REPORT OF DEMONSTRATION OF THE WORKING OF THE POULSEN SYSTEM.

The Annual Report, 1906, W.T. Appendix, contained a short description of the Poulsen system of W.T.

A demonstration of the working of the apparatus was given by the Amalgamated Radio-Telegraphic Company before representatives of the Admiralty and the Post Office at Cullercoats, near Newcastle, on the 6th, 7th, and 8th February 1907.

Position of station.

The position of the station is close to the edge of a cliff 150 feet above the sea level.

Aerial and earth.

The aerial wires (7 in No.) are arranged vertically and supported by a mast 210 feet in height.

The earth consists of a network of wires spread at a height of 2 feet 6 inches above the ground close to the base of the aerial.

Power supply.

The instrument house is supplied with power from the town at a pressure of 500 volts D.C.

The station is used for experimenting with Esjberg and Lyngby on the Danish coast, distant 300 and 500 miles respectively.

Mast.

The mast is constructed of a framework of wood which can be built up and fitted with its stays whilst laying on the ground. After being completed it can be quickly raised into position. The cost is believed to be about 1*l*. per foot.

Instruments.

The arc was enclosed in a marble box and supplied with hydrogen gas contained in a cylinder.

A wavemeter was used for recording the current in the aerial. Power used, 5 K.W.

The coupling of the receiving circuit could be varied by adjusting the distance between two inductances:—

Experiments 6th Feb.

(1) Establishing communication between Cullercoats and Esjberg.
(2) Reception of signals by "Furious."
(3) Interference from "Furious" at anchor, distant 2½ miles.

Results.

(1) Signals were not strong, and varied considerably, but several messages were exchanged by the operators, who were accustomed to the instruments.

(2) Signals were reported as being very loud on board the "Furious," but difficult to read on account of the hissing noise of the arc. Parts of certain messages were received by "Furious" correctly."

(3) "Furious" interfered first on the same wave-length and afterwards on one 3 per cent. different; in both cases interference was so loud as to prevent any other signals being heard; no alteration of the receiving circuit appeared to reduce the strength of the interference by any appreciable amount.

Feb. 7th.

Similar experiments were carried out on the 7th, attention being specially directed to prevent "Furious" receiving the signals sent from Cullercoats. The first arrangement tried was one of altering the system of sending. Instead of making and breaking the primary circuit of the transmitter, the primary was thrown in and out of resonance with the aerial circuit without breaking it. The result, however, was the same as before, strong signals being received in "Furious."

The second arrangement consisted of substituting another form of arc, which was considered to be a more constant one and less liable to variations; no signals were received in "Furious," but neither were they heard by the Danish station, so that the results in this case were inconclusive. In this case no sending key was used, the signals were made by moving the secondary of the oscillator near to and far away from the primary. This method prevented the variation in the arc due to the make-and-break of the sending key, the sound of which was the principal cause of signals being received in "Furious." It is necessary, however, to add that with this arc, only 3 K.W. could be used.

Feb. 8th.

The object of the experiments on the 8th were:—

(1) To ascertain up to what range signals from Cullercoats could be received on the Service instruments.
(2) To ascertain the distance at which signals from "Furious" on the same wave-length could interfere with the reception of messages at Cullercoats.

Results.

As regards (1): The "Furious" left the harbour and steamed south, and at a distance of 40 miles lost all trace of Cullercoats signals, her receiving instruments being adjusted for a 3,000-foot wave.

It was also arranged that "Vernon" should try to receive signals from Cullercoats, and although no signals could be heard when adjusted for the 3,000-foot wave, distinct and sometimes loud signals from the arc were detected when her receiving instruments were adjusted for a 1,000-foot wave.

It is very possible that the irregularities in the arc cause the omission of a Poulsen wave of 3,000 feet, with a spark wave of 1,000 feet superimposed. When the improved arcs are used, this spark wave will be eliminated, and the signals would then be inaudible on a receiving instrument such as the magnetic detector.

As regards (2): Up to 80 miles, "Furious" interfered, and made the reception of signal from Esjberg unreadable at Cullercoats; at this distance experiments ceased, so that the limit of range of interference in this case was not reached.

Advantages of the system.

The advantages are as follows:—

(1) The low tension of the aerial, by means of which the insulation of the aerial is more easily effected and there is less liability to shock.

(2) The transmitting instruments in the office are not dangerous to touch, and therefore elaborate safety arrangements are not required.
(3) The compactness of the instruments, and consequently reduction in weight.
(4) Silent as compared to spark telegraphy.

Disadvantages.

Its disadvantages are :—
(1) The variations of the arc. This appears to be a serious difficulty, causing the signals to be erratic.
(2) The difficulty of keeping the circuits accurately in tune with one another. If there is an error of ·3 per cent. in the tuning between the primary and the aerial circuits, practically no energy can be radiated.
(3) The necessity of storing hydrogen or coal gas, which might present considerable difficulties in seagoing ships and shore stations.

Adaptability to Service requirements.

In its present form, this system is not recommended for adoption in seagoing ships or shore stations abroad, but considering its early state of development, it is probable that many improvements will be introduced, and the disadvantages gradually overcome. It therefore appears most desirable to start without delay a series of practical experiments with these instruments.

One 5-K.W. set has been purchased by the Admiralty, and a similar set is being lent by the company for trial with it, in order that more definite information as regards the possibilities of applying the system to Naval requirements may be obtained. It is proposed to instal one set in "Vernon" and one in "Furious" for the experiments.

D.N.O., M. 01340/07.

ABSTRACT OF REPORT BY LIEUT. LORING, R.N., ON A DEMONSTRATION OF DIRECTIONAL W.T. DEVISED BY LIEUT. TOSI AND SIGNOR BELLINI, OF THE ITALIAN NAVY, DATED 8/10/07.

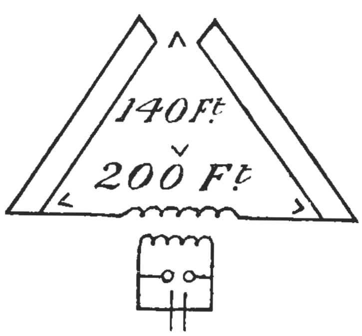
The experiments took place on September 26th and 27th, at Dieppe and Harve.

Position of stations.

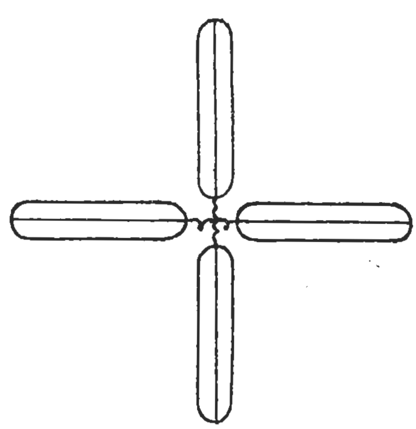
The two stations were 45 miles apart overland. The masts were 150 feet high, and the power used was $\frac{1}{2}$ K.W.

Principle of the system.

The principle of the system is as follows :—An insulated elevated loop, incomplete at its highest point, will transmit and receive energy in the direction of its plane. It will neither receive nor transmit at right angles to that plane.



Elevation of one pair of fixed loops.

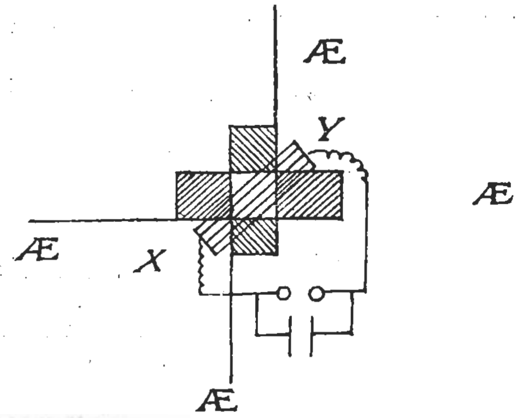

Plan of the two pairs of fixed loops at right angles.

Results.

Signals were transmitted from Dieppe, and received at Harve, when the loops at both stations were in the same plane. Nothing was received at Harve from Dieppe, when—
(1) The transmitting aerial at Dieppe was at right angles to the direction of Harve.
(2) The receiving aerial at Harve was at right angles to the direction of Dieppe.

Adaptation of system.

The above system can be adapted to finding the direction from which signals are coming by using two fixed aerials and secondaries, and a movable primary called the directional jigger; the latter indicates the approximate direction from which signals are coming.



Results.

(1) The directional jigger X Y was revolved, and the rise and fall of signals was satisfactorily noted.

(2) By means of X Y the bearings of Dieppe, Newhaven, Culver Cliff, and "Vernon" could be ascertained approximately.

The whole system transmits and receives mainly in the direction that the revolving jigger is pointing.

Distant signals were strongest over an arc of 20° on either side of the true direction, and disappeared altogether 60° on either side. Signals close by, 2–3 miles distant, could not be cut out.

The system can be earthed, which considerably strengthens signals, but all directional effect is then lost.

LAGOS MANŒUVRES, FEBRUARY 1907.

Abstract of Results of W.T. Exercises carried out on the Fleets parting Company.

Object.

To ascertain up to what distance communication could be kept up between Channel, Atlantic, and Mediterranean Fleets on the various tunes, by day and night.

Orders.

Ships of the Channel Fleet were detailed to transmit messages requiring answers at any time in any tune to any Fleet; the time from the transmission of the messages to the reception of the answer was taken.

Results.

S, T, and U.

Trials commenced at 4 p.m., February 22nd, on S, T, and U tunes, the Fleets separating at the rate of 22 miles an hour.

U lost touch at 100 miles.

T not established.

S lost touch at 160 miles.

The average time from the sending of a signal to the reception of the answer was over an hour.

The bad results appear due to:—

The re-organisation of the Fleets.

General distrust of the longer wave-lengths, due to want of practice.

These distances have been doubled by ships of a Fleet communicating together.

Q and R.

No communication was established on Q and R after daylight on the 23rd until 8 p.m., when Q was good and R fair until 4 a.m. On the 24th, 25th, and 26th, at night, communication was established in Q tune, maximum distance 750 miles.

Remarks and conclusions.

The following points were brought out:—

(1) Impossibility of using more than one tune at a time without the most careful organisation, which would have to be adhered to by all Fleets.

(2) Great reduction in distance and speed of signalling directly ships join up with other Fleets, emphasizing the necessity for exactly the same procedure to be adhered to by all Fleets, and for combined Fleet exercises to be carried out whenever possible.

(3) Great superiority of Q and R tunes over the longer wave-lengths with the present installation; the average time for the transmission of a message on Q to the reception of an answer was 15 minutes.

940/543. 24th October 1906.

WIRELESS MESSAGES INTERCEPTED DURING THE ITALIAN NAVAL MANŒUVRES.

The Italian signals were nearly all *en clair*, and three wave-lengths were employed, viz., 2,500 feet, 1,200 feet, and 500 feet.

As regards signalling procedure, the sign R D seems to be used in place of R R R, as stated on page 25 of N.I.D. publication entitled "Wireless Telegraphy, British and Foreign," 1906, and the commercial signs O K and T S T appear in constant use.

The rate of signalling is usually from 15 to 20 words a minute.

EXTRACT FROM LIEUTENANT N. USBORNE'S REPORT ON "WIRELESS TELEGRAPHY IN THE GERMAN NAVY."

Wireless Telegraphy in the German Navy is in an efficient state, thanks to the wonderful excellence of manufacture and finish of their instruments, and to the astonishing lavishness with which these are supplied; it is in a backward state as regards actual progress, on account of the equally astonishing lack of training of both officers and men, which results in their being unable to take any part in its development along lines suitable for Naval purposes.

Personal.

An Executive Lieutenant who has been through a *two-weeks'* course of W.T. is in charge of the installation. The Engineer Officer doing electrical duties is responsible for the working of the apparatus, but he too has only had either a fortnight's course or none at all. The function of the Executive Officer appears to be the control of signals during manœuvres or war.

When W.T. watch is being kept, two men are always in a watch. This necessitates at least eight men, but more are usually available; thus in the "Konigsberg," of 3,200 tons, there are eleven operators, namely, 3 P.O.'s, 1 signalman, 4 stokers, and 3 bluejackets. Some of these have been through a two-months' course, most of which consists of Morse. These long-course men appear to be thoroughly practical signalmen, and some of them can trace the circuits of their installations, though unable to make intelligible diagrams and unacquainted with the contents of the various boxes, such as the electrolytic coherer box, or the ordinary coherer box.

As an example of the standard attained by officers and men in the "Konigsberg," "Hohenzollern," and "Scharnhorst," none of the three Wireless Officers knew of any unit of inductance, in spite of their sending aerial tuner being marked in centimetres; they did, however, measure capacity in centimetres. The senior telegraphist in each of these ships knew the units, but had no idea as to whether their own various capacities were of the order centimetres or farad. It was stated that the course for officers is going to be greatly extended, in order that they may know more than their subordinates.

General.

Standardisation exists throughout. Thus, all aerials are similar, notwithstanding the difference in types of ships. Sending gear is identical throughout; receiving gear is also standardised, though the latest sets have an extra aerial tuner, and an extra shunt in circuit with the battery across the electrolytic coherer.

Tunes.

Four tunes are used, namely:—

(*a*) Short wave for Fleet signalling, 150 metres.
(*b*) "N.W." wave for International signalling, 350 metres.
(*c*) "G" wave, 550 metres.
(*d*) "D" wave, 780 metres.

Aerials.

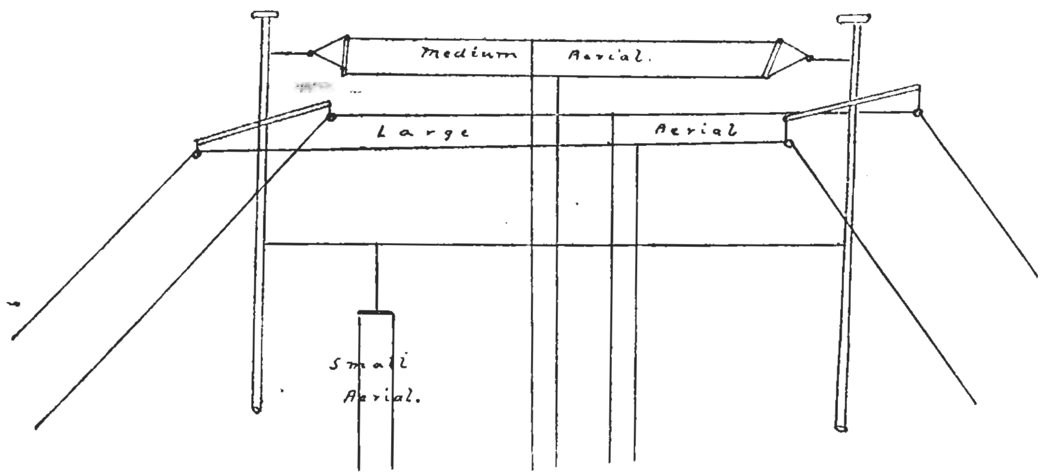
There are three aerials:—

(1) A short twofold vertical aerial for 150-metre wave.
(2) A short twofold roof aerial between the extreme tops of the pole masts. This is used for N.W., and usually for 550-metre wave.

(3) A long roof aerial; it starts on the forecastle about 15 feet above the upper deck, extends horizontally between the masts about 12 feet below (2), and finishes above the upper deck right aft. This is used for the 780-metre wave, and sometimes for the 550.

(2) and (3) are fed in the middle.

Fig. (1).



Power. The power in all ships is obtained from a rotary and transformer.

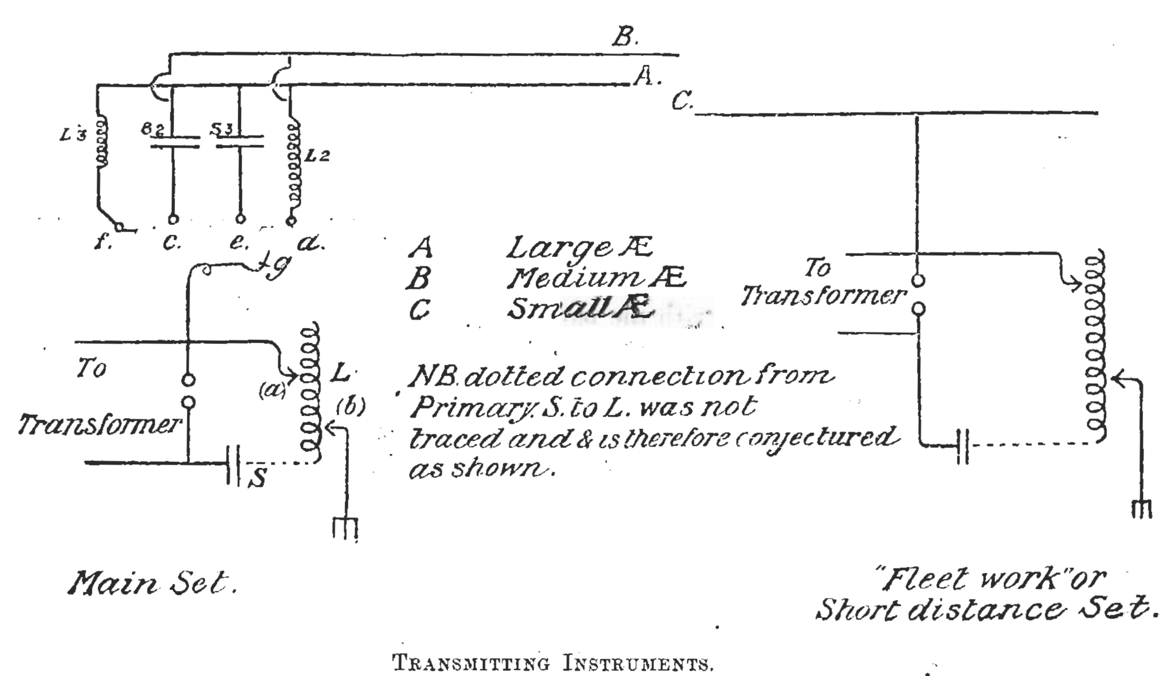
In the older sets the rotary output is 40 ampères at 50–60 volts, the frequency being 25 cycles.

The newer sets have an output of 10 ampères at 110 volts, and frequency of 25 cycles. These sets have also a small 25-cycle rotary for "Fleet work."

Switchboard. There is one general switchboard, on which all the D.C. and A.C. switches and meters are mounted, also a frequency meter.

Transmitting instruments. There are two sets of transmitting instruments, the main set for the large and medium aerials, and a smaller set for the short distance aerial.

Fig. (2).



Transmitting Instruments.

Fig. (2) shows the circuits of these two sets, the one on the left being the main set, the short distance one being on the right.

Main set.

The primary circuit of the main transmitting set consists of a capacity S, and adjustable inductance L; this primary is common to the two larger aerials, and is adjusted by sliding the contact (*a*) up or down the inductance (L).

The secondary and aerials are adjusted by sliding (*b*) up or down the inductance (L), and by inserting the plug (*g*) in one of the contacts (*c*), (*d*), (*e*), or (*f*).

Plugging up—
- (*c*) adjusts the aerial and secondary for a 350-metre wave on the medium aerial;
- (*d*) for 550-metre wave on medium aerial;
- (*e*) for 550-metre wave on large aerial; and
- (*f*) for 780-metre wave on large aerial.

Capacities.

The primary capacity (S) consists of 7 large Leyden jars in parallel.

The secondary, or aerial, capacities (S_2) and (S_3) are made up of a number of tubular condensers, 10 inches long and $\frac{3}{4}$ inch in diameter.

The capacity (S_2) is smaller than (S_3).

Spark gap.

The spark gap consists of 5 pairs of balls in parallel, hemispherical in shape, $\frac{3}{4}$ inch in diameter, and made of aluminium.

The maximum spark appears to be about 25 mms.

"Fleet work" or short distance transmitting set.

This installation is precisely similar to that already described, except that it is rather less than two thirds of the size of the main transmitting set, and that the aerial lead goes straight from the spark gap to the aerial, and not through an aerial condenser or tuner.

The spark gap, in this set, consists of a single pair of balls, and the maximum spark is about 10 mms.

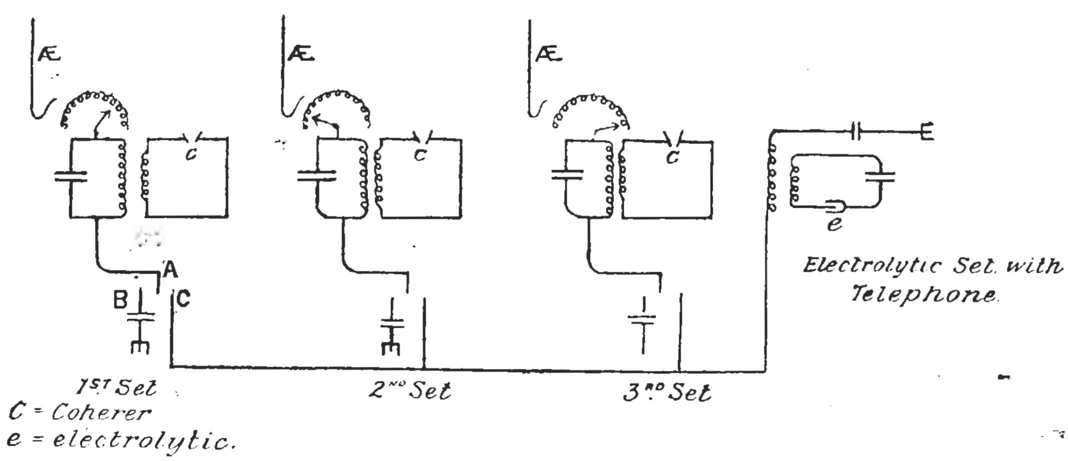
Importance of short distance installation.

This is the gear most used; it is said to give no trouble and to be invaluable.

Receiving instruments.

In every ship there are three sets of "dry coherer and inker" instruments, and a fourth set containing an "electrolytic coherer" for telephonic reception.

Fig. (3).



Receiving Instruments.

Fig. (3) shows the receiving circuits.

Method of working.

To receive on, say, No. 1 coherer set, the switch (*a*) is put over to the contact (*b*), thus earthing the aerial through the No. 1 receiving circuit, and a condenser.

If it is desired to receive on the telephones, the dry coherer circuit is thrown out of use by switching (*a*) over to (*c*), thus earthing the aerial through the electrolytic, and breaking the former earth lead. The secondary of the jigger is removed.

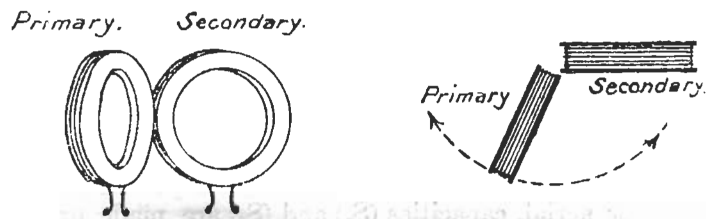
Adjustments in receiving instruments.

All the inductances and capacities are adjustable.

The mutual inductance of the jigger is varied by winding the primary and secondary on the circumference of two rings hinged together, so that the mean distance that the two are apart can easily be altered (*see* Fig. (4)).

The secondary winding of the jigger is fitted with clips. Each office has 25 of these secondary windings, each one having a different inductance, which is stamped on its face. The inductance of the coherer can therefore be adjusted as requisite.

FIG. 4.



TWO VIEWS OF JIGGER. PRIMARY AND SECONDARY WINDINGS.

Dry coherer. Similar to those recently in use in our Navy, except that the plugs are flat-faced instead of being chamfered, and are extremely close together. Very fine filings are used, presenting the appearance of silver liquid.

Inker. The inker is self-starting. No tapper was visible or audible.

Multiple reception. Recently three signals were read simultaneously. The wave-lengths were 350, 1,300, and 2,000 metres.