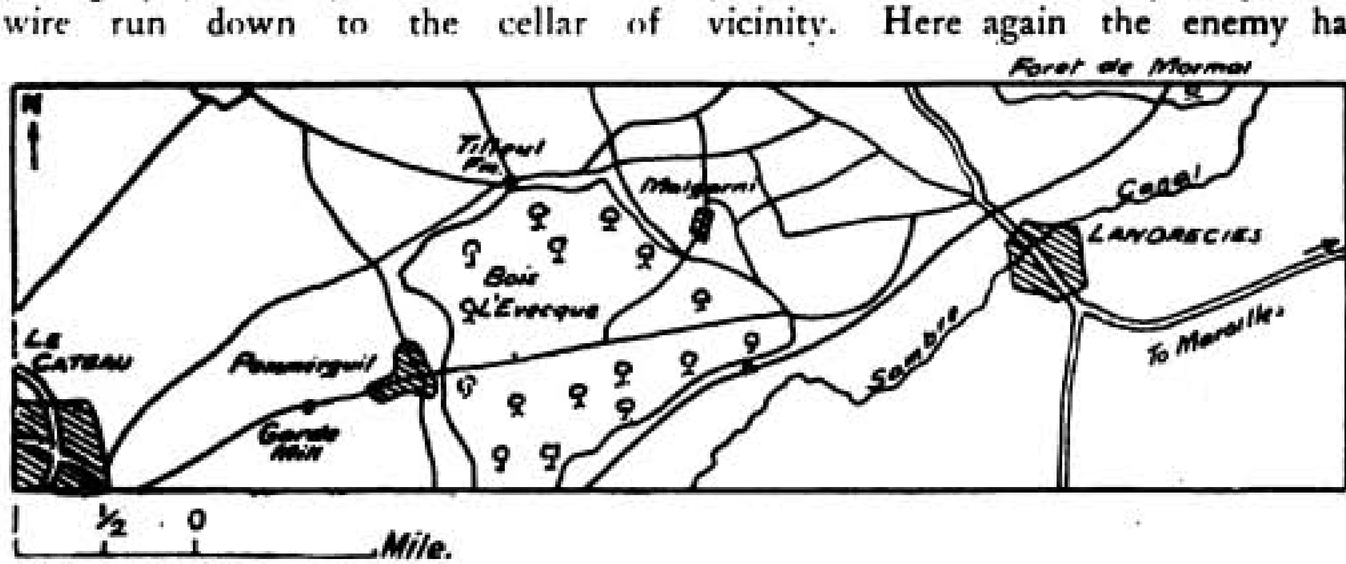
The Sambre canal was crossed by the advanced troops on improvised rafts and shortly after bridges were constructed by the Engineers under heavy shell fire.

That day saw a wireless station situated in Landrecies, communicating forward to positions between Landrecies and Maroilles. The first aerial erected at Landrecies was set up as shown in the photograph, No. 6,* and the lead-in wire run down to the cellar of the house. Later the aerial was swung round to point east and west and ran along the back of a row of houses, the aerial being supported from two upper windows.

The stations in front of Landrecies were moving rapidly from place to place but successful communication was always maintained with the rear station.

The civilian population in these parts was quite numerous. They had retired into their cellars while the battle had raged and passed over their heads and had afterwards emerged little if any the worse for the experience. Some were inadvertently killed but these were comparatively very few. Those who remained were most generously disposed towards the British troops and welcomed them with hot coffee as they passed by.

By November 6th the most forward of the wireless stations had advanced beyond Maroilles and on the same day the Landrecies station received orders to proceed to Maroilles and open up in the vicinity. Here again the enemy had



* See "W. W.," April.

Wireless Station, Maroilles. No. 7

done all in his power to upset the advance by blowing up roads, bridges, etc. Some of the mines were discovered before they had exploded and the fuses of these were removed in time. At Maroilles the wireless station set up the aerial as shown in photograph No. 7, and at once gained touch with the forward stations which had been erected well to the east of Maroilles.

The Maroilles station was first erected after dark, the station itself being established in a room on the first floor of a chateau and the aerial being run out from an upper window of the chateau to a portable 15-feet mast erected in rear of the chateau. In the morning this arrangement was altered and the aerial run out in front of the chateau and stretched from an attic window to a tall tree in the vicinity. This arrangement gave the best results and is the one shown in the photograph of the Maroilles station.

About this time the diminished working of Bosch wireless was very noticeable. During the earlier stages his wireless had been most energetic, but latterly he became so disorganised and was moving back so rapidly that his communications must have become very scanty, if his wireless working was an indication at all. The quantity of wireless material and stores which the Germans were leaving behind them in their hurry to get away quickly, was ever increasing. Large quantities were found at Landrecies and again at Maroilles. This material consisted amongst other things of complete portable German wireless sets, accumulators, insulators, aerial wire and boxes of valves, also accumulator charging sets. At times he was able to destroy the main parts of these stores, but at other times he must have been hard pressed, for he left them intact.

On the other hand the British wireless communication was amply keeping pace with the advance, rapid though it was, and it bore well the great strain of work at times put upon it.

In front of Maroilles a wireless station

W.T. Station near Taisnieres. No. 8

was erected south of Taisnieres and thence communication was established with Dompierre, a town still further forward. In selecting the site of the Taisnieres station much care had to be exercised on account of the extreme closeness of the country. The site selected was at a large farm house situated on fairly high ground, and the aerial was run out from an attic window to a 30-feet mast erected in a neighbouring field on the side of the farm nearest Dompierre. The station itself was on the ground floor of the farm. Between this station and Dompierre stretched a wide valley through which flowed a broad river—the River Helpe. On account of the valley wireless communication forward was made much easier than it would otherwise have been, as there were fewer natural obstacles in the way. The Taisnieres station is shown in photograph No. 8.

At Dompierre the wireless station was erected in a large chateau on the top of a hill just on the outskirts of the town. The aerial was run out from one of the top windows and stretched across to some stable buildings in the vicinity and belonging to the chateau. The Germans had only left the chateau a short time before the station was established there, but before leaving it they had made as big a mess of the furniture as they could, even going to the trouble of polluting it and defiling the tables, pianos and drawers of the cupboards. Why they did so is difficult to imagine, since it could do them no good and could only give them an ill reputation.

By this time the majority of the German wireless stations on this front had closed down, and there were extremely few to be heard working. As one Britisher remarked: "They must have been going back in trains" and indeed their retreat seemed almost to have turned into a complete rout.

The following day orders were received to establish a station at Trois Paves, a junction of three main roads about three miles north-east of Avesnes. This station was instructed to get in touch with a similar station at Maroilles.

The station with its personnel arrived by motor transport as dusk was settling down and halted on the road junction, which, it was afterwards discovered, was mined in two places. The wonder was it had not already "gone up." However, the miners were at work on the task of rendering the explosives useless and before dark had removed the fuses from both mines. The wireless station was set up in a house on the northern road, some 300 yards from the road junction. The aerial was run out from a high tree near by, the far end of the aerial terminating on a 30-feet portable wireless mast erected in a field across the road. The station itself was placed in the upper story of the house. On account of the necessary long lead-in wire the aerial had to be greatly curtailed in length, but the additional height amply compensated for this and good reliable communication was quickly established.

What followed is now mostly public news. First rumours of the Armistice were mooted, then came the order for "cease fire" to give the German delegates time to pass through our lines; the order was originally given till midnight but was afterwards extended till 6 a.m. the next morning. Then followed strong rumours of the Armistice to take effect from 11 a.m., and later came the confirmation message over the wireless, and orders for the Trois Paves station to pack up and return. Though the station at Trois Paves was never actually required for any real serious work, wireless had already amply fulfilled its part, and had taken a noble share in the fighting up to the memorable 11th of November.

One cannot conclude this article without paying a tribute to the excellent work carried out by the men of the wireless service during the very trying conditions of the last phase of fighting. Often under the most adverse circumstances and under very heavy shell fire not one man shirked his duties, and it was untiring energy and loyal co-operation of all that enabled the wireless work to be carried through without a hitch in the last great battles before the Armistice.

Wireless Station, Trois Paves. *No. 9*

Notes of the Month

THE AMERICAN NAVY AND THE WIRELESS COMPANIES.

WE notice with pleasure that during the Congressional hearing of the bill for Government control of wireless, Captain Hooper paid a fine tribute to the valuable services rendered to the American Navy by various manufacturers of wireless plant. Captain Hooper laid special stress upon his appreciation of the work done by Mr. E. J. Nally, vice-president and general manager of the Marconi Wireless Telegraph Company of America, which Company, he said, " more than anyone else suffered through what war brought upon them."

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ANOTHER ASSOCIATION OF WIRELESS TELEGRAPHISTS.

We have been notified that in November, 1918, the Dutch wireless operators belonging to the staff of the Belgian Marconi Company of Brussels and the Telegraph Company " Radio-Holland " of Amsterdam have constituted the Vereeniging van Radio-Telegrafisten ter Koopvaardy (Association of Wireless Telegraphists of the Mercantile Marine) with headquarters at Westeinde 5/1 Amsterdam. The Board is composed entirely of members of the staff of these Companies, the Secretary being Mr. T. A. v. d. Vlies. The purpose of this Association is to further the interests of the operators by all lawful means in co-operation with similar Associations in other countries. The Association has been recognised by the Companies as representative of the operating staff.

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SCIENCE MADE EASY.

From the *Electrical Experimenter* we copy the following choice sidelights on science :—

" You know when you hook up some plants in parallel that there enters a condition known as ' harmonics ' that juggles the peak around and cuts it off, and goes negative when the generators are trying to make a positive impression on the line. Alternating current is great stuff and the guy that can get reactance and impedance kicking right and pull the wattless current off the line don't need to worry about such prosaic things as room rent and meal tickets. . . ."

" Speaking of wireless, Hertz looked over our heads and saw something we had overlooked since Galvani's ' return shock ' on the frog's hind kicks. Then Marconi and others, notably De Forest, boosted the proposition along, so that now, with the audion amplifier, we transmit music, both chin and instrumental, for miles and miles on thin ether."

In fairness to our contemporary we must add that the article from which the above was extracted is entitled " Science in Slang."

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CENSORSHIP OF TELEGRAMS.

The censorship of wireless messages to and from commercial coast stations, and vessels in West Atlantic and Pacific waters, has been abolished by the Canadian and U.S. Governments. Telegraphic traffic between the United States and Great Britain is now censored only in the country of origin.

WIRELESS RELIEF FOR CABLE SYSTEMS.

As there is still a serious delay on telegrams to and from India and the Far East, partly on account of broken cables and due partly to the unusually heavy traffic occasioned by the war, an auxiliary wireless service has been established between Great Britain and Egypt.

Also between the Isle of Man and England a wireless service is being organised, to take the place of the cable which is broken.

Marconi's Wireless Telegraph Company has offered to erect in Australia high-power stations capable of communicating with England and to establish a regular service between the two countries. Owing to the present delay and congestion of traffic this offer has been enthusiastically received by business men and the general public in Australia.

On account of telegraphic delays the Hong-Kong Chamber of Commerce is asking the Government to arrange for the temporary use of the naval high-power wireless station there.

COPPER LEADING-IN WIRES FOR VALVES.

A method of using copper or iron for the leading-in wires of electric lamps is described in the *Revue Generale de l'Electricite*. The wires are first oxidised on the surface and after being introduced into the glass are strongly heated. The result is that the oxide combines with the silicic acid of the glass, forming a silicate which is soluble in molten glass. The co-efficient of expansion of the wire and the glass are thus approximately equalised.

WIRELESS TELEGRAPHY ON FRENCH SHIPS.

The French Government has decreed that all French vessels of more than 500 tons gross displacement on which wireless apparatus was installed during the war must retain their installations for a period to be fixed by the Minister of Marine.

LLOYDS AND SENATORE MARCONI.

At a committee meeting which took place on April 9th, Senatore Marconi was elected an honorary member of Lloyds.

WIRELESS CLUB NOTES.

Amateurs resident in S.E. Essex are requested to write to Mr. Alexis J. Hill, 63, Strone Road, Forest Gate, E.7, with the view of forming a club.

A club has been formed in Plymouth under the name of the Three Towns Wireless Club, its present address being 7, Brandreth Road, Compton. Major The Hon. Waldorf Astor, M.P., has accepted the Presidency and Mr. J. Jerritt, the principal of the Bedford Park Telegraph Training School, has been elected Chairman. The Club will be run on social and instructive lines, the principal items of the programme being lectures and electrical demonstrations. The subscription has been temporarily fixed at 3s. per quarter. Readers desirous of joining are requested to communicate with the Hon. Secretary, Mr. W. Rose.

CORRESPONDENT WANTED.

Mr. P. Blancheville, 13, Rue Antoine Vollon, Paris, in order to improve his knowledge of English would like to exchange correspondence with a wireless amateur.

The Amateur Position.

A Slight Improvement.

SCARCELY a day passes but we receive fresh evidences of the growing anxiety which exists amongst the amateur wireless workers of this country with regard to the possibility of state control. We have received a large number of letters on the subject, the tone of which affords a clear indication that the writers are men prepared to do serious work and to co-operate with the authorities in discouraging "fooling" in any form likely to be detrimental to official, commercial,—or amateur—radio working. The press, too, has paid a gratifying amount of attention to our arguments in favour of the abolition of the restrictions and up to the present we have not detected any note of opposition. The *English Mechanic* says:—

"We heartily endorse the campaign. Thousands of our own readers who, by their manifold contributions to our pages, did much to advance wireless telegraphy and promote fraternal co-operation, are impatiently demanding the removal of restrictions. Let them do their utmost to help all whom they can induce to send 'Dilly' and 'Dally' to the right-about."

D.O.R.A. BEGINS TO RELAX.

In a letter dated March 24th, the Secretary of the Post Office notifies manufacturers of electrical apparatus that it has been decided to remove the restrictions imposed on the sale of buzzers, which may now be sold without enquiries as to the use to which the purchasers propose to apply them. *The restrictions on the sale of thermionic valves remain unaltered, which means that at present the amateur cannot legitimately own or buy valves.* Spark coils, telephones, etc., may be purchased now on condition that the buyer gives a written undertaking that the apparatus will not be used in connection with the sending or reception of messages by wireless telegraphy except with the written permission of the Postmaster-General. Thus for the wireless amateur these concessions serve but little to relieve the situation; we hope, however, that we may regard them as the first of a series which will in the near future permit the independent worker to come into his own again.

"THE AMATEURS SAVED THE DAY."

Speaking before Congress during the hearing of the wireless control bill recently introduced—and dropped— in America, Captain Hooper said:—

"The amateurs saved the day when we had to man practically the entire merchant marine by naval radio operators in order to incorporate the merchant marine into the naval system."

In respect of war services rendered it is impossible to pay a higher tribute than this to any body of men, and although it would be an exaggeration to say that British amateurs saved the wireless situation when war broke out, we do know that but for the large number of them who hastened to the recruiting offices or to wireless training schools during the first few months of the war, the wireless services of the army, navy and mercantile marine would not have reached so quickly their high degree of efficiency.

What amateurs desire and ask for is nothing more than permission to resume their researches unhampered by any restrictions other than those which all reasonable men would agree to be essential to the regulation of traffic through the aether. By all means let wireless communications be regulated by laws and let private investigators of wireless bow to the priority claims of the public services; but these desirabilia can be attained without the entire prohibition of amateur-owned stations. If the present ban is not removed private aircraft will have to be navigated without the assistance of wireless telegraphy! That will be most encouraging to the pioneers of the British Mercantile Air Service.

We publish below a further selection of letters bearing on the whole question:

"SIR,—The control of amateur wireless could in my opinion be most effectively and economically regulated by granting experimental licences only to members of the various clubs (or societies).

"If an amateur interfered with a Government or Commercial Station it would be a simple matter to send a complaint to the Club and the latter could penalize the offender under its Rules (*e.g.*, abolish his transmitting powers) and if necessary recommend that his licence be cancelled. If the Club failed in its duty, all its members, or at least its committee's licences, could be suspended.

"Discipline could, and must be strictly enforced, especially in the vicinity of real stations.

"A disenfranchised (?) licencee trying to carry on with secret wireless would easily be traced down by local members.

"Not only would the suggested course be most cheaply administered, not only would delegated authorities stimulate responsibility (as is found in our best schools) but the interchange of ideas between members would be most helpful to all.

"Standard Rules could be formulated for all clubs, and the feared amateur nuisance scotched. (He was, by the way, frequently more of a nuisance to brother amateurs than to the regular stations.)

"There is another side to this question. Is it not a fact that electrical development in this country was most seriously hindered in the 'eighties by shortsighted bureaucratic control?

"The writer is under the impression that the Legislature gave Municipalities the right to buy up any local electric light or tram undertaking which might turn out well. Result, snug lethargic non-progressive jobs for some lucky electrical engineers, and capital and brains can take themselves away to where there is less control.

"As a preliminary step to the question why not collect the doings of amateurs in the war? To mention only one case it will probably be found that an amateur designed the most popular crystal amplifying valve attachment regularly used (unofficially perhaps) in the navy to-day, while the 60-guinea set it replaced is generally used as a convenient seat.

"Scores of other amateurs, whose keenness made them useful are now demobilised (dispensed with) and they are not allowed to study this most valuable life-saving science. It isn't cricket.

"Yours, etc.,

"SAGITTA."

"SIR.—Your article dealing with the future legislation of Wireless published in this month's WIRELESS WORLD touches upon a matter of great interest to those associated with Wireless, both commercially and scientifically. The question raised is one of national importance, and as such, deserves the interest and earnest consideration of all those having the industrial and economic welfare of our country at heart.

"There has, in the past, been a tendency on the part of the Government to place too much reliance on the recommendations of Government officials without fully investigating the possible consequences and obtaining the views of those interested on the commercial side. The times, however, have now changed, so that those of us knowing the attitude of the Government Wireless officials towards control, and realising how control as they understand it would affect the economic position, hold forth great hopes that the restrictions now in force will be repealed. Nothing less than the opportunities afforded in pre-war days to amateur investigation in this line of science will be satisfactory.

"The arguments of those favouring a continuance of the present control may be summarised under the following four headings:—

(*a*) Elimination of jamming.

(*b*) Secrecy.

(*c*) Practised control in case of an emergency when this may become necessary in the interests of the State.

(*d*) Increased facilities for public service.

"With regard to (*a*) the seriousness of jamming by amateurs and private investigators in this country in pre-war days has been very much over-rated. In point of fact it is doubtful whether commercial or Government stations have ever been interfered with to any extent by such jamming. It is generally realised, however, that some sort of legislation is necessary to cover the possibility of such interference occurring in the future. The practice in force before the war of issuing licences restricting those having private stations to certain limits with regard to power and wavelength was entirely satisfactory and should be resumed. It must be admitted that during the course of the war apparatus has improved to such an extent that the effective radius of a station of a given power has more than doubled, but the difficulties which this fact may seem to create are more than compensated for by the improved selectivity of present day apparatus. It may be found advisable to restrict the issuance of such licences to persons of a prescribed age having such technical knowledge as will enable them to intelligently interpret the language of the laws affecting their work.

"With regard to (*b*) the comments in your article are very much to the point. It would be a mistaken idea to suppose that any restriction however stringent would suppress the efforts of those who for any reason deliberately set out to intercept wireless messages in course of transmission.

"I would add that in the near future it should be possible to arrange a secret method of Wireless Communication to be used in cases where it is absolutely essential. In any case it is highly improbable that the interception by amateurs would cause serious embarrassment to any of the interests concerned.

"In respect to (*c*) it would not be a difficult matter for the Government to assume absolute control if at any time an emergency arose which would necessitate such steps being taken. It is difficult to believe that such an emergency will occur during the next decade.

"With regard to (*d*) increased facilities would not be afforded for public service should the Government assume absolute control.

"Experience in the past has taught us that the Government has lacked a good deal of enterprise in the matter of administrating its public Wireless Service. It is a fact, that in pre-war days messages could be sent to England at a cheaper rate through Wireless stations at Bergen in Norway and Scheveningen in Holland than through the medium of British stations. An instance of Government unfairness may also be found in the ruling that Shipping Companies should pay five shillings for the receipt of each message addressed to the commanders of their ships giving the state of the weather at coastal wireless stations, notwithstanding the fact that most of the larger class of steamers compile and transmit, free of charge, messages to the Meteorological Office in London giving them full particulars of weather conditions on the North Atlantic and elsewhere.

"The chief arguments against control apart from those dealing with the position of personnel may be summarised under three heads:—

(1) Hindering of development.

(2) Robbing wireless of the talent it would otherwise absorb.

(3) Prevention of competitive enterprise.

"With reference to (1) there is no doubt in the minds of those who have been associated with the development of Wireless, or of those interested in it, that to deprive amateur investigators of the facilities for experimenting which they hitherto enjoyed would seriously retard future progress. As Senatore Marconi so aptly stated in your columns Wireless Telegraphy had by no means reached finality in any of its branches and I think that the extent of progress in the future, as in the past, will depend in a large degree on the efforts of the independent and amateur investigators.

"With regard to (2) an article dealing with the future of Wireless Telegraphy published in the *Electrician* of February 21st says: 'It may be contended that inventions of the first class are the work of a few exceptional men. This is true, but the point is, that if widespread education is not encouraged these exceptional men are never produced, or at least their gifts are never deflected into the channel in which they might be peculiarly useful. Education in this sense means, not merely book-learning; contact with apparatus, and the struggling with experimental difficulties are infinitely more essential.'

"This point has been very clearly illustrated during the war. Professional Wireless men in the Services have been surprised at the keenness and ability of the amateurs who so patriotically came forward to fill the demand for Wireless personnel. When these men return to their civilian occupations they will rightly contend that their services have entitled them to a large amount of consideration in regard to their Wireless activities. Universities and other educational institutions in this country will do well to follow the lead of America in the matter of creating a keen interest in Wireless among their students by having up-to-date Wireless Apparatus installed in their laboratories.

"With regard to (3) there is no doubt that to eliminate entirely private competitive enterprise would act very much against national interests. To quote again from the article in the *Electrician*: 'No amount of liberty for established firms could compensate for the extinction of the independent worker; in fact, this extinction would assist these firms to become great monopolies.' It is a matter of great doubt whether in view of the force of public opinion it will be advisable to exercise any form of drastic control which would eliminate entirely the Wireless amateur.

"Yours, etc.,

(Signed) "RONALD FERGUSON."

Practical Notes on the Use of Small-Power Continuous Wave Sets

BY J. SCOTT-TAGGART, M.S.Belge E., A.M.I. Radio E.

Continued from April Number, page 46.

IN order to measure continuous-waves accurately it is necessary to have a graduated miniature receiving circuit in which persistent oscillations are taking place. The design of such a wave-meter has been already fully discussed by the writer,* but as such an apparatus is essential to the working of C.W. sets, a short explanation will not be out of place.

Fig. 2 shows a simple arrangement, consisting of a reaction coil *R* and a plate oscillatory circuit composed of the lower half of the same coil shunted by a variable condenser *C*. In the plate circuit is a small high-tension battery of about 40 volts, and a pair of low-resistance 'phones. By means of *S* the filament current may be switched on, and the system made to oscillate continuously on a wave-length depending on the value of the variable condenser *C*. The softer specimens of hard valves generally work best on such a wave-meter.

If the key *S* of the transmitter be depressed, and the heterodyning wave-meter brought within range, the waves emitted will set up oscillations in the

* *Vide* "The Measurement of Continuous Waves," THE WIRELESS WORLD, October and December, 1917.

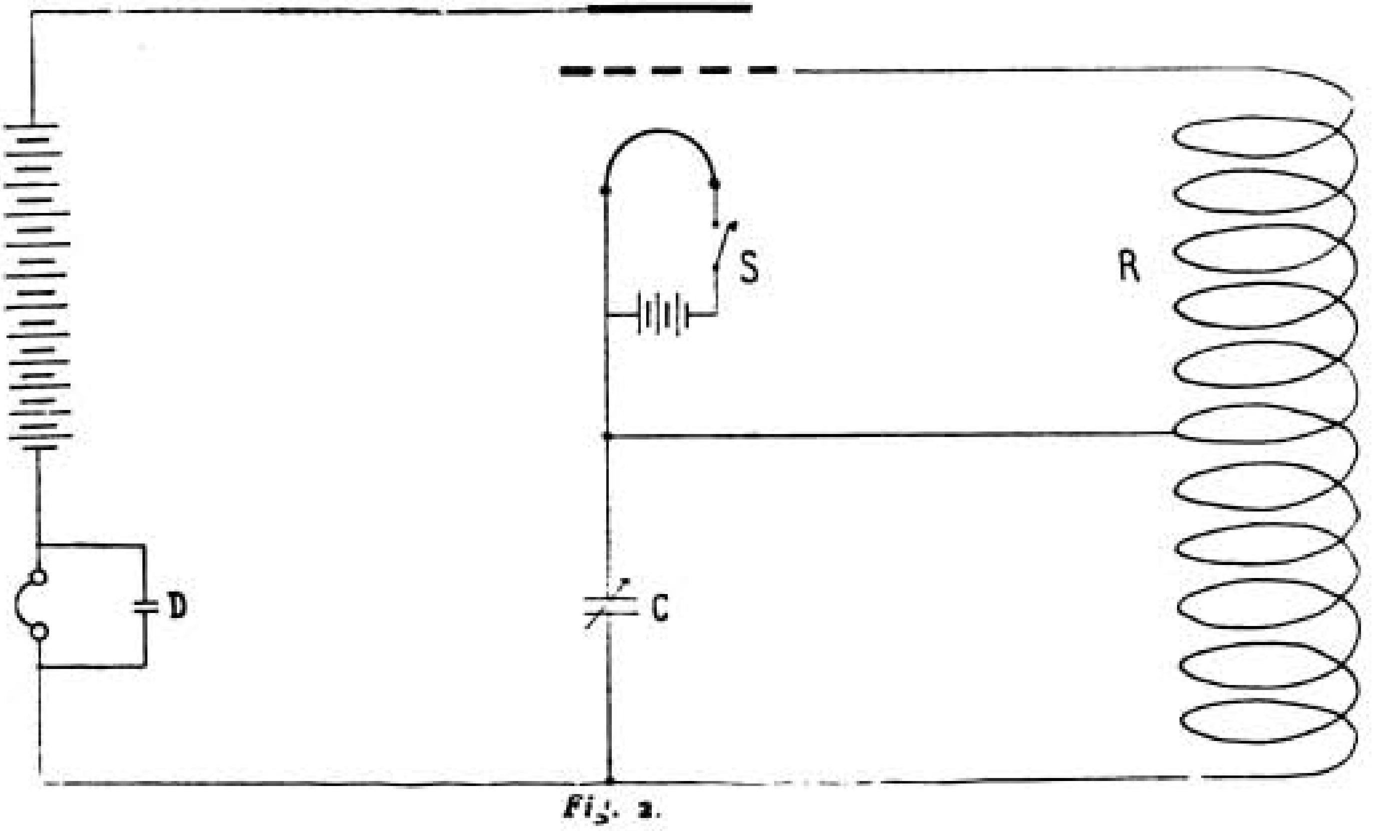


Fig. 2.

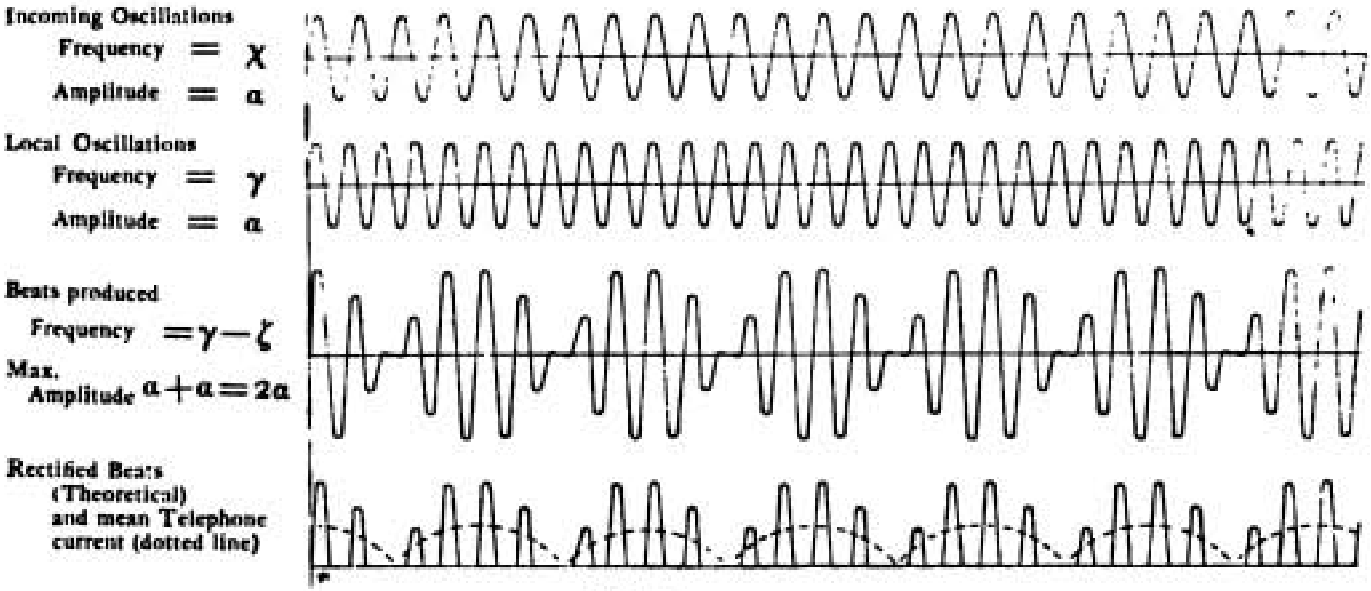


Fig. 3.

wave-meter which will combine with those already taking place. Suppose the instrument is brought up to a set which is sending out waves of, say, 800 metres length. These waves will have an interference effect on the oscillations already taking place in the wave-meter. If the wave-meter is set to, say, 750 metres, the system will be oscillating at a frequency of 400,000. When the wave-meter receives the 800-metre continuous waves, oscillations of 375,000 frequency are set up in addition. These two sets of oscillations, superimposed upon each other, will produce a resultant oscillating current with beats when the two sets of oscillations are momentarily assisting each other. The frequency of these beats will be equal to the difference of the two separate frequencies, and will in the present case be 25,000.

The valve is also acting as a detector in addition to generating oscillations. The beats, therefore, are rectified, and will produce in the telephone receivers a note having a frequency equal to the beat frequency. This note, to be audible to the human ear, must be below a frequency of 14,000. It is obvious, then, that if the wave-meter be set to 750 metres, nothing whatever will be heard in the 'phones. Only when the wave-meter condenser is turned round till 770 metres is reached will anything at all be heard in the ear-pieces, and then only an exceptionally high note. As the wave-meter condenser is turned nearer to 800 metres—*i.e.*, as the two

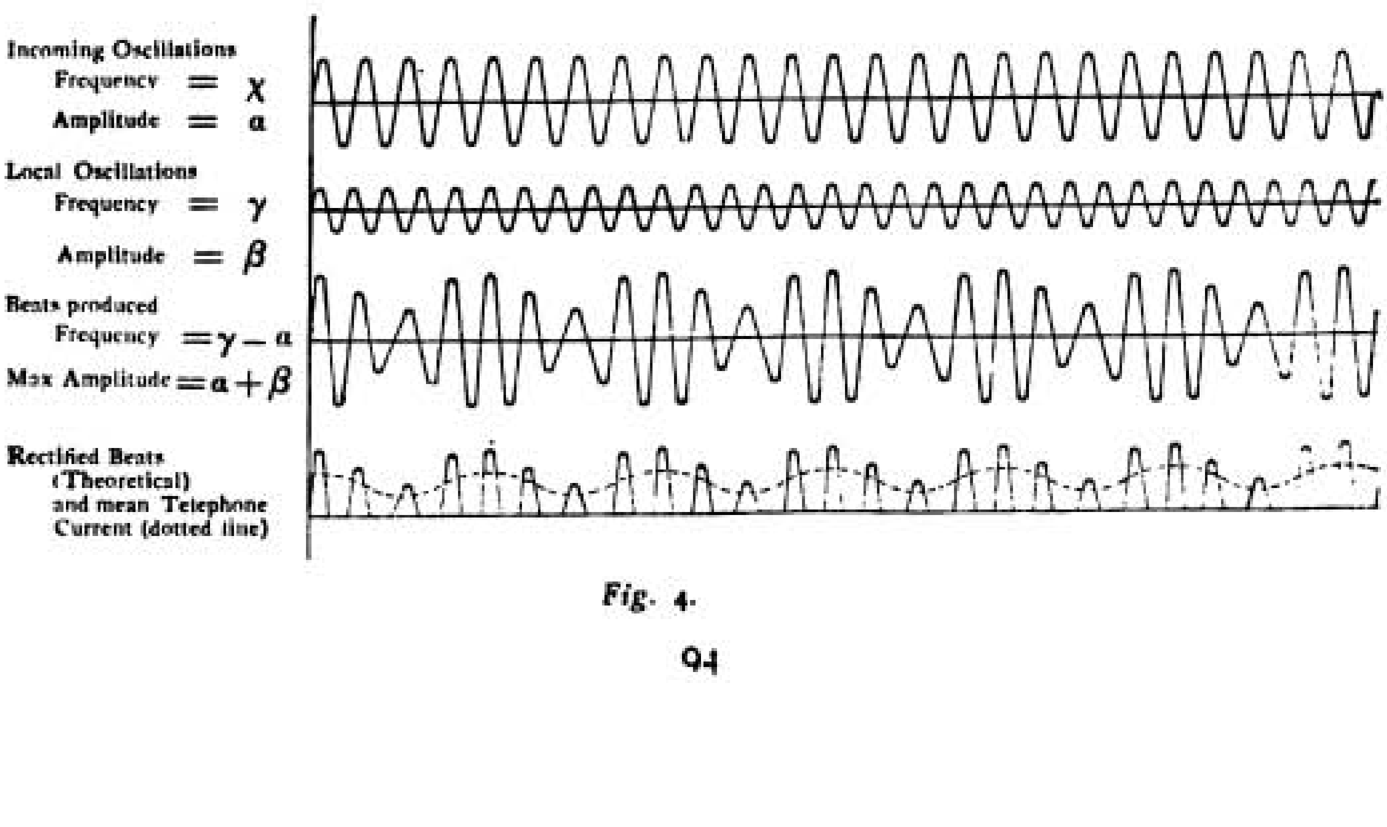


Fig. 4.

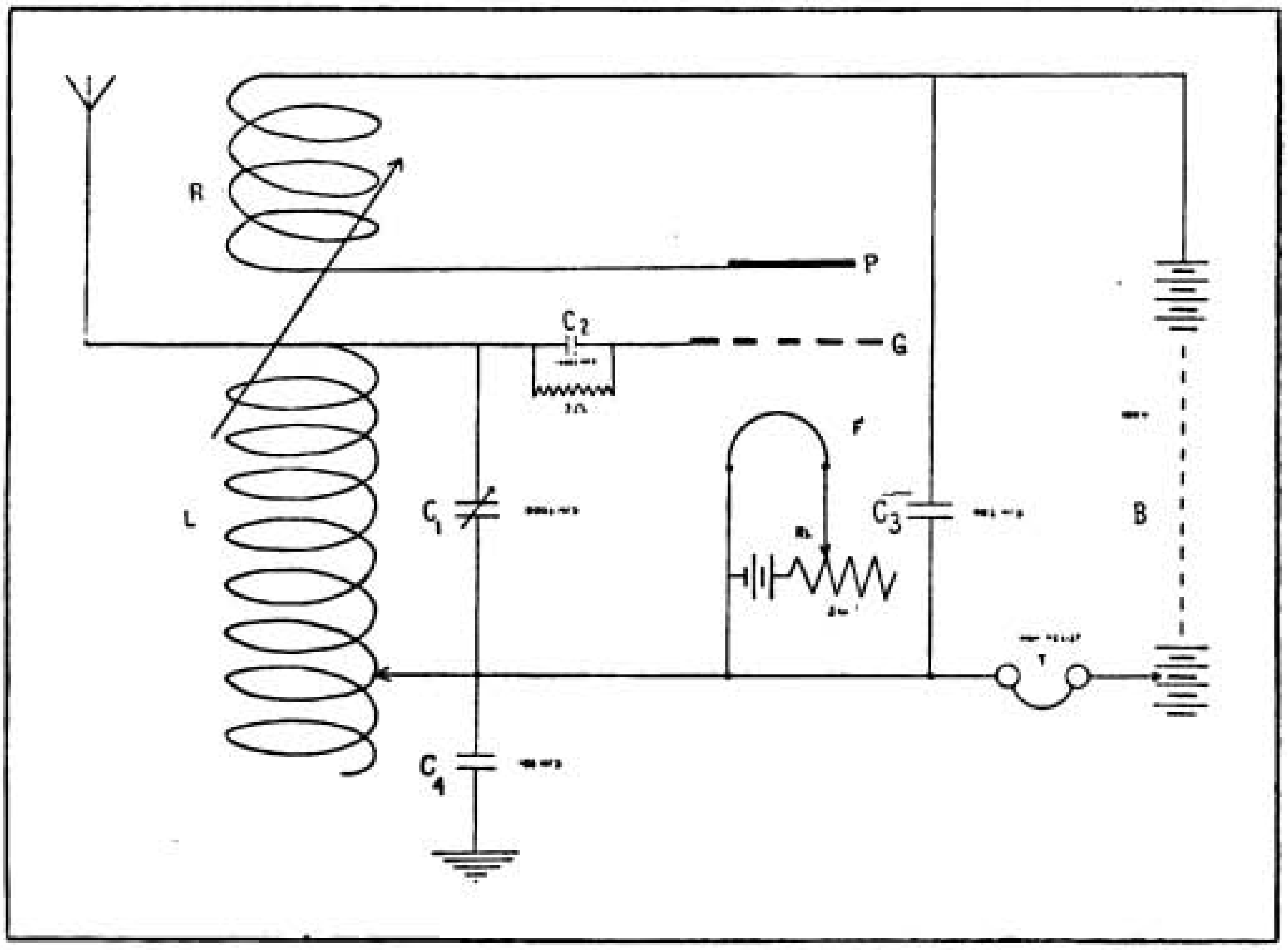


Fig. 5.

frequencies approach each other—the note in the telephones gradually gets lower and lower till, at 800 metres, nothing whatever is heard. The two frequencies, local and superimposed, are now identical, and, whether in phase or not, produce resultant oscillations of constant amplitude, and which therefore are unable to affect the telephones, even when rectified.

As the condenser of the wave-meter is gradually turned further round to wave-lengths higher this time, than 800 metres, beats begin to be formed, and a low note is heard which gradually gets higher as the condenser is turned, until at 830 metres the note gets so high that the ear can no longer hear it.

It is therefore seen that if the wave-meter is over 30 metres " out " on either side, nothing will be heard at all.

From the above consideration it will be seen that, in order to measure waves of an unknown length, it is only necessary to turn the wave-meter condenser round until a " chirp " is heard. This " chirp " when analysed consists, as described above, of a high note, gradually getting lower till nothing is heard, and then rising from a low note to a high one again. The wave-meter is adjusted to the middle part, so that, which ever way the condenser may be turned, a note will be heard which rises higher and higher. The reading on the wave-meter will now give the wave-length required.

Very misleading results are often obtained by having the wave-meter too near the set or aerial. Frequently the fundamental wave is too strong and produces little and sometimes no effect in the telephones. On the other hand, complications arise owing to the weak harmonics generated in addition to the fundamental waves. These harmonics frequently produce much louder " chirps " than the fundamental waves when the wave-meter is too close

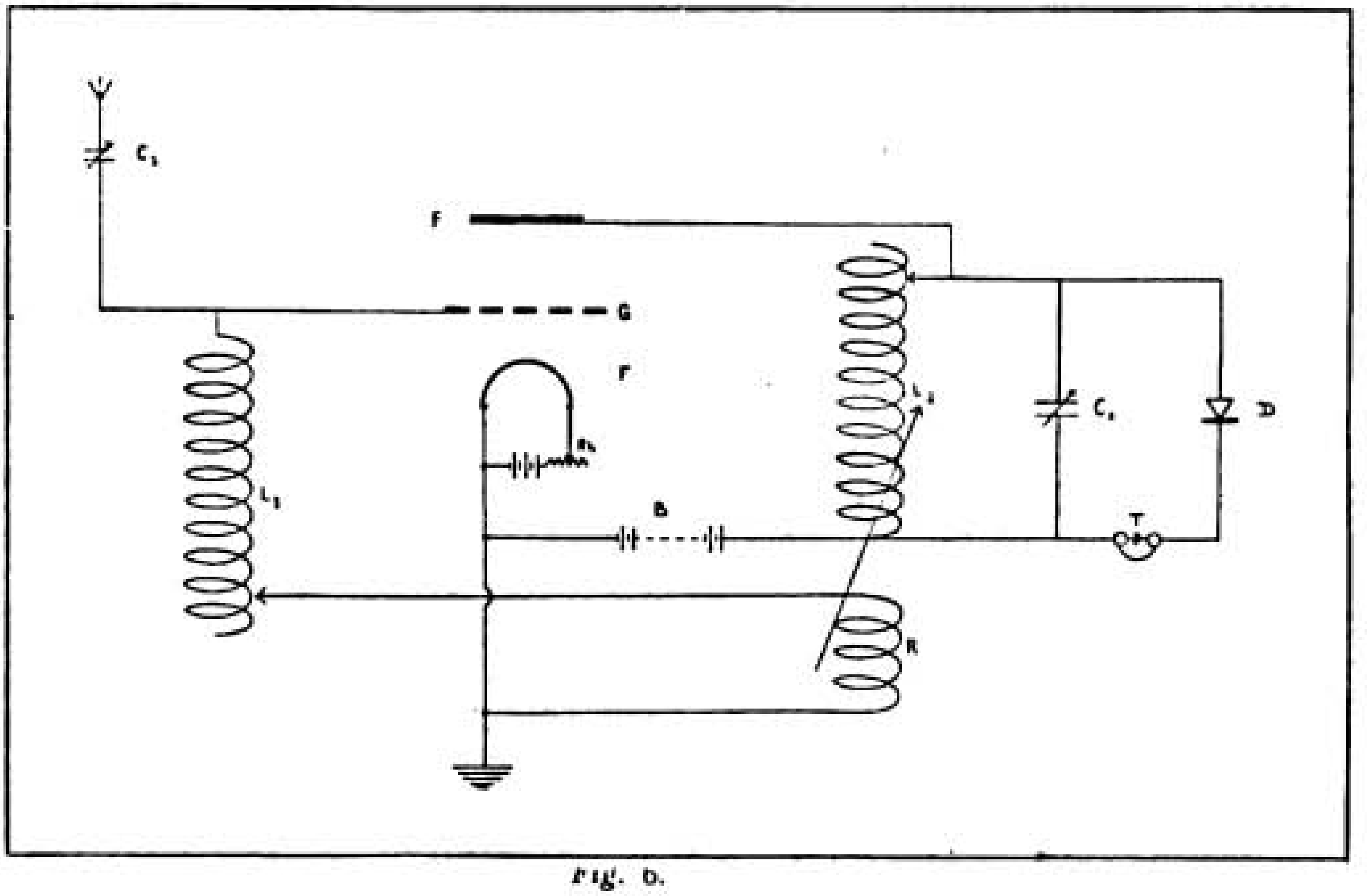


Fig. 6.

to the instrument, and so may give rise to incorrect assumptions. At a distance, though, these harmonics are too weak to influence the wave-meter, which will then only respond to the real fundamental waves. It would be as well, perhaps,to point out that it is not sufficient to move the wave-meter alone away. The telephones and the operator wearing the receivers should also be at some distance from the instrument. Fig. 3 shows an example of what takes place in a wave-meter circuit. When the incoming oscillations are equal in amplitude to the local oscillations. Fig. 4 shows the effect of having local oscillations weaker than the incoming ones. Less accurate results are obtained, harmonics are frequently measured by mistake and the " silent interval " is too long.

II

RECEPTION

Let us now consider the receiving station. Fig. 5 shows a typical circuit suitable for the reception of continuous waves. Figs. 18 and 19 of the writer's Paper* on "The Valve as an Amplifier" (Part iii) also show simple circuits for the same purpose. They are reproduced in Fig. 6 and Fig. 7.

In Fig. 5 the aerial tuning inductance is connected across the grid and filament of a valve. The inductance is shunted by a condenser C , which is used for obtaining fine tuning. C_4 is a blocking condenser of .01 mfd. in series with the by a resistance of several megohms; a suitable resistance consists of a few earth. C_2 is a small condenser shunted pencil lines on a sheet of ebonite. This leaky condenser makes the valve more efficient as a rectifier, although good results may be obtained without it.

In the plate circuit of the valve is an aperiodic reaction coil *R*. and a high-tension battery *B* variable by means of plugs to give any voltage up to about 100 volts, and a pair of high-resistance 'phones *T*. A small blocking condenser C_3 is placed across the 'phones and high-tension battery; this condenser does not affect the tuning of the plate circuit, but affords an easy passage for oscillations

* *Vide* THE WIRELESS WORLD, March, 1918.

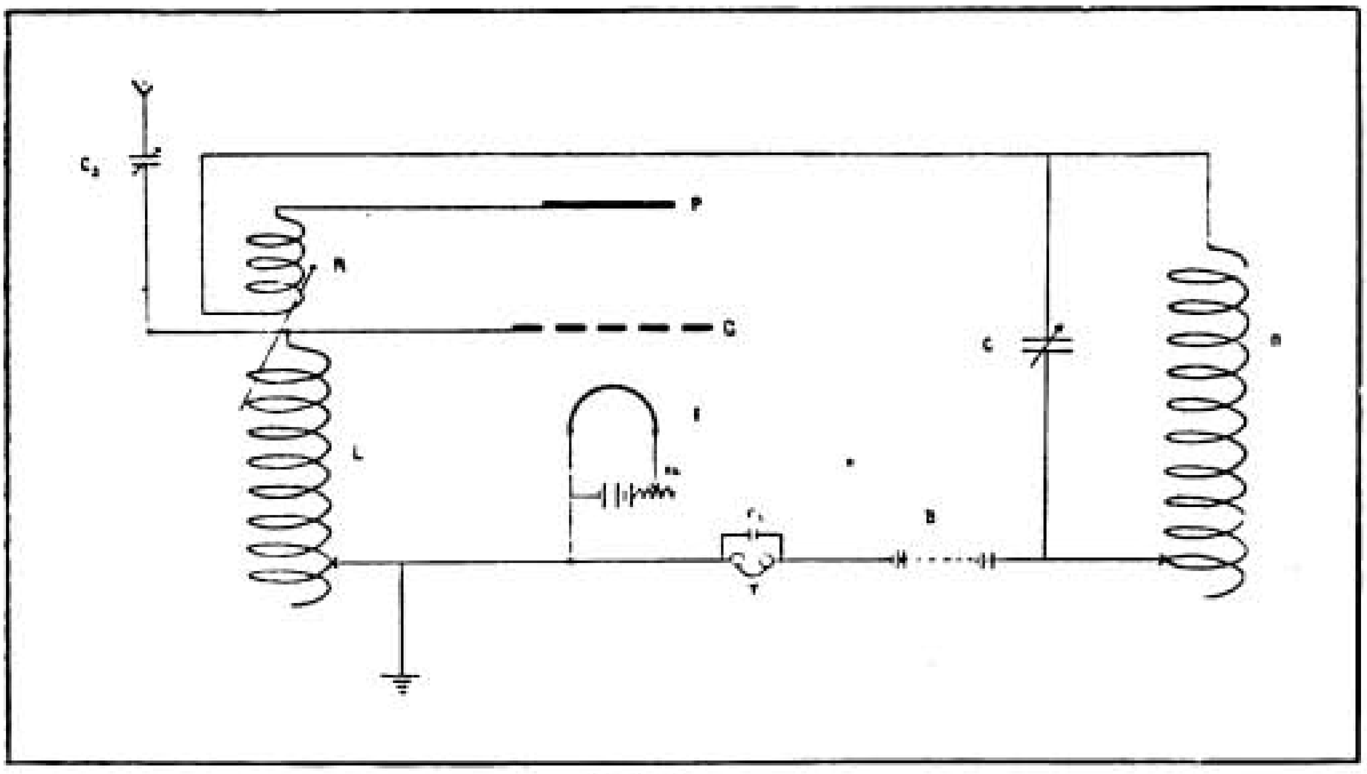


Fig. 7.

taking place in the circuit. Instead of using high-resistance 'phones, the high-resistance primary of a step-down transformer is preferable, a pair of low-resistance 'phones being connected to the terminals of the secondary. The advantage of this arrangement is that the main steady-plate current does not pass through the 'phones, and therefore there is no chance of them being demagnetised through being connected the wrong way round, or being injured by a break down of their insulation. Moreover, there is not the same chance of the operator receiving shocks, since no current passes through the 'phones except when signals are being received and the main plate current is varied.

The filament of the valve is heated by a four-volt accumulator. *V* is a variable resistance for varying the value of the filament current, and is preferably a spiral of resistance wire fitted with a sliding contact in order to vary the current smoothly. Its resistance is 5 ohms.

Before tuning in, it is necessary to see that the valve is oscillating on approximately the adjustment on which it is intended to work. There are several ways of telling when the set is in a condition to receive continuous-wave signals. When the valve is oscillating all spark signals heard are very hoarse, no matter what their real spark-frequency may be. On touching the aerial terminal a sharp click should be heard. If the aerial tuning inductance is variable in studs, clicks should be heard when the switch is moved across the studs in use. Also, if the condenser C_1 shorts when moved to 0° or 180°, clicks will be heard at these positions. If none of these effects are noticed, the valve is not oscillating, and is therefore not in a position to heterodyne incoming continuous waves.

(To be continued in June number.)

SHARE MARKET REPORT.

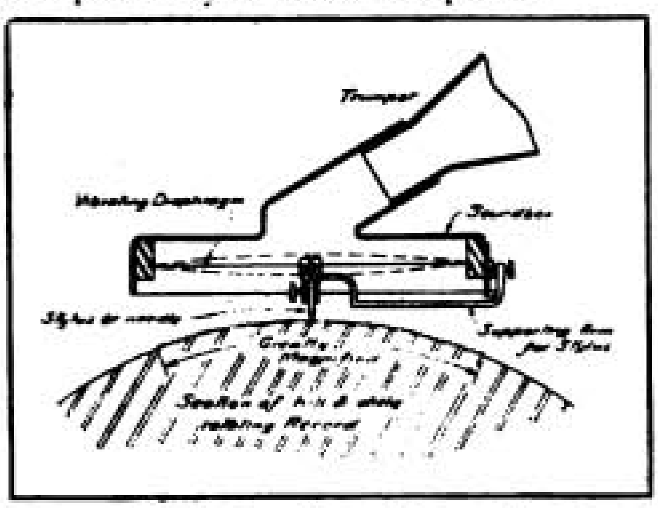
Business in the shares of the Marconi group have been very active during the past month. The shares of the International Marine Company show a marked advance in price due to the new issue which constitutes a large bonus to the shareholders. The prices as we go to press (April 14th) are:—Marconi Ordinary, £4. 18. 1½; Marconi Preference, £4. 2. 6; American Marconi, £1. 9. 6; Canadian Marconi, 15s. 6d.; Spanish and General, 14s. 6d.; Marconi International Marine, £4. 13. 9.

The Wireless Telephone and the Evolution of Speech Transmission

By J. J. Honan.

THE PHONOGRAPH.

IN the case of the phonograph, the air vibrations which give rise to "speech-sounds" are caused by the oscillation of a diaphragm by mechanical means, namely, the traversing by a needle point of the hill-and-dale or similar tracings on the ebonite record. The consequent oscillatory motion of the needle is transferred to the diaphragm, thereby setting the adjacent layer of air into the particular form of air wave-motion, which, impinging on the human ear, is interpreted by the brain as speech.



The Action of the Phonograph.

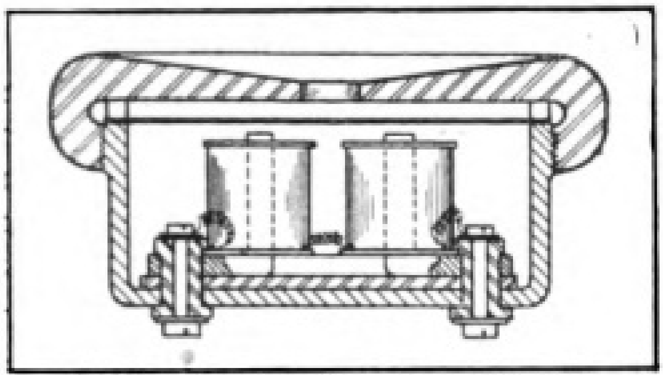
In preparing the record, the reverse operation is performed. By speaking on to a diaphragm to which a needle is attached, the pointed end is caused to score the soft wax mould with speech-form serrations, which are preserved in the hard ebonite records that are cast from the mould. In both cases, air is the medium which conveys the sound to or from a mechanical device which registers the wave form in facsimile.

THE LINE TELEPHONE.

In the case of the ordinary line telephone, the initial and end operations are similar, but a magnet is employed in place of the phonograph needle to transfer the effects between the diaphragm and the recording means, which in this case is also the medium of transmission, viz., the electric current.

Speech-form air vibrations impinging upon the telephone diaphragm cause it to vary the normal magnetic flux in a magnetic circuit (comprising a horseshoe magnet and the telephone diaphragm) by increasing or diminishing the distance between the diaphragm and the poles of the magnet. This variation of magnetic flux reacts inductively upon the line circuit between the receiver and transmitter, because a portion of that circuit passes around the magnet. As the magnetic flux is increased or diminished, the normal electric current flowing in the line circuit rises or falls according to the well known law of electromagnetic induction.

The variation in the normal line circuit so set up is of course repeated at the receiving end of the circuit, where again the line wire passes around the legs of a horse-shoe magnet, provided with a metal disc or diaphragm in close proximity to its poles—identical with the transmitting arrangement. Here, however, the increase or decrease of the current sets up a corresponding variation in the magnetic flux springing from the magnet, the result being that the diaphragm is pulled towards the magnet with a varying force which follows exactly the fluctuations of the circuit current. In this way the receiving diaphragm is vibrated, and as the initial variations "poured" into the transmitter



Section through Telephone Receiver.

are exactly reproduced, the layers of air adjacent to the receiving diaphragm are set into identical speech-form vibrations, which thence spread outwards through the air until received by the ear.

THE WIRELESS TELEPHONE.

The wireless telephone may be similarly comprehended with some difference in detail. The primary distinction is, of course, that no wire exists to carry the electric current and any variations that may be imposed upon it.

This difficulty disappears when one realizes that the main difference between the electric current carried by a wire and the electric disturbances conveyed by means of ether waves is one of form rather than of quality. Both represent the transfer of electric energy propagated at identical speeds, and both are capable of producing " end effects " of a similar nature upon suitable receiving-devices. In the case where the passage of electric energy takes place along a wire it is confined, practically speaking, to the path of that wire; whereas in the case of ether waves the electric energy spreads outwards from the source equally in all directions, *i.e.*, the distribution of energy is that of a sphere with the originating point in the centre, and the outer boundary limited only by time and infinity—the " borders " of which it approaches at the rate of approximately 186,000 miles per second.

Keeping these distinctions in mind, then, for the transmission of speech without wires we must first reproduce the equivalent of the steady circuit-current in the case of the ordinary phone. This is done by means of suitable electrical apparatus, such as an oscillating valve or Poulsen arc, which sets the adjacent layers of ether into a state of steady sustained electric vibration at a definite frequency and with a definite amplitude.

In the case of the valve, one of the factors producing and determining this steady state of ether vibration is the value of potential applied to the sheath of the valve. So long *cœteris paribus* as that potential is maintained as a fixed steady value, the amplitude of the ether waves generated remains constant.

At the receiving end is a very similar " detector " valve. So long as this detecting-valve receives only the steady ether vibration, it produces in a certain part of its attached circuit a constant electric current which does not affect the phones. Here we have the same condition of things that exists in the ordinary line phone before it is spoken into.

The next step is to impose upon this steady condition a periodical variation which shall exactly follow in frequency and quality those alternations of air pressure which we know as speech.

Attached to the transmission valve is a circuit containing a microphone, which is nothing more nor less than a slightly modified telephone transmitter.

The effect of speaking into the microphone is to vary the steady value of the electric current flowing in its circuit in exactly the same manner as in the case of the line wire phone. In other words oscillations in current value are set up which correspond in their alternation to the speech-form variations causing them.

These current disturbances are enhanced by means of a " control " valve, and are then converted by a choke-coil into exactly similar variations of electric potential. The latter are finally applied to the before-mentioned sheath of the oscillating " power " valve, and being superimposed upon the existing constant potential (applied there from a separate source), thereby cause the steady wave output of ether vibrations to be varied *in amplitude* in a precisely similar degree.

The disturbance caused by the speech-form vibrations poured into the microphones have therefore now been translated into analogous variations in the form of the ether waves that are speeding through space towards the receiver. It will be remembered that these variations exist in the form of alternations of amplitude. But amplitude is a measure of the amount of energy contained in the ether vibrations, so that when they impinge upon the receiving-device, instead of creating a steady current in the associated circuit, currents of varying strengths are set up corresponding to the varying amounts of energy (*i.e.*, wave amplitude) received. These varying currents, passing around the magnets of a pair of phones, operate upon the telephone diaphragm to pull it with varying degrees of force, and thereby set it vibrating in such form as to reproduce the exact variations that caused the initial disturbance to the state of electric equilibrium at the transmitting end (*i.e.*, speech into the microphone). These disturbances are in turn communicated to the adjacent layers of air and so reach the ear as speech.

And thus distance is annihilated and the apparently impossible converted into an accomplished fact.

DEATH OF SIR WILLIAM CROOKES

It is with great regret that we record the death at the age of 86 of Sir Wm. Crookes, O.M., F.R.S., which occurred on April 4th at his residence in London. This great man who was born in London in 1832, and who has left an indelible mark upon every department of science in which he engaged, was first and foremost a chemist. After working under Hofmann he became in 1834 the superintendent of the meteorological branch of the Radcliffe Observatory, Oxford, and in the following year lecturer in chemistry at Chester Training College. Shortly after this he came to London, where he lived for the remainder of his days. He discovered Thallium, did much valuable work in connection with radioactive substances, founded and edited *The Chemical News*, and published an enormous amount of work relating to chemistry, both pure and applied.

Following up the researches of Plucker and Hittorf on electric discharges through rarefied gases, Crookes propounded the theory, which more recent physics confirms, that cathode rays consist of material particles which are emitted with great velocity in a direction normal to the surface and traced in straight lines, and he stated that their deflection by a magnetic field is owing to the fact that they are negatively charged. Here we have the foundation of the modern electronic theory. The charge carried by a particle of Crookes' "radiant matter" has been measured by Sir J. J. Thomson and is now adopted as a natural electrical unit. A determination of the mass of the particle has shown that the electron is of ultra-atomic dimensions.

Sir Wm. Crookes who received his knighthood in 1897 has been the recipient of almost every honour coveted by men of science. These include the Fellowship of the Royal Society, the Royal Medal, the Davy Medal, the Copley Medal, the Order of Merit and the Albert Medal of the Society of Arts. With his death there has passed one of the few remaining survivors of the band of eminent men who helped to make the Victorian era so serviceable to humanity.

Aircraft Wireless Section

Edited by J. J. Honan (late Lieutenant and Instructor, R.A.F.).

These articles are intended primarily to offer, as simply as possible, some useful information to those to whom wireless sets are but auxiliary "gadgets" in a wider sphere of activity. It is hoped, however, that they may also prove of interest to the wireless worker generally, as illustrating types of instruments that have been specially evolved to meet the specific needs of the Aviator.

AIRCRAFT WIRELESS SETS.

I—The Sterling Transmitter.

GENERAL DESCRIPTION.

THIS little spark set has been without doubt the most widely used of the many service wireless installations during the war. It is a well-designed efficient instrument, very compact, and takes up but little space in the bus.

Diagrammatic sketches of the set are shown in Figs. 1, 2 and 3, the same lettering being used to indicate similar parts in all three diagrams.

The dimensions of the box are roughly 8-in. by 8-in. by 5-in.

On one face is mounted a spiral or helix of metal ribbon forming the closed-circuit inductance, the free end being at the centre. Two leads make adjustable connection with the helix; one F^1 coming from the centre is the closed-circuit tuning-clip; whilst the other K^{11} is the coupling-clip.

The spark gap 3 is housed within the top right-hand side of the box, the width of the gap being adjusted by means of the side screws shown. The make-and-break is arranged just below the spark gap and is also adjustable. This side of the box is hinged so as to allow access to these parts of the set.

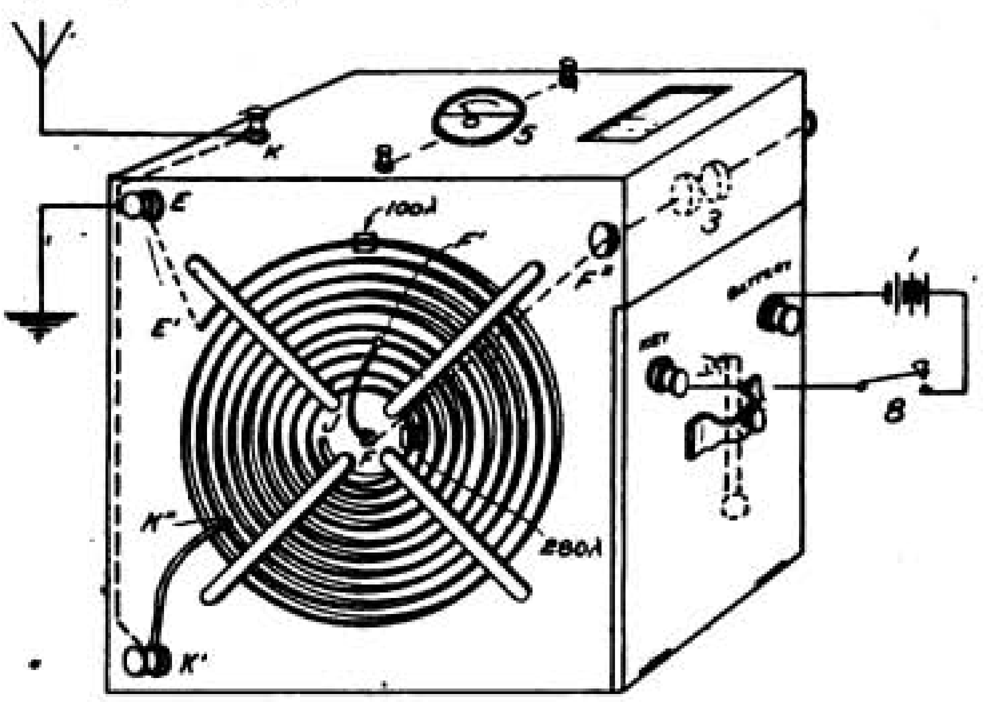


Fig. 1.

On the exterior of the same side are

placed the key and accumulator terminals. A hot-wire ammeter 5 is mounted at the top of the set, and the aerial and earth terminals *E*, *K* are as shown.

The set is essentially for short ranges only. With a crystal detector and fair atmospheric conditions it proved efficient up to 20 miles between plane and earth; but this distance could be considerably increased under conditions more favourable than those of active service, and with a more efficient kind of receiver than a crystal detector.

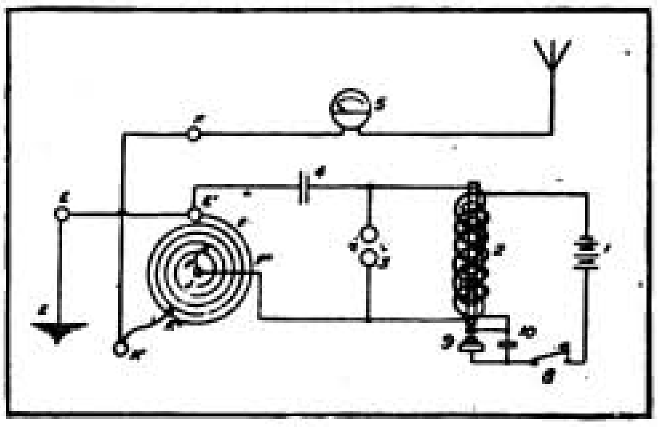


Fig. 2.

In fact, within a specified limit of short-range work it forms a type of transmitter that is capable of very successful adaptation to the wireless needs of commercial flying.

The ordinary service set as illustrated was designed for transmission on wavelengths ranging from 100 to 300 metres.

CIRCUITS.

The transmitter is best considered as consisting of the following simple circuits:—

I—The primary circuit comprises three 2-volt accumulators, the key 8, and primary of the induction coil 2.

II—The secondary circuit comprising the secondary of the induction coil, a part, namely F^1E^1, of the helix inductance, and the condenser 4, which, when it becomes charged from the induction coil to a sufficient voltage breaks down the spark gap 3, thereby forming a *new* circuit viz.:

III—The closed oscillatory circuit consisting simply of the portion F^1 E^1 of the helix inductance and the condenser 4 now connected by the new path opened up through the spark gap. It is in this last circuit that the high-frequency oscillations are first generated. The portion K^{11} E^1 of this circuit is also common to—

IV—The open or radiating circuit, consisting of the aerial *K* hanging down below the bus, the part $K^{11}E^1$ of the helix inductance through which the transfer of energy from circuit III takes place, and the earth lead which connects with the engine and metallic parts of the bus.

ACTION OF THE SET.

The current flowing in the primary circuit is interrupted by the "break" 9, thereby inducing high voltages across the terminals of the secondary winding of the induction coil. These charge up the condenser 4 to a corresponding value, and at the same time are sufficient to break down the dielectric at the spark gap, thereby providing a path for the condenser to discharge through the portion of the inductance F^1E^1 that is included in its circuit. This initial discharge, owing to the "inertia" action of the inductance "overruns" itself and charges up the other plate of the condenser so that the next flow of current is in the opposite sense and so on. The high-frequency oscillation thereby set up continues so long as the persistence of the spark affords a free path for the surging current.

Actually in the set, the current passes and repasses the gap path from 30 to 40 times during the life of each spark.

During the passage of each surge of current through the portion $K^{11}E^1$ of the helix there exists a periodic back e.m.f. due to induction, which is free to act along the condenser circuit formed by the aerial and earth.

This open circuit, being duly tuned to the frequency of the current surges in the closed or spark-gap circuit, reacts readily to the periodic impulses so applied, and a high value of current is rapidly established, oscillating between aerial and earth, and reacting upon the surrounding ether to produce those alternating disturbances of electromagnetic equilibrium which are radiated as ether waves.

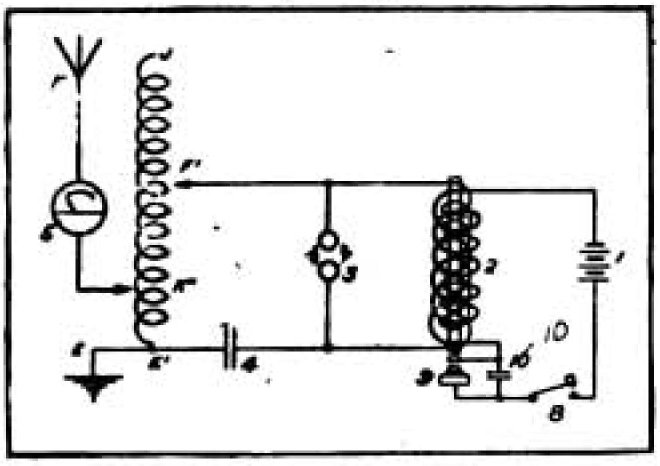


Fig. 3.

TUNING THE CLOSED CIRCUIT.

As will be seen from the diagrams, the open and closed circuits are auto-coupled, the portions $K^{11}E^{1}$ of the spiral inductance being common to both circuits.

The tuning of the closed circuit presents no difficulties. The spiral inductance has been tested and calibrated by the manufacturers, and the tuning-clip F^{1} is therefore simply connected to the helix at the correct position as indicated by the scale.

The fixed condenser in the set under discussion has a value of .0025 mfds., and the variable inductance is so calibrated that the clip when fixed at say 200 metres on the scale thereby determines the L.C. value of the circuit so that it oscillates at the correct frequency to give this wavelength.

The clips used are of the form shown in Fig. 4 and straddle the helix ribbon as indicated. They are somewhat troublesome to manage at first, and are rather liable to become displaced under vibration when in the air, so that it is well to have an eye upon them from time to time.

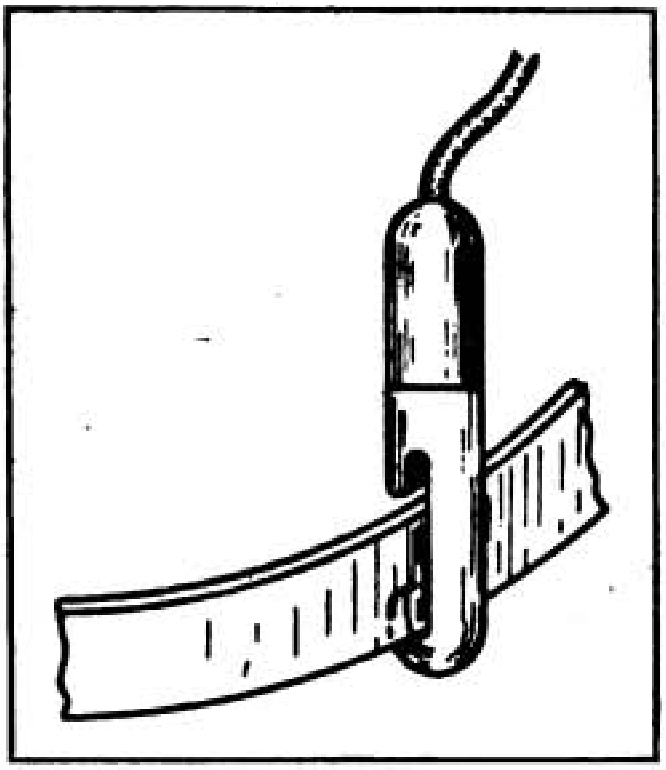


Fig. 4.

(To be continued.)

WIRELESS ON TRAWLERS.

We learn that the demobilisation of mine-sweeping trawlers is duly proceeding, but that whilst the authorities seem to lay no claim to the paint composing the camouflage of these boats, they have dismantled the wireless installations, and the point is raised as to whether it would not be a sound plan to fit a certain number of trawlers in each fleet with wireless so that they could supply the fishermen with information regarding the state of the markets and so on. There is certainly a great deal to be said in favour of this. The country owes the men who work these vessels a heavy debt on account of their great services during the past four years of mine-fishing, and any practicable arrangement making for their convenience and prosperity ought to receive proper consideration.

Aviation Notes.

THE TRANSATLANTIC FLIGHT.

PREPARATIONS for the great attempt are being rapidly pushed forward. The adverse weather conditions of the early Spring will add a further strain to the already severe test of endurance both for pilot and machine, represented by an uninterrupted flight of over two thousand miles even under the most ideal conditions. Nevertheless from the eager spirit of rivalry displayed it appears that the start will not be much longer delayed.

The following is a list of competitors as at present announced:—

TYPE.	H.P.	M.P.H.	PILOT.
Fairey ..	375	120	Mr. S. Pickles
Sopwith ..	320	100	Mr. H. G. Hawker
Whitehead ..	1600	115	Capt. A. Payze
Short	350	95	Maj. J. C. P. Wood
Handley-Page	1600	110	Lt.-Col. Collishaw
Curtis Seaplane	440	—	Capt. H. Sundsted
" "	—	—	Lt.-Com. Bellinger
Martinsyde ..	285	100	Mr. F. Raynham

One of the big Italian Caproni machines will also probably be a starter.

It is understood too that, in spite of reports to the contrary, the R.A.F. intend to try their luck with the giant Porte triplane flying-boat, which is to be shipped to Newfoundland and flown back.

Various routes are favoured by different competitors. The most "sporting" and of course the most risky is the practically straight non-stop flight from St. John's to the South-west of Ireland — approximately 2,000 miles. One alternative is a non-stop run from Newfoundland to the Azores (1,400 miles) and thence via Lisbon (900 miles) to England (1,000 miles). Another suggestion is to take a more Northernly path with breaks at Greenland and Iceland. One pilot—Major Wood—proposes to make the passage Westwards, starting from Limerick.

All the machines will of course be fitted with wireless sets and most of them will depend to a large extent upon direction-finding wireless in steering their course, obtaining their bearings in this way from "beacon" ships located at intervals *en route*. This will enable them to compensate for "drift" more accurately than is possible by any other known means—particularly over the sea where "landmarks" are very few and far between.

Possibly in our next issue we may be able to acclaim the winner; and within a few years—without detracting one iota from the initiative and pluck of the present pioneers—it will probably become our habit to regard the feat as a commonplace and everyday occurrence.

THE CONTROL OF CIVIL AVIATION.

Now that Major-General Sir F. H. Sykes has been appointed Comptroller-General of Civil Aviation we may shortly expect to be informed as to the general line of policy to be taken by the new Department.

No doubt this will fall roughly under three main headings:—

(1) Planning the main arteries of aerial traffic, and arranging questions of international policy to the best mutual advantage.

(2) Setting up the necessary chain of aerodromes and meteorological and wireless stations—*and staffing them!*

(3) Drafting a code of air laws to govern the conduct and procedure of aerial traffic generally.

Divisions (2) and (3) involve many points of interest to those who follow wireless as a career. For one thing it is practically certain that all aircraft will be compelled to carry wireless installations, not only for their own protection in cases of emergency, but also for purposes of control by the Customs, Police, and other authorities.

It is already the law at sea, and there is even more necessity in the case of aircraft.

This, in combination with the necessary co-operating land and sea wireless stations, opens up for the future a considerable field of activity and scope for the wireless engineer and operator.

NAVIGATION BY DIRECTION-FINDING APPARATUS.

A considerable amount of misconception still exists as to the precise value of D.F. sets as a means of locating positions in the air.

There are two principal ways of using the radiogoniometer or direction-analyzing receiver.

The first is to instal it on land and use it to analyze the direction of origin of signals transmitted from a plane—in other words to find the "bearings" of the plane from the receiving station. The station then transmits this information back to the lost wanderer. If this is done by two land stations whose location is known by their code call, the pilot can by means of his chart rapidly re-locate himself with sufficient accuracy.

This method has the advantage that the analyzing work of the radiogoniometer is done on land and under the most favourable conditions for ensuring the greatest sensitivity and accuracy. The drawback is that the range of usefulness is limited by the *transmitting range of the plane* which at present is relatively restricted.

In the other arrangement the radiogoniometer is installed in the plane and may be "swung" to take the bearings of high-powered land stations such as Poldhu and the Eiffel Tower.

Even with the unfavourable conditions existing in the air—so far as receiving is concerned—the range of usefulness with the latter arrangement is many times greater than with the first. Magneto-noise trouble has practically been eliminated, the cascade-valve sets give remarkable sensitivity, and the calculations necessary to interpret the bearings are reduced by specially-prepared charts to a mental level but little removed from that involved in calculating how many beans make five.

The latter point may have some soothing effect on those who find a nervous pleasure in "crabbing" anything that smells of wireless on the excuse that it introduces unnecessary and wearisome complications to the business of flying.

RADIOPHONES OVER LONDON.

The daily newspapers created a considerable stir about the middle of last month over a little practical illustration of the possibilities of wireless telephony from the air.

The occasion arose from the visit of a flight of planes fitted with telephony sets, and their indulgence in pleasant converse whilst manœuvring over the precincts of Leicester Square.

This was duly appreciated by the operators at the various Government wireless stations in and about town, who promptly "tuned in" and listened.

It was by no means the first event of the kind, but apparently Fleet Street was let into the game on this occasion and made hay accordingly. So now we know that it *can* be done, and that the peevish language and hiatused Limericks that have, from time to time, filtered through our phones when up aloft were *not* the psychic voices of aerial spooks, nor yet the creations of an over-ripe imagination.

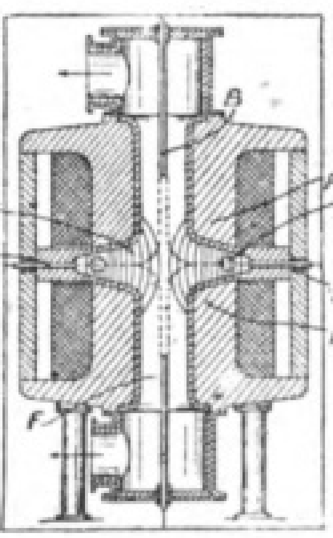
The departure from the precise phraseology set out in the official "book of words" supplied for the guidance of transmitters must be attributed to some obscure ether-wave reaction not subject to the penalties laid down in King's Regulations.

Patent Section

Under this heading will be printed each month abridgments from the Illustrated Official Journal (Patents) of wireless patents recently published.

122,173. Electric currents, generating electric furnaces. Petersen, C. 25, Bogstadveien, Christiania. December 30th, 1918, No. 21811. Convention date, January 8th. Not yet accepted. Abridged as open to inspection under Section 91 of the Act. (Classes 1 (ii) 35, 39 (iii) and 40 (v).)

Current is generated by forcing gases to rotate in a magnetic field, and may be utilized externally or may effect reactions in the gases. Oscillatory currents for wireless signalling and the like, may be produced. As shown, the gas is blown into a circular chamber *K* through tangential inlets *D*, and escapes by one or two axially-arranged passages *F*, the gas currents may, however, be reversed in direction Pole-pieces *P*, P^1 of an electro-magnet are situated on opposite sides of the chamber. Radial electrodes *A*, or an annular electrode, and axial electrodes *B*, which may be in contact, are provided; the walls of the chamber may also form an electrode. The negative electrodes emit ultra-violet rays under the action of ionic bombardment, thus promoting ionization. Initial ionization may be effected by quartz lamps emitting ultra-violet rays; or the electrodes may be initially or continually supplied with high-pressure current. By the use of an alternating magnetic field, or of a multipolar arrangement, alternating current may be obtained. The chamber may be higher and the field radial; a central iron block may be provided. If gas reactions are to be effected, electrodes may be dispensed with, or employed as auxiliaries only. The gases may be air, steam, or combustion products. The pressure for forcing them into the chamber may be produced by combustion of coal gas, oil, or the like in a closed vessel; or combustion may take place in the chamber itself. For producing nitrogen oxides the gas may contain



an excess of air, or the oxygen may be obtained by decomposition of the carbonic acid or steam. The combustion air and fuel may be pre-heated by the gaseous products, and the air may be led around the apparatus. Most of the heat of combustion may be used for raising steam, burning tiles, and other purposes. Ammonia may be prepared from a mixture of steam and combustion gases. The electric current obtained may be used for magnetization and for compressing the gases.—*Illustrated Official Journal (Patents)*.

The Construction of Amateur Wireless Apparatus

This series of Articles, the first of which was published in our April number, is designed to give practical instruction in the manufacture of amateur installations and apparatus. In the following article the author deals with the important question of insulation. The Wireless Press, Ltd., has arranged with Marconi's Wireless Telegraph Co., Ltd., to supply complete apparatus to the designs here given, as soon as Amateur restrictions are released.

Article Two: Insulation and Insulators.

IN the last article we indicated broadly to the amateur the lines along which he should proceed when laying his plans for the erection of an aerial and the construction of an earth system. Before going into detailed arrangements of masts and aerials we propose to make a few remarks on the materials of construction employed in a station.

Insulating materials play a large part in both receiving and transmitting stations and their correct use is necessary for efficiency's sake. In a wireless station insulation is used for such widely different purposes as supporting an aerial and to form the dielectric of a condenser. In the first case the insulation is exposed to the action of weather, etc., whereas in the second it is completely protected. It will then be most convenient to classify insulators according to the purpose for which they are to be used.

It must be borne in mind that the insulation of the component parts of an oscillatory circuit must always be of the very highest order. Insulation which would be quite good enough for ordinary purposes, such as lighting circuits and bell installations, is not suitable for a transmitter or receiver for wireless telegraphy. Bad insulation of an oscillatory circuit is followed by reduced efficiency. In a receiver this results in weakening of signals; in a transmitter loss of power; and if spark waves are being emitted an unduly high damping. The three main questions of insulation are (1) The aerial, (2) Leading-in insulator, (3) Insulation of instruments. In the last class we include all the component parts of a transmitter and receiver.

Aerial Insulation. Undoubtedly the best material for all outside work is glazed porcelain. The desiderata of an aerial insulator are that it should have a good mechanical strength and that it should be unaffected by weather. Glazed porcelain fulfils both these conditions. Many types of insulators may be purchased which are constructed from insulating compounds moulded into various shapes. All of these suffer from the disadvantage that the surface of the material deteriorates under the action of weather. This weathering action is most important. Nearly all the conductivity of an insulator is due to faulty surface. The point is well illustrated in the behaviour of an ebonite insulator employed out of doors. Ebonite, under the influence of sunlight, undergoes a chemical change on its surface, resulting in the liberation of free sulphur. If a piece of ebonite be left exposed to sun and rain for a few days this effect can be easily observed; the surface will change to a greenish-yellow colour in place of the dead black of clean ebonite. This liberated sulphur, in contact with moisture and the oxygen in the air becomes oxidised to sulphurous and sulphuric acids, with the result that a conducting layer is formed and the insulation resistance of the insulator as a whole is lowered. This explains why an aerial suspended from ebonite insulators has a better insulation resistance after a shower of rain. The rain washes the surface of the ebonite and so removes some of the conducting acids which have formed. It will, therefore, be obvious that any articles made of ebonite should always be protected from direct sunlight and damp. For this reason ebonite has been abandoned for aerial insulation. Rubber suffers from the same disadvantage to a lesser degree, but possesses the important quality of flexibility and is not fragile like ebonite. Rubber "strop" insulators are consequently largely used for ship work, but it is necessary to keep the surface of the insulator covered with some inert insulating coating to protect it from the weather. A varnish having bitumen as a base is generally used.

The aerial insulator the amateur uses should therefore be either porcelain or rubber. Porcelain rod insulators made specially for aerial work can be purchased in various sizes. Such an insulator is shown in Fig. 1. It simply consists of a straight rod of porcelain with

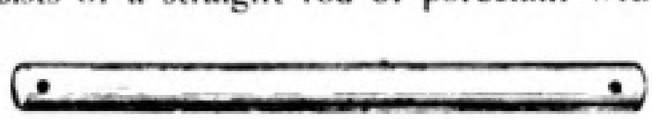


Fig. 1.

a hole at each end. These insulators are everlasting and strong and are recommended. Care should be taken when hoisting the aerial, as, of course, they are brittle, but once the aerial is aloft and the insulators are consequently under only tensile stress they will be found strong and durable. For a portable station the rubber "strop" insulators shown in Fig. 2 should be used. These are specially moulded with a fibrous core

Fig. 2.

to give strength. Eyes are fitted at each end for attachment. These insulators are the only ones suitable for aerials which are constantly being erected and dismantled—any ordinary pattern would soon be broken in the process. Under these conditions it is not necessary to treat the surface of the insulator with any protecting varnish, as the aerial is never exposed for a long enough period for weathering to occur.

Excellent aerial insulators can also be made by stringing a series of porcelain "reel" insulators together. The reels are made in various sizes and patterns, that shown in Fig. 3

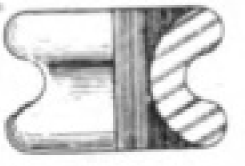


Fig. 3.

being a suitable type. The advantage of this method lies in the fact that the wire loops used for making the chain can be passed one round the groove of the reel and the next through the hole in the centre; so that a chain is produced which does not let down the aerial should a reel be broken. The wire loops being interlocked, the chain simply loses an insulator and becomes a little longer when such a breakage occurs. This type of insulation is strongly recommended whenever the aerial is erected above telegraph or telephone wires, as fouling will not occur should an insulator break. The number of reels to employ in each string depends on their size and design, five ordinary reels about $2\frac{1}{2}$ inches in diameter will generally be found sufficient for a transmitting aerial and two for a receiving aerial. The numbers, of course, refer to the reels per chain insulator. It is obvious that in order to obtain the highest insulation, such as that given by the porcelain rods before-mentioned, a considerable number of reels per chain would have to be used; this makes the chains long and cumbersome and also reduces the height of the aerial. Readers are therefore advised only to employ this type of insulator when necessary for safety's sake.

Leading-in Insulator. The correct function of a leading-in insulator is to insulate the bare aerial lead from the wall through which it passes into the wireless room, and *not* to take the pull of the aerial down lead. The down lead should be strained to an insulator attached to some fixed point, such as a stake in the ground or a strong hook driven into the wall of the building, and the end of the aerial wire or wires should be led quite loosely through the leading-in insulator to the wireless room. The method is shown in Fig. 4. Of course, the "no joints" principle must be adhered to, the wire not being made off at the straining insulator but passed through the hole

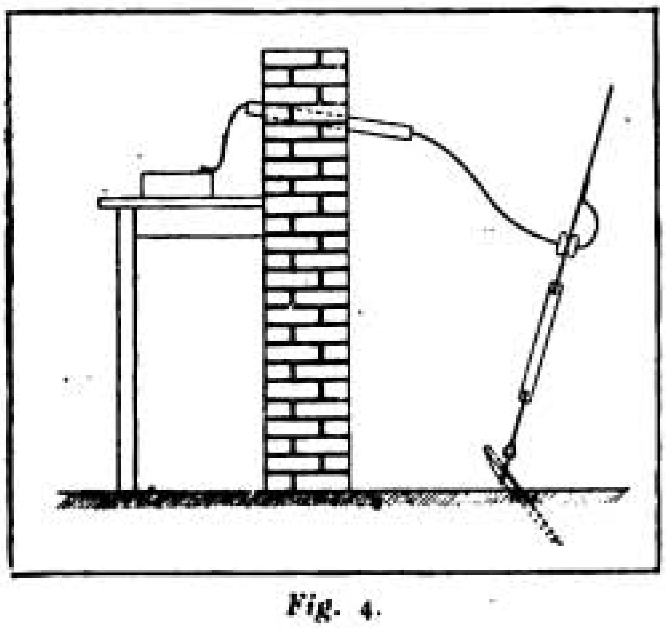


Fig. 4.

and whipped with soft copper wire. For all aerial work No. 20 soft copper will be found most suitable for whipping loops and eyes. By employing this method we are enabled to use a simple porcelain tube for leading-in. These tubes are made in various lengths up to about 36 inches long, a suitable diameter (outside) being about 1 inch or $1\frac{1}{4}$ inches. They may be either straight or may be curved over at the end. When the latter type is employed the curved end should be on the outside of the building and the tube should be fixed so that the mouth is downwards to prevent rain entering the building. In general, the straight tube will be found to meet all requirements. A cork in the outside end, with a central hole for the passage of the wire, will keep out the wet. The tube should project at least one foot clear of all roof drips on the outside and about 3 or 4 inches inside. No special holding arrangements are necessary. A hole into which the tube will fit tightly in a window frame or the wall of a wooden building is sufficient as there is no mechanical stress on the insulator. For leading through a brick building the tube may be cemented into a hole drilled through the wall.

Insulating materials for the construction of apparatus. (*a*) *Formers for coils.*—Undoubtedly the best material to employ for tubes and formers for inductance coils is the best quality ebonite. It has the advantage of being an insulator of a high order and at the same time is good material to work and is everlasting. Ebonite formers are used for the coils of the best receivers produced commercially. Of course, the remarks we have just made with reference to the deterioration of this material do not apply when the ebonite is used for the construction of instruments. Nevertheless, even indoors, apparatus made of the material should not be left exposed to direct sunlight for long periods.

There are many patent insulating materials sold for wireless purposes, nearly all these fall short of ebonite in some respect or other; consequently we advise the amateur who wishes to do the very best work to use it for all instrument work.

There is one point in this connection to which we would draw the reader's attention. It is found in practice that the operations of moulding ebonite articles, such as tubes, etc., results in the formation of a thin skin on the surface of the material which has a lower insulation resistance than the main body. This fact is of importance in several directions. For example, an inductance coil wound on a cylindrical former which has a more or less conducting surface, must have unnecessarily high losses in it when a high frequency current is flowing through the winding. Consequently, it is always necessary, before using commercial ebonite, to make sure that this conducting skin is not present. A simple test to enable the experimenter to settle this point is shown in Fig. 5. It simply consists in winding a few turns of copper wire on the article (a cylindrical former is shown in the figure) in two sections; the sections being each connected to the terminals of a spark coil. The distance between the nearest turns of the two windings is chosen somewhat greater than the spark length of the induction coil. If then, on working the coil a series of sparks are seen to jump over the surface of the ebonite we may be sure of the existence of the conductive skin. Of course, care must be taken, before the test is made, to see that the surface is perfectly dry and clean or a false result will be obtained. The amateur can easily modify the experiment himself in order to apply it to any moulded article of irregular shape. When the conductive surface is found to exist the skin of the material must be removed before it is used in the construction of any apparatus. This can be done by careful scraping or by rubbing down with first coarse and then fine glass-paper.

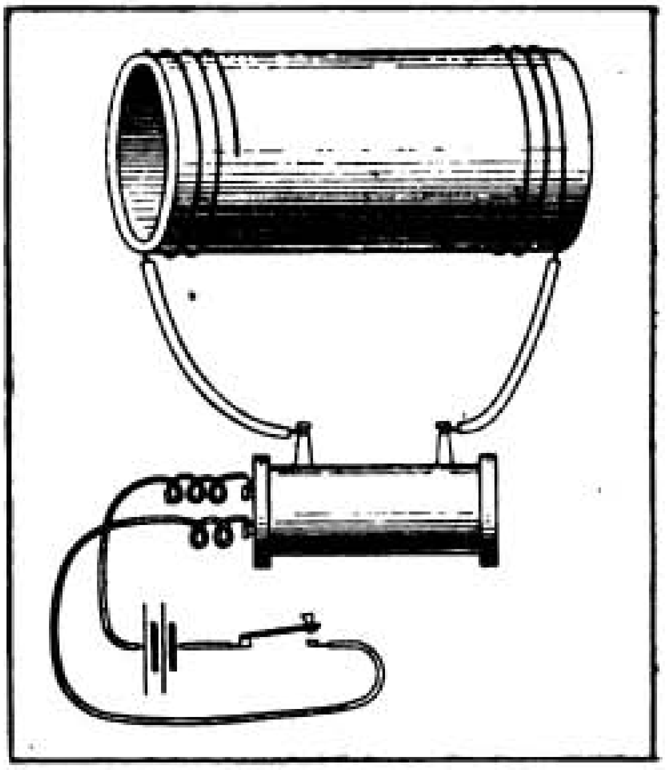


Fig. 5.

Many amateur wireless telegraphists will, no doubt, not wish to go to the expense of using ebonite for their instruments. Quite good results can be obtained from inductances wound on formers of paraffined cardboard.

The two main points to observe are: (*a*) the cardboard *must* be clean and dry before impregnation and (*b*) the wax must not be overheated when melting. The tubes, or sheets, of cardboard should be kept in a dry place and it is as well to warm them for a few hours before immersion. The paraffin wax should be of the very best quality and should not be melted over an open flame. Some form of "double boiler" is best for the purpose. A glue-pot serves well for small parts, but the amateur can easily make up a suitable bath for larger tubes and sheets. Thick cardboard, well impregnated, is quite suitable for mounting up receivers. Wood is not recommended, as individual specimens vary so much in insulation resistance.

The Library Table

ELECTRICITY MADE PLAIN. By G. R. PEERS, A.M.I.E.E. London: John Heywood, Ltd. 2s. 6d. net. (2nd edition).

IN this little book the author sets out to explain in a manner suited to the non-scientific reader the various uses of electricity. Such an aim is necessarily very ambitious and covers almost the entire field of industry, yet we are of opinion that it has here been accomplished in a most creditable manner. Chapters 1, 2 and 3 are mainly given over to elementary explanations of electrical theory, whilst the remainder of the book introduces the reader to electricity at work in well-nigh every way of which one can think. Eight-and-a-half pages out of a total of a hundred and thirty-seven are devoted to wireless telegraphy and give a pretty good account of the subject—considering the public for which it is expressly intended. The book concludes with a glossary of electrical terms.

Having in view the author's attainments and the general excellence of this volume it is surprising to find here and there certain imperfections of writing.

On page 5 the author says, "In "dealing with the flow of a current of "electricity, it is necessary to understand "three terms, known as 'Ohms Law,' "which are: Volt, Ohm, Ampere . . ." And in the Glossary the ampere is defined as "One of the three funda- "mental electrical units (upon which all "electrical calculations are based) known "as 'Ohm's Law.'" The definition of Ohms Law itself (p. 137) is not at all happy.

On page 57 we read:—

"In the ordinary electric bell it will "be found that when the armature to "which the hammer is attached to the "magnet, and the bell is ringing, little "electric sparks are produced at the "point of contact, and each of these "sparks is sending out into space electric "waves, which with a sensitive apparatus "for indicating their presence can be "picked up and made use of. Such an "instrument is called a 'detector.'"

On p. 61 it is stated that the Eiffel Tower time signals are sent out at midday. Actually they are transmitted at 10 a.m., 10.44 a.m. to 10.49 a.m. and 11.44 p.m. to 11.49 p.m.

The third paragraph on p. 124 strikes us as inaccurate. Surely in an X-ray tube the electricity passes from kathode to anode, producing X-rays at the latter or at the anti-kathode, and not *vice versa* as stated.

The book is exceedingly well illustrated and well worth its price.

TEMPERATURE CONVERSION TABLE. Cambridge: The Cambridge Scientific Instrument Co., Ltd.

This table, printed in two colours on a stout glazed card 14½-in. by 12-in. takes the form of a spiral curve of four to five turns. On one side of the curve is shown the Fahrenheit scale, ranging from $-460°$ to $3,630°$ by steps of $2°$ and on the other side is the Centigrade scale from $-270°$ to $2,000°$ in steps of $2°$. By this means conversion from one scale to another is reduced to a process of simple inspection. To provide for the conversion of temperature from the Réaumer degrees to both Centigrade and Fahrenheit degrees the necessary formulæ are prominently shown.

The card is a most useful study, laboratory or workshop companion and is issued by the publishers free of charge on receipt of sixpence to cover postage.

Personal Notes

NEW APPOINTMENTS.

Mr. Henry William Allen, F.C.I.S., Director (formerly Secretary) and Mr. William Walter Bradfield, C.B.E., Director (formerly Manager) have been appointed Joint General Managers of Marconi's Wireless Telegraph Company, Ltd., and The Marconi International Marine Communication Co., Ltd. Mr. H. W. Corby, F.C.I.S. (formerly Assistant Secretary) has been appointed Secretary of the Companies.

RETIREMENT OF SIR J. J. THOMSON.

We learn that Sir J. J. Thomson has resigned his position as Professor of Experimental Physics at Cambridge. The Governing Body of the Cavendish Laboratory has appointed Sir Ernest Rutherford to succeed him.

Sir Ernest Rutherford is a New Zealander and was educated at Trinity College, Cambridge. In 1906 on the recommendation of Sir J. J. Thomson he was appointed Professor of Physics at McGill University, Canada. Twelve years later he returned to England to succeed Professor Schuster as Langworthy Professor of Physics at Manchester University.

Sir Ernest Rutherford carried out some important pioneer work to which was due the invention of the famous Marconi magnetic detector.

HONOURED BY THE KING.

From the London *Gazette* we learn that Major and Brevet Lieut.-Colonel (temporary Lieut.-Colonel) Bernard Calwoodley Gardiner, R.M.L.I., Fleet Wireless Officer, has been appointed by the King to be an Additional Member of the Military Division of the Third Class, or Companion of the Most Honourable Order of the Bath.

WIRELESS MAN GAINS AIR SERVICE MEDAL.

Sergt. Observer G. T. Newbold, R.A.F., has been awarded the Air Service Medal much to the gratification of his many friends. Sergt. Observer Newbold joined the R.N.A.S. as a wireless operator in June, 1916, being at first attached to the seaplane base in the Scilly Isles. From January, 1917, until January of this year he was engaged on flying duties, either searching for submarines, or as a member of escorting convoys to vessels in the English Channel or the Atlantic.

AIRCRAFT EXHIBITION FATALITY.

At Newcastle on the 26th of March the Coroner held an inquest on Lieut. Frederick Fenwick, test pilot, of Newcastle, and John Henry Underwood, air mechanic and wireless operator, of Dorset, who were killed at the Aircraft Exhibition owing to a mishap to their machine in mid air. After having heard the evidence the jury brought in a verdict of "accidental death." Evidence showed that the accident was caused by one of the wings of the aeroplane coming in contact when at a height of about 1,000 feet with the wire detention cables of a kite balloon.

Company Notes

REPORT OF THE DIRECTORS OF THE MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA

To the Stockholders:

The Directors of the Marconi Wireless Telegraph Company of America respectfully submit herewith balance sheet, profit and loss account, and a summary of operations for the year ended December 31st, 1918, as certified to by Arthur Young & Company, Certified Public Accountants.

The operations for the fiscal year show, before allowing for Reserves, a net income of $998,358.14 as compared with $780,592.44 for the year 1917.

The net profits for the year, after utilizing $286,516.37 for Reserves, amounted to $711,841.77 as against $617,772.69 in 1917, or an increase of 15.23 per cent. This amount has been added to the Surplus, increasing that account, after payment of $499,975.00—1918 Dividend—to $1,631,415.78 at December 31st, 1918, and the Reserves set aside at that date for depreciation amount to $629,176.27 additional.

Your Directors are pleased to call attention to the dividend of 5 per cent. per annum which was paid August 1st, 1918, and to the declaration of another dividend of 5 per cent. per annum payable on July 1st, 1919, to stockholders of record June 1st, 1919.

Your company continued in 1918 its whole-hearted efforts to co-operate with the Government in every way possible, in the conduct of the war.

Of approximately twelve hundred male employees on its roll, four hundred and fifty-six were numbered in the stars of its service flag, and seven were called upon to make the supreme sacrifice for their country.

Official recognition of your company's war service was expressed by Commander S. C. Hooper, of the Navy Department, on December 13th, in his testimony at the hearings before the House Committee on Merchant Marine and Fisheries on the bill providing for Government ownership of all radio stations. He said: (*Here follows an extract from Commander Hooper's speech in which he pays a tribute to the fine co-operation of the American radio manufacturers, inventors and amateurs with the Navy Department when the United States entered the war, mentioning specially Mr. E. J. Nally, the Vice-President and General Manager of the Marconi Company.*)

But, notwithstanding these fair words from its representative, the Navy Department never for a moment departed from its original desire to monopolize the radio business. Shortly after the signing of the armistice, it caused to be introduced in Congress, for the third successive time, a bill providing for Government ownership and operation of all wireless stations. This bill, known as H.R. 13,159, was considered by the Committee on the Merchant Marine and Fisheries, House of Representatives, at public hearings from December 12th to 19th. On January 16th, this Committee decided, by unanimous vote, to table the bill, and it is believed that no further attempt will be made to introduce similar legislation during the present session.

This danger, however, is by no means permanently ended, and every stockholder should remain on the alert and should promptly protest to his representative in Congress whenever any new attempt is made to pass measures calculated to destroy the business of your company.

The following pages taken from the "Hearings before the Committee on the Merchant Marine and Fisheries, House of Representatives" contain the arguments made by your officers at the hearings referred to, and will repay your careful reading.

For the Directors,

John W. Griggs, *President.*

MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA.

Balance Sheet as at December 31, 1918.

ASSETS

Current Assets:			
Cash—			
At Banks and on Hand	$140,489.20		
Collateral Call Loans	100,000.00		
		$ 240,489.20	
Accounts Receivable (less Reserve)		1,620,391.76	
Investments at Cost (Market Value December 31, $2,928,964.75)		2,989,316.97	
Inventories at Cost		1,008,106.42	
Total Current Assets and Investments			$5,858,304.35
Stocks in Subsidiary Companies			548,000.00
Fixed Assets:			
High Power Stations		$4,376,547.07	
Ship Stations		202,888.80	
Other Real Estate, Buildings and Machinery		232,784.55	
			4,812,220.42
Deferred Charges			20,178.92
Patents, Patent Rights and Goodwill			2,082,467.80
			$13,321,171.49

LIABILITIES AND CAPITAL

Current Liabilities:			
Accounts Payable		$ 521,180.40	
Time and Demand Loans		190,500.00	
Total Current Liabilities			$ 711,680.40
Deferred Liability to Affiliated Company			349,399.04
Capital Stock:			
Authorized and Issued—			
2,000,000 Shares of $5 each		$10,000,000.00	
Less: In Treasury		500.00	
			9,999,500.00
Reserves for Depreciation and Obsolescence, etc.:			
Of Ship Stations—			
As at January 1, 1918	$ 91,333.26		
Less: Amount utilized during 1918	57,000.00		
	$ 34,333.26		
Add: Amount set aside from 1918 Profits	20,288.88		
		$ 54,622.14	
Of High Power Stations—			
As at January 1, 1918	$ 87,470.64		
Add: Amount set aside from 1918 Profits	172,506.65		
		259,977.29	
Against Expiration of Patents—			
As at January 1, 1918	$200,000.00		
Add: Amount set aside from 1918 Profits	100,000.00		
		300,000.00	
Miscellaneous:			
As at January 1, 1918	$ 12,719.17		
Less: Amount utilized during 1918	1,651.52		
	$ 11,067.65		
Add: Amount set aside from 1918 Profits	3,509.19		
		14,576.84	
			629,176.27
Surplus:			
Balance per Certified Accounts, January 1, 1918		$1,419,549.01	
Add: Net Income for year ended December 31, 1918, after charging $286,516.37 Reserves		711,841.77	
		$2,131,390.78	
Less: Dividend paid in 1918		499,975.00	
			1,631,415.78
			$13,321,171.49

New York, February 19, 1919. We have examined the accounts and records of Marconi Wireless Telegraph Company of America, and have prepared therefrom the above Balance Sheet and accompanying Summary of Operation for the year 1918. These in our opinion correctly set forth the financial position of the Company at December 31, 1918, and its operations for the year ended that date.

Arthur Young & Co.,
Certified Public Accountants.

Questions and Answers

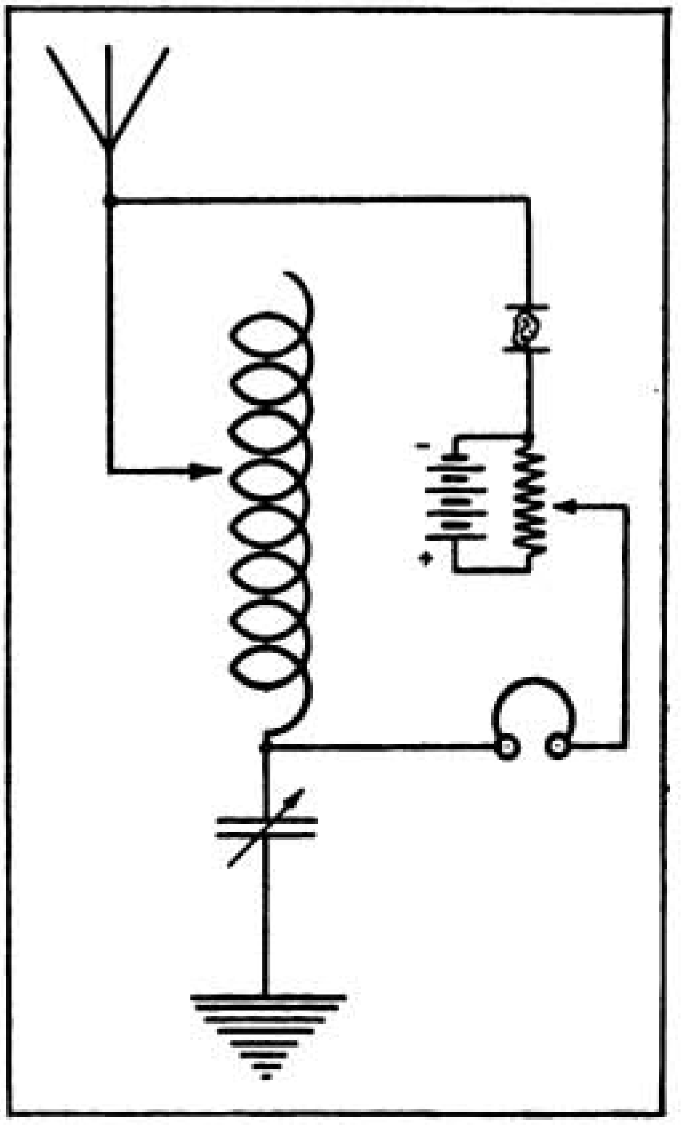
NOTE.—*This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless telegraphy. Readers should comply with the following rules: (1) Questions should be numbered and written on one side of the paper only, and should not exceed four in number. (2) Queries should be clear and concise. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (4) The Editor cannot undertake to reply to queries by post. (5) 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." (6) Will readers please note that as amateurs they may not at present buy, construct or use apparatus for wireless telegraphy or telephony. (7) Readers desirous of knowing the conditions of service, etc., for wireless operators, will save time by writing direct to the various firms employing operators.*

CAPT. DE LA R. (Paris).—Asks several questions about valve circuits. As these questions are of general interest to our readers we have reproduced the diagrams in full.

Question A.—If all the circuits Nos. 1, 2, 3 and 4 work under exactly similar conditions, how would they compare for sensitiveness and strength of signals. The crystal used in No. 1 Circuit is a good carborundum crystal?

Answer.—Comparing circuits 1 and 2, the strength of signals received by circuit 2 will depend on whether they are strong signals or weak signals when received on circuit 1. If the signals are very weak then it is quite possible that the average increase of the current in the plate circuit, due to the positive half of the received oscillations is the same as the average decrease in the plate current due to the negative half of the received oscillations. In such a case therefore the average current flowing through the telephones will be zero. If, however, the signals are sufficiently strong a rectified current will flow in the plate circuit. Assuming that exactly the same amount of energy is received by each aerial of circuits 1 and 2, and is sufficient to give readable signals on circuit 1, stronger signals would be produced by circuit 2 owing to the fact that practically no energy is taken from the aerial circuit, as in the case of the crystal detector.

In circuit 3, an inductance coil and tuning condenser is added to the plate circuit, a rectifying crystal being connected across the condenser. There is now no necessity to rectify the incoming oscillations by means of the valve, and therefore the initial potential of the grid can be adjusted to such a value that for a given variation in the grid potential, due to the received oscillations, the greatest variation in the plate current is produced. By the use



No. 1.

of this circuit it is easy to receive signals that would be quite inaudible if received on a crystal circuit.

In circuit 4, we have the same circuit as in 3 but with the addition of an extra inductance coil in the plate circuit. By the introduction of this coil, the oscillations in the plate circuit are made to help the oscillations in the grid circuit, which in turn strengthen the oscillations in the plate circuit. When a valve circuit contains a reaction coil in the plate circuit, the

WHY YOU WILL BECOME A PELMANIST

SIMPLE FACTS AND THEIR MORAL.

EVENTUALLY you will become a Pelmanist. It may not be soon; it may be weeks or even months hence; but sooner or later you will enrol for the study of Pelmanism because you will be convinced that it is essential to your welfare.

You will have read the tributes paid to Pelmanism by distinguished men in every sphere of activity and the recommendations made by a great part of the Press. You will have read the personal testimony to Pelmanism by students of the System. You will perhaps have seen the effects of Pelmanising on people of your own acquaintance; but you will not be wholly convinced that Pelmanism is a necessity to you until you have written a postcard to the Pelman Institute and received the literature which is published on the subject and freely offered to the public.

Then the conquest of your indifference will begin, because you will come to a complete knowledge of what Pelmanism is and what Pelmanism does. You will not be left with a shadow of a doubt as to its surpassing value in your own case. You will realise that your mind is just as amenable to discipline and exercise as are your muscles. And you will further come to an understanding of the fact that the human mind—your mind—is even more *pliant* than human muscle—that mental exercise is immeasurably more resultful than physical exercise.

When you have appreciated this you will lose very little time in enrolling as a Pelmanist. Your erstwhile indifference will have given place to absorbed interest and keen enthusiasm, and you will be impatient for the arrival of the first of the wonderful "little grey books" that so surely smooth away the rough places on the path to prosperity and success. The first lessons and exercises of Pelmanism will open out to your mind's eye a new vista of possibilities. You will gain a new conception of your place in the world. You will see what you have missed and foresee what you can gain.

You will heartily endorse the popular verdict on Pelmanism; the odds are that after the first lesson you will yourself be bearing testimony to the System and agreeing heartily that Pelman indeed does "enlighten understanding."

And then, later, as the beneficial influence of Pelmanism makes itself felt, you will report that you have obtained all that you sought from it, and much more.

And in this you will be in no way unique, for it is all but a brief record of the Pelmanic progress of thousands—ay, hundreds of thousands—of other men and women. But *you* must make the first move. Pelmanism is never forced upon anyone. It is never canvassed nor is a single worrying letter sent after the literature on Pelmanism is once delivered. You become a Pelmanist of your own free will. There are few Pelmanists who do not bless the postcard that expressed their will to know more about this wonderful System that the Public, the Press, and leaders of thought throughout the nation are unanimous in acclaiming as the very keynote of "success in industrial business, social or professional life."

CONSIDER THESE POINTS.

There is no parallel to the amazing success of Pelmanism amongst all classes; and every month every week, its success and popularity increase.

It is perfectly simple and easy to master, takes but very little time, and can be studied anywhere. Being taught entirely by correspondence, it does not matter where you live. Many successful Pelmanists took up the Course when living overseas in remote corners of the Empire.

It has now been adopted by over 400,000 men and women, *and no thorough student of the Course has ever yet failed to secure "results."*

INTERESTING LETTERS.

From a Director.

I consider the Pelman Course is of the utmost value. It teaches one how to observe and to think in the right way, which few realise who have not studied it. The great charm to me was the realization of greater power; power to train oneself for more and more efficiency. I gained from each lesson right up to the end of the Course.

From a Clerk.

Looking back over the time since I first enrolled for the Course, I marvel at the changed outlook and wide sphere which it opened out to me. The personal benefits are a great increase of self-confidence and a thousandfold better memory. If only the public *knew* your Course I am sure your offices would be literally besieged with prospective students.

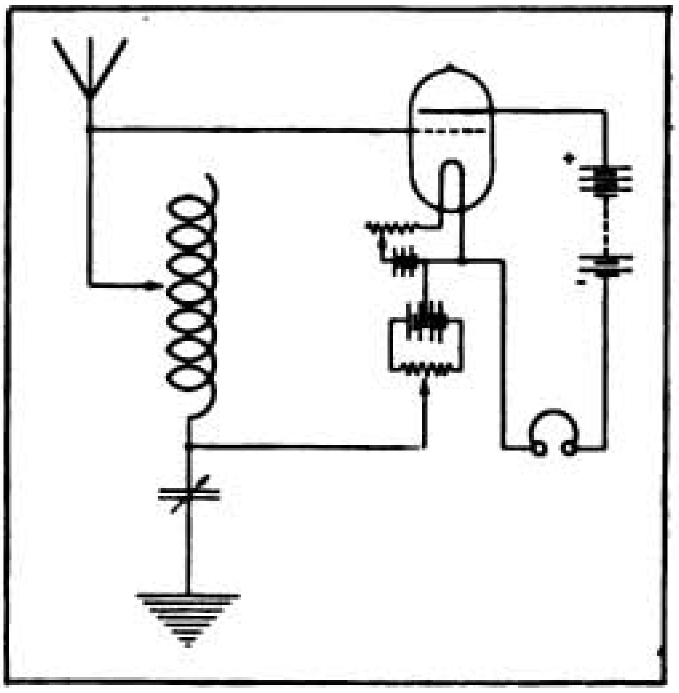
From a Works Manager.

Your system has certainly been of great assistance to me in a variety of ways. Up to recently I was works manager for a big firm of yarn spinners, but have now attained the position of right-hand man to the owners, being removed from the executive to the administrative side of the business.

From a Bank Cashier.

I have much pleasure in testifying to the practical value of the Pelman System as a means of developing one's mental powers. My chief regret is that I did not take the Course years ago. I have found the training of great value in clearness of mental vision, quickness of decision, and greater self-confidence. The outlay is quite nominal compared with the great advantages attained.

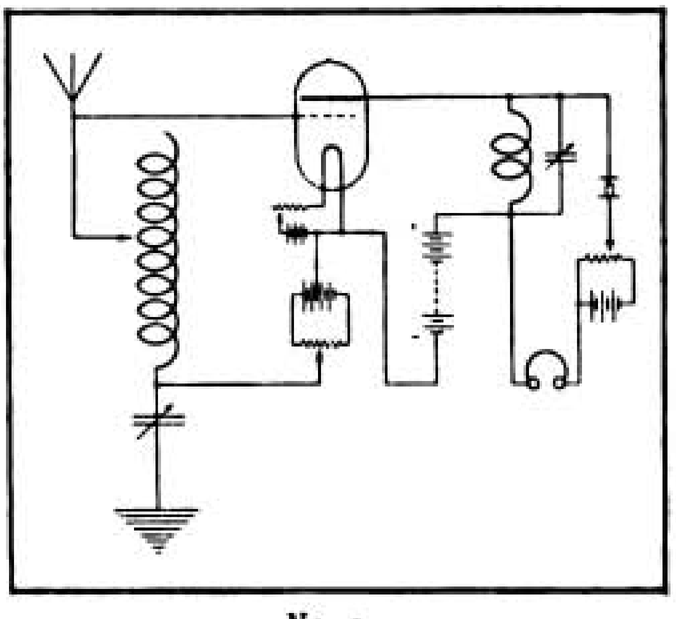
"Mind and Memory" (in which the Pelman Course is fully described, with a Synopsis of the lessons) will be sent, gratis and post free, together with a full reprint of "Truth's" famous Report on the Pelman System and a form entitling readers of "The Wireless World" to the complete Course at a reduced fee, on application to the Pelman Institute, 145, Pelman House, Bloomsbury Street, London, W.C. 1.



No. 2.

strength of the received oscillations can be enormously increased by making the proper adjustments, and very weak signals can be magnified so that they are readable a foot or so away from the telephones.

A valve circuit takes a smaller amount of energy from an aerial than a circuit containing a crystal detector. By means of a reaction coil in the plate circuit it can feed energy back into the aerial circuit, therefore the net result



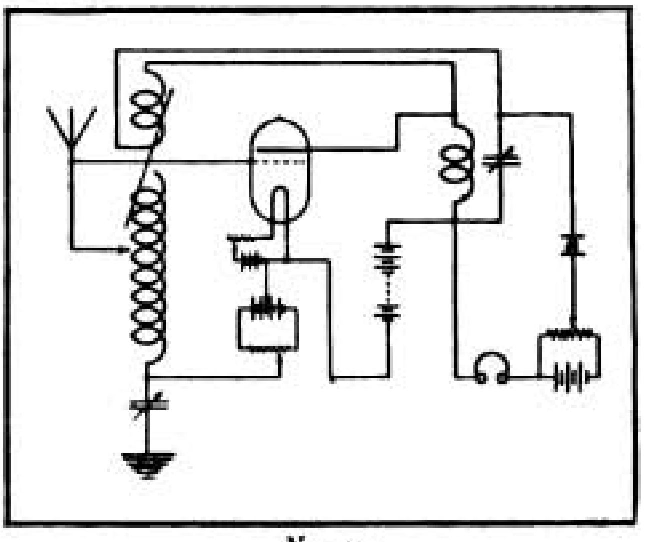
No. 3.

is that the losses in the aerial circuit are greatly reduced, and in fact the damping in the aerial can be made zero. Hence greater selectivity and sensitiveness is obtained with valves.

It is not possible to make any definite statement as to the relative magnifications of the circuits as so much depends on the efficiency of the valves and the conditions under which they are used.

Question B.—Looking at circuits 3 and 4 is it better when using a carborundum crystal and valve, to rectify first with the crystal and then amplify with the valve, or *vice versa?*

Answer.—The practice of the Marconi Co. is to amplify with the valve and then rectify with the crystal. This method presuppose that the signals to be rectified are of the average strength of signals on a non-magnifying receiver, and hence are suitable for ordinary crystals which are selected for signals of this strength.



No. 4.

Question C.—Could not the grid battery be suppressed as in circuit 5 by combining the grid and filament batteries?

Answer.—Yes. This method is employed by the majority of valve receivers, thereby effecting economy of batteries.

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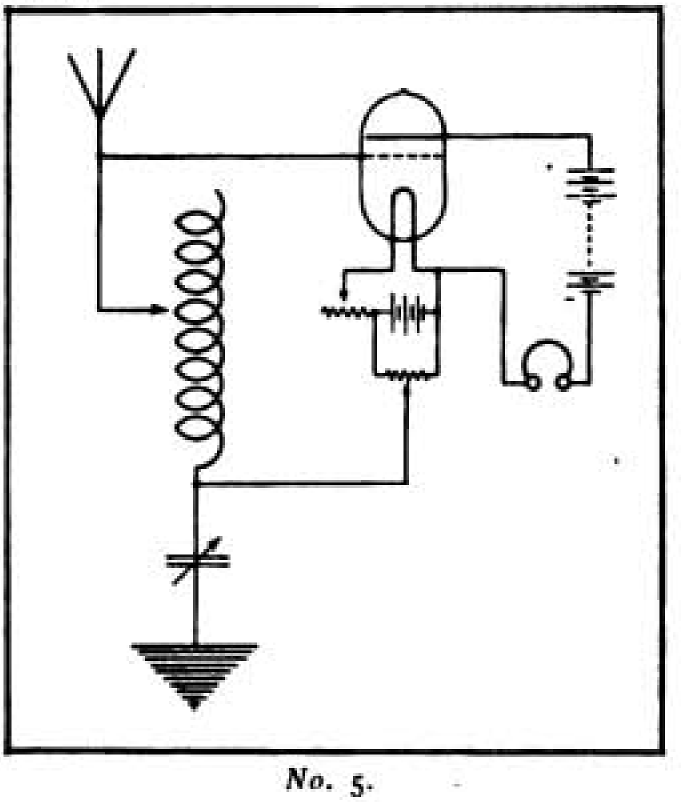
Question D.—Can circuit 6 be used for the reception of spark signals and continuous waves?



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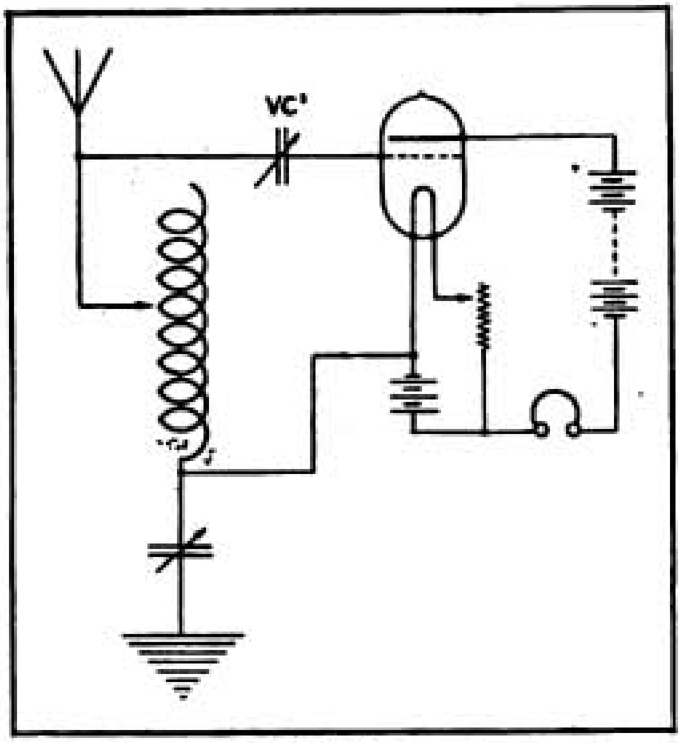
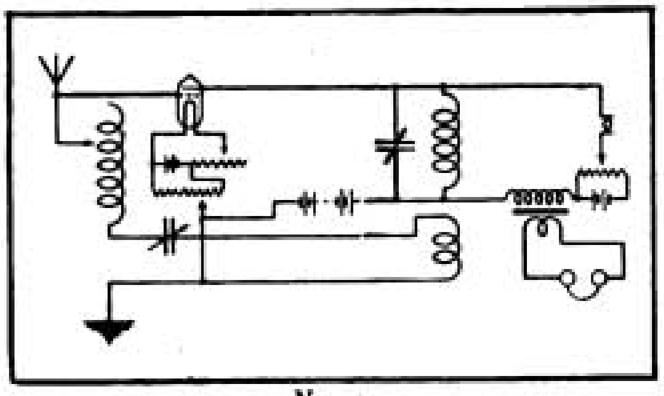


No. 6.

Answer.—This circuit is quite suitable for the reception of spark signals. The insertion of the condenser V.C. in the grid circuit is a common one in a number of American receivers. This condenser stores up the currents which are rectified by the valve. The charge and discharge of this condenser during the reception of incoming oscillations decreases and increases the Plate current at a low audible frequency, the group frequency in fact of the received waves.

This circuit is not suitable for the reception of continuous waves unless some external source of alternating current is made to super-



No. 7.

impose oscillations on the aerial circuit thus giving rise to what is known as "beat" reception.

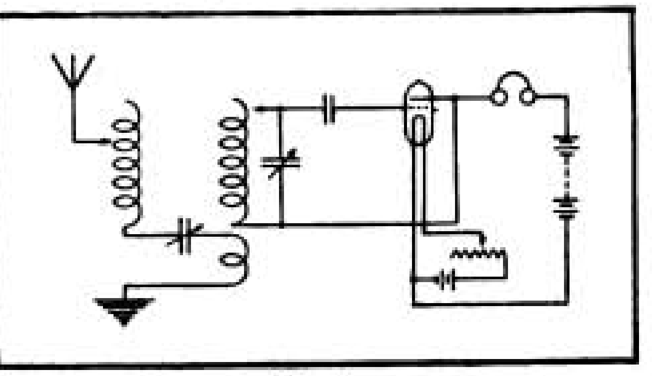
✠ ✠ ✠

Question F.—Would circuit 8 be suitable for the reception of continuous waves?

Answer.—This circuit is not very suitable for the reception of continuous waves. A somewhat similar circuit was used by Dr. de Forest some years ago and since improved. This circuit will only react, thus becoming suitable for the reception of continuous waves, when the aerial and secondary circuits are slightly out of tune. There is, therefore, no control over the frequency of the beats set up.

✠ ✠ ✠

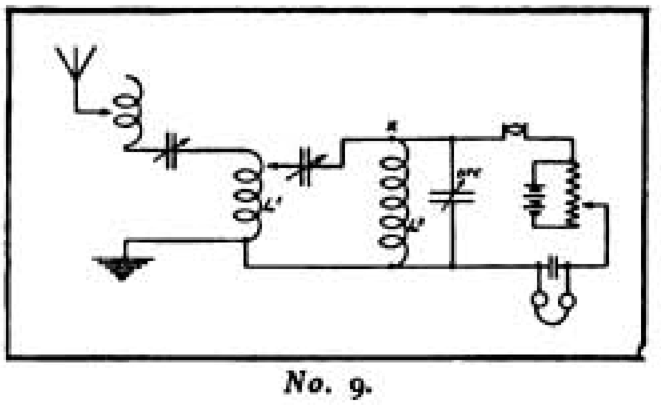
Question E.—Is not circuit 7 the most usual connections compared with circuits 3 and 4?



No. 8.

Answer.—Low resistance telephones in conjunction with a step-down transformer are generally used in the plate circuit because the operator is then less liable to shocks than when using high resistance telephones directly connected to a high tension battery.

Also less damage can be done to the insulation of the windings of L.R. telephones when breaking the high tension circuit than would be the case if H.R. telephones were used.



No. 9.

Question G.—Are the results obtained with this circuit good? Can L^1, L^2 be the same as in an ordinary two-circuit receivers? Can a valve, or valve and crystal together, be used in this circuit? What distance must separate L^1, L^2 so that they do not interfere one with the other?

Answer.—This circuit is a usual type of crystal circuit, and can be made to give good results, but it is better to have separate coupling coils.

L^1, L^2 can be of same construction as the inductance coils of an ordinary receiver.

If a valve were used the fact that the coupling is not adjustable through zero would probably prove detrimental to its use.

The distance between L^1, L^2 must be so great that the mutual inductance is very small, say so small as to give 1 or even 0.1 per cent. coupling. The best practice is to arrange these two coils at right angles one to the other.

T.S.E. (Goole, Yorks.).—(1) There is no P.M.G. Certificate issued for Wireless Telephony at present. (2) The Postmaster-General is prepared to conduct an examination in the Marconi system of using continuous waves, if the applicant so desires. (3) As the aerial postal service does not exist at present we cannot answer your question. (4) In the preamble to a radio telegram the word "Radio" should be used as it has been officially accepted as meaning "wireless."

A.J.H.O. (Seven Kings, Ilford).—(1) The maximum age limit for operators joining the Marconi service is 25; the age limit for other technical positions depends upon what the position is, and as you do not specify any in particular we cannot answer you more fully. (2) As you possess a First Class P.M.G. Certificate you might apply to The Marconi International Marine Communication Co., Ltd., to be placed on their waiting list, but we do not think that you will obtain a shore position. For a post on shore you might try the firm you mention.

D.H. (Manningtree).—Subject to there being a vacancy we think that you would be eligible for an appointment such as you mention. You could get a definite ruling on the question by applying direct to the Company.

SYSTEMS (East Ardsley).—(1) We do not know of any book dealing exclusively with the Telefunken system, but can recommend you to read the section devoted to it which appears in *Wireless Telegraphy* by R. Stanley. (2) Similarly with the Poulsen system we know of no book dealing entirely with this. It is however discussed in most standard books on wireless telegraphy. (3) The Postmaster-General will examine an applicant in these systems if requested to do so, afterwards endorsing any certificate issued to the effect that the holder has passed in such systems.

G.L.C. (London, S.W.).—Sir O. Lodge has written a book entitled "The Aether of Space."

H.S. (Millom).—(1) Under a provision of D.O.R.A. you cannot at present obtain a licence to erect a wireless aerial. (2) When the said provision ceases to exist your application should be made to the Secretary, G.P.O., London. (3) You may not buy or make apparatus for wireless at present; follow the series of articles on the construction of such apparatus which commenced in our April issue, and study "The Elementary Principles of Wireless Telegraphy" by R. D. Bangay. (4) A handy man can make a very good amateur set if he understands the principles of the art of wireless telegraphy. Amateur apparatus will, we believe, be supplied by Marconi's Wireless Telegraph Company, as soon as law permits.

F.A. (Leeds).—(1) We think not. Why not apply direct to the various wireless and aviation companies. (2) You do not say to whose "Waiting List" you refer. If you mean that of The Marconi International Marine Communication Co., Ltd., the answer is "No."

J.B. (H.M.D., Sunset).—You do not say what position you want, or with what firm. If you mean the Marconi International Marine Communication Co., Ltd., apply direct to the Traffic Manager, addressing your letter to Marconi House, Strand.

"EX-OPERATOR" (Leicester).—(1) This matter is regulated by the Board of Trade to whom your enquiry should be addressed. (2) At present, the Board of Trade. It is not yet obtainable by private traders. (3) The bonus to which you refer has not yet been paid.

E.G.W. (Nottingham).—Has experienced trouble when using a wavemeter by the fact that when the wavemeter was brought near an oscillating circuit a constant sound was heard in the telephones. This effect might be caused either by some turns of the inductance becoming short-circuited, or some of the plates of the condenser being shorted. It is possible in either case that owing to a tight coupling between the wavemeter and the oscillation circuit, the wavemeter circuit was in a state of "forced" oscillation, thereby giving rise to a sound in the telephones but not capable of being tuned.

Were the safety spark gaps of the condenser cleaned, as a particle of dust will sometimes cause a leak between the condenser plates.

J.K.H. (Plymouth).—Asks (1) If a valve receiver when oscillating does not transfer energy to the aerial circuit and thus act as a transmitter? Yes, whenever a valve oscillates the set acts as a transmitter and any receiver in close proximity, tuned to the same wavelength, would be effected by the radiated oscillations. The set would of course be a very inefficient transmitter, but even this is sometimes quite sufficient to interfere with another receiver in the neighbourhood.

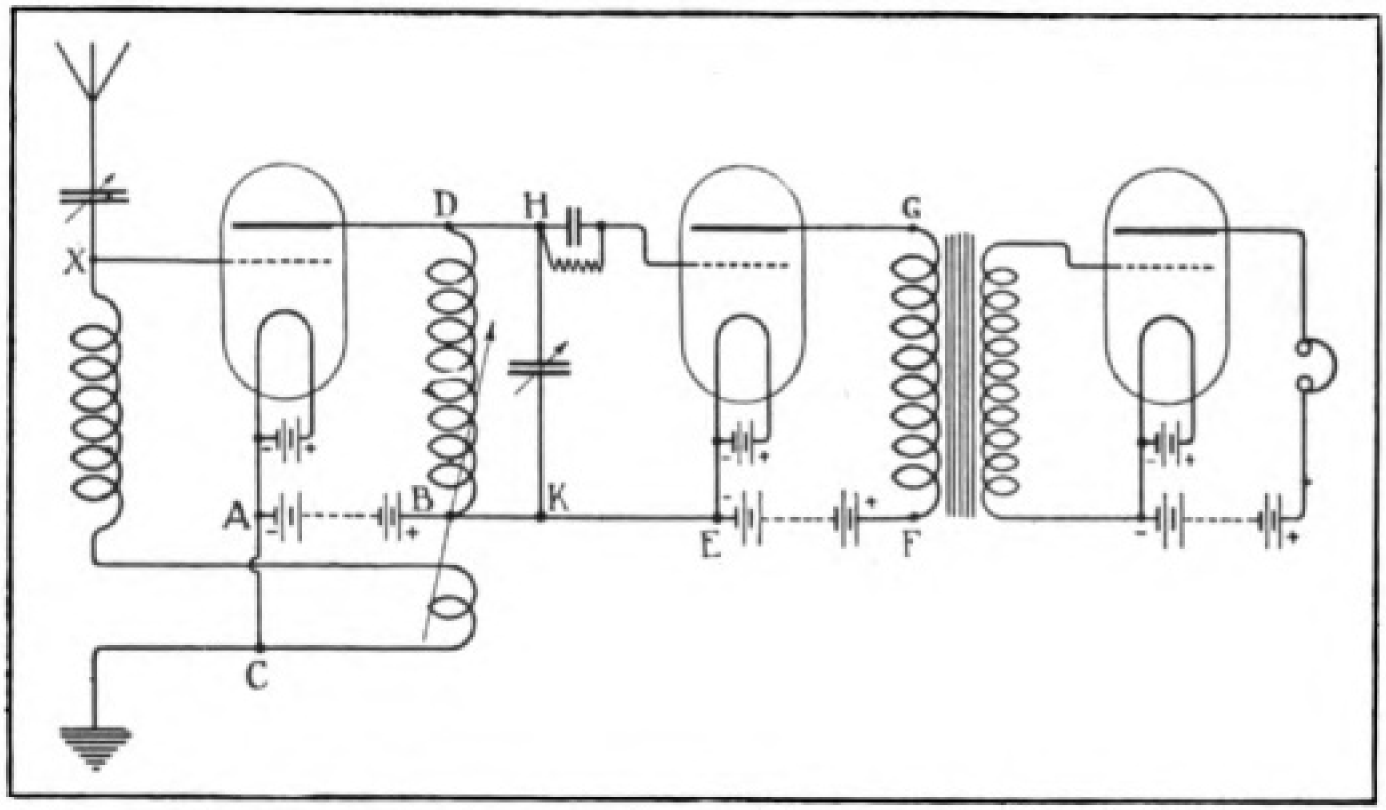
(2) The diagram on page 281 of E. Bucher's book showing the connections of a "beat" and "amplifier" valve receiver, are quite satisfactory and the receiver is capable of great selectivity and sensitiveness. The English Marconi Co. usually dispense with the grid condenser C.3 and the plate current tuning condenser C.4 as being unnecessary refinements. There is practically no difference between the valve illustrated and those manufactured by the English Marconi Co. In the American valves the grid takes the form of a fine winding whereas in those used in this country the grid is made of fine tungsten net.

L.J.B. (Blyth).—Full information on the subject appears in our issue for May, 1918. See also answer to A.E.W. (Catford) in this year's April number.

E.E.J. (Leytonstone).—Asks: (1) Why he gets better signals with long waves on a Type 16 (Marconi) receiver when the earth arrester is screwed up tight? (2) When one side of the telephones is connected to the A.T.I. handle why are signals increased when receiving on wavelengths above about 2,000 metres?

Answer.—(1) If " E.E.J." means that when his earth arrester is screwed up tight there is still an insulating space between the two plates then we are inclined to think that the earth arrester is acting as a small capacity across the A.T.I. of the receiver, the better strength signals then being due to better A.T.I. tuning. Possibly a few turns of the A.T.I. are short-circuited, and the earth arrester acting as a capacity, make up for the loss of turns. If screwing up the earth arrester causes the two plates to touch one another then the A.T.I. becomes short-circuited, and we are at a loss to account for the increase in the strength of signals.

Answer.—(2) By connecting one side of the telephones to the A.T.I. the receiver works on a plain aerial, with no electro-magnetic coupling between the primary and secondary circuits. The coupling is greater when using a plain aerial, but the extra coupling is obtained at the expense of selectiveness, it being much more difficult to " tune out " any particular station.



CAPT. DE LA B. (Martenet).—Wishes to know if in a three-valve receiver it is not possible to combine the high and low tension batteries into two batteries?

Yes, it is usual to let one high tension battery suffice for all the plate circuits and one low tension for all the filaments. Connect the filaments in parallel, and then connect the negative side of the high tension battery to the negative side of the low tension battery. This connects points *AE* and the negative limb of the third filament to the negative side of the High Tension battery. Break the connection between the plate circuit coil of the first valve and the negative side of the second valve filament, *i.e.*, *KE*, and insert a condenser of capacity not less than .01 mfd. The points *B* and *F* and one side of the telephones can now be connected to the positive side of the High Tension battery. The reason for inserting the .01 mfd. condenser is because the connection *KE* would short circuit the High Tension battery. The rest of the connections remain the same.

R.K.L. (Birmingham).—Wishes to know whether an ordinary gramophone sound box can be used in conjunction with a gramophone record for the reception of wireless signals.

It would be practically impossible to use a gramophone to record wireless signals under the above conditions. To use successfully this method a special sound box would be required fitted with very sensitive telephones, such as Brown's telephones, and the received signals have to be strong enough to cause the diaphragm of the gramophone to vibrate sufficiently in order to mark the record. This usually means that the signals have to be magnified several times in order to render them loud enough.

The only method of cleaning a record of old tunes or words is by taking a thin cut along the face of the record. Gramophone makers supply a special " shaving " machine for this purpose.