General Remarks.

Although very little of what was seen could be of immediate use for Naval purposes, it is considered that the lines on which the station is being developed appear to be sound, and that, if the experiments referred to above are successful, the station will be capable of dealing with a large amount of traffic and has a great future before it.

Probability of interference with other stations.

The tight coupling which the station is using, and the fact that they have a spark gap in the earth connection of the aerial circuit, may very possibly cause considerable interference with other systems, since—

(*a*) The shorter of the two waves produced by the tight coupling is considerably shorter than the 14,000 feet which the station is licensed for, and near to the waves used by the Naval high power stations.

(*b*) The spark gap in the earth connection is liable to set up subsidiary waves which may interfere with ships' wave lengths.

EXTRACTS FROM REPORT ON VISIT TO CLIFDEN AND POLDHU.

By Captain R.ff. Willis, R.N.

The stations were visited by Captain Willis in August 1909.

Aerial.

Aerial.

The manner in which the aerial is now laid out is shown in Plate IX. Not only is the receiving aerial entirely insulated from the transmitting aerial, but each length of wire is insulated from its neighbour throughout, except at the deck insulators where they pass into the receiving and transmitting houses.

Insulation of aerial.

Each wire passes freely through the middle of a porcelain thimble, and it is the duty of one man to go round every morning and take up the slack of each of these wires. This he does by winding up at the "E" masts, judging by eye when they are sufficiently taut. This takes about two hours daily.

Additional earth wires.

In addition to the earth connections already reported (consisting of two broad copper gauze strips running into the lake) 30 galvanised iron wires have been laid along the ground under each aerial wire. These wires run from the transmitting house to the "D" masts; they are not insulated, and as they are burning away the turf, it is proposed to bury them a few inches. It is also proposed to run additional earth connections out to the "E" and "F" masts, and to replace the galvanised iron by copper wires. This is being done to improve the conductivity of the "earth plate" of the "aerial condenser."

The aerial is made up of silicon bronze stranded wire, size 7/19, having a conductivity of 55 per cent. that of pure copper.

All the old phosphor bronze aerial has been removed.

It is proposed to abolish the existing 2 m.m. spark gap between the transmitting aerial and earth.

Power House.

Boilers.

The six boilers, of nominal 40 H.P., but capable of 120 H.P., are of the ordinary locomotive type, and are now burning peat entirely. The results are quite satisfactory and show a great saving in cost of fuel, also peat leaves only 20 per cent. of ash as compared to coal.

Engines, &c.

The two 500-H.P. engines are each coupled direct to a 500-Kw. alternator, and also by a belt to a 50-Kw. dynamo.

The alternators have 8 pole rotors, 375 R.P.M., 25 cycles, 1,000 volts. The rotor of the second alternator weighs 10½ tons (No. 1 weighing 7½ tons).

The chief additions to the power house are four high voltage 50-Kw. dynamos, which are being moved over from the transmitting house. A suitable switchboard is being erected for these machines. These dynamos are used solely for charging up the 10,000 transmitting accumulators.

The dynamos are of the Thury type, but manufactured by Dick Kerr & Co., who have the British rights.

Not only is the bed plate of each dynamo embedded in bitumen giving an insulation resistance of 10 megohms, but the whole of the floor of this section of the power house is covered with a specially insulating asphalte to a depth of 1 inch, so that the dynamos can be handled with safety.

The segments of the dynamo commutators are air insulated from each other, and so shaped inside that the air is caught and driven outwards between the segments.

Transmitting House.

The length of the transmitting house was given as 350 feet (and not 400), the centre room occupying 25 feet of this, leaving two wings of 162½ feet each for the air condensers.

Condensers.

These condensers are built up of 1,820 zinc plates, suspended by 2 feet porcelain rod insulators, each plate measuring 29½ feet in height by 12½ feet wide. There are 70 rows of continuous plates in each wing and 13 plates in each row edges strapped together (*i.e.*, 13 feet by 12½ feet = 162½ square feet), with a distance of 12 inches allowed for between each row, but owing to the buckling of the plates only 9 inches can be relied on. If the plates had been supplied "stretched" this buckling would have been very much minimised and rows could have been placed closer together; in fact, it is stated that, with the present system of sending with the revolving disc and direct current at 20,000 volts, the cubic space occupied by the present air condensers could be reduced to one-sixteenth without altering the capacity (1·8 microfarads), by closing the plates to 3 inches.

With plates 3 inches apart, an air condenser (450 jars) for Cleethorpes W.T. station would occupy a space of 80 feet by 18 feet by 8 feet high, with an extra two or three feet in height for insulators, and clearance, &c. The present oil condensers occupy 16½ feet by 10 feet by 6 feet high.

Primary coil.

The wooden former of the present primary transmitting coil has a 10-inch diameter cross section, and the cotton insulated wires are laid spirally round it for one complete turn, so that all wires bear their full share of the current. The wooden former itself is bent round in one almost complete circle which measures, with wire in position, 3 feet 10 inches internal diameter, and 5 feet 10 inches outside diameter—it is finished off with two parallel copper plates which form the terminals of the coil.

Two such single coils are placed together and connected up in series by a short copper plate, and constitute the primary transmitting coil.

The secondary consists of 7½ turns of cable wound on a skeleton wooden former, which is insulated outside with strips of ebonite—the outside diameter of the coil is 3 feet, so that when it is required to get a very tight coupling, the secondary can be pushed inside the primary coil, and there would then be 5 inch clearance between the coils.

The primary and secondary coils are *in duplicate*, and stand on the roof of the spark gap room, the cable connections passing through a block of asphalte down into the room.

Coupling and wave lengths.

The coupling used up to date has been about 3 per cent., but now it is intended to use one of 2 per cent. Also, the wave-length for Glace Bay is now going to be the 14,000 feet length of wave only, for it has been found that on the whole more favourable results have been obtained with this long wave, being freest from atmospherics; it has been decided therefore to give up the complications of alternative wave-lengths, and no arrangements are now being made to switch over from one wave-length to another. Notwithstanding this statement, a small primary and secondary coil of half the above dimensions are now being made in the workshop, and are intended for news messages for Atlantic liners only, and for sending wave-lengths more suitable for their small aerials.

Revolving disc spark gap.

The revolving disc spark gap has been fitted *in duplicate* on the ground floor of the centre of this building. The two sets stand about 6 feet high, and are contained in a room 13 feet long, 12 feet wide and 8 feet high.

This silencing room is built up of wood outside, asbestos inside, and 4 inches of wool slag in between. The doors are fitted with double ruby glass observation windows.

Referring to the report on visit, dated 24th May, the chief alterations seem to be the doubling of the number of rectangular studs from 6 to 12 on the revolving disc, and on one machine the disc was being bored with additional intermediate round holes, so that a total of 24 studs rectangular and round could be fitted for experimental purposes.

Also, the stationary metal cover fitted over this disc has been tapped on one side, and an air blast arranged thence to the magnetic key, so that the disc now acts as a blower for the key, the extra power taken being given as only 1 Kw.

The side discs are fed direct from the 10,000 transmitting accumulators, which are accommodated on the top floor of the centre of this building.

Magnetic key.

The magnetic key is in this circuit (and not across the spark gap as formerly fitted), the latest pattern seems to be a great success, and it is claimed that a speed of 60 words a minute can easily be sent. This key was not, however, seen under working conditions.

The key is very compact. Plate X. shows the dimensions and working arrangements.

The moving coil is wound on an aluminium frame, and all parts in connection with this are kept as light as possible; the spindle is kept under tension on ball bearings top and bottom of a brass holding frame. The fixed magnet coils are fed with continuous direct current at 50 volts.

The moving coil receives 50 volts D.C. through one way when the key is pressed, and in a reverse direction when the key is raised. The coils are in a tank full of thin oil, and the tank and ebonite air conduits are all contained in a wooden box 12 inches square and 10 inches high. The only spring is the steel arm itself, and it was stated that there was no rebound off the leather buffers or contacts when made.

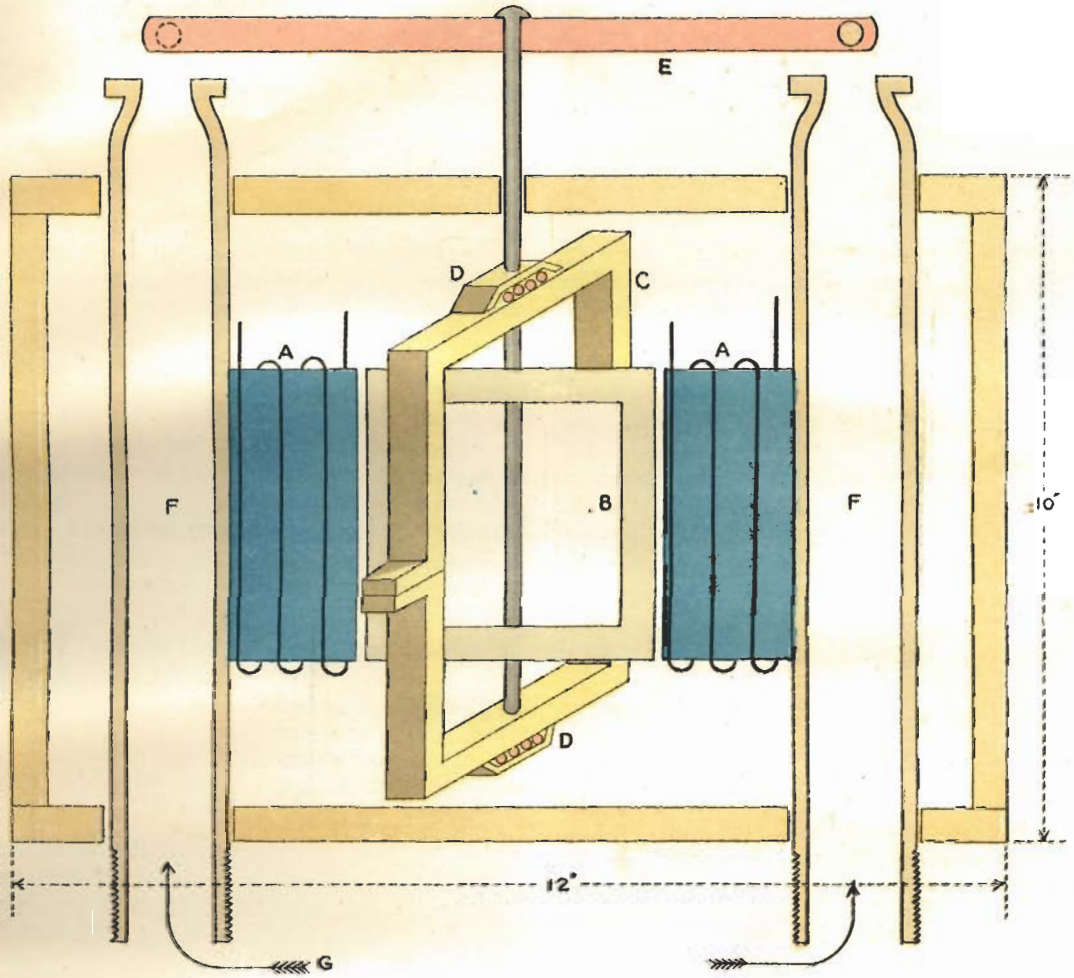
The total clearance between contacts when at maximum distance apart is 1⅛ inch.

Transformer room

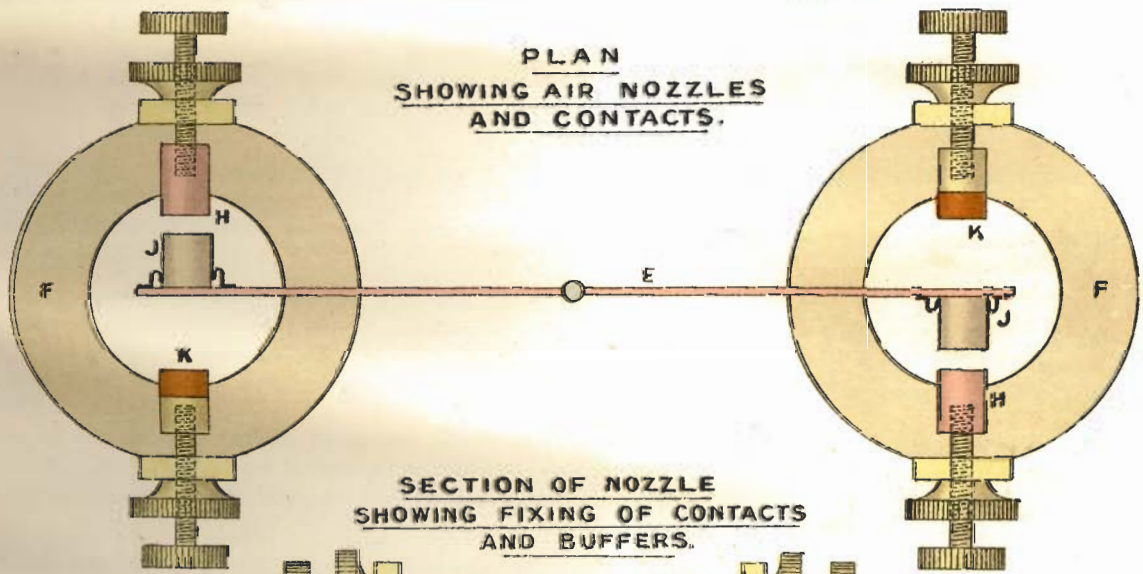
Besides the spark gap room on the ground floor, all the transformers and choking coils are being installed in the space recently occupied by the 5,000 volt dynamos.

MAGNETIC KEY.

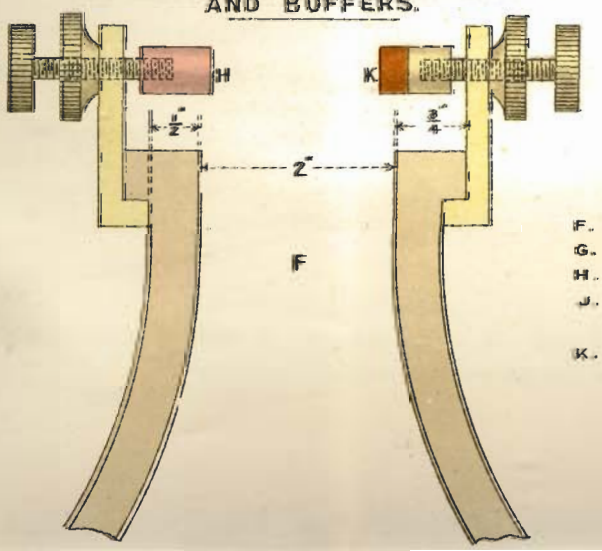
SIDE VIEW.



PLAN
SHOWING AIR NOZZLES AND CONTACTS.



SECTION OF NOZZLE
SHOWING FIXING OF CONTACTS AND BUFFERS.



REFERENCE

A. FIXED COIL.
B. ALUMINIUM FRAME CARRYING MOVING COIL.
C. BRASS HOLDING FRAME.
D. BALL BEARINGS.
E. STEEL ARM, 8" x 3/4" x 1/16"

REFERENCE

F. EBONITE AIR CONDUIT.
G. AIR BLAST FROM REVOLVING DISC.
H. COPPER CONTACT 1/2" DIAM
J. CARBON " " "
HELD BY SPRING CLIPS.
K. LEATHER BUFFER.

Receiving House.

Situated on the far side of the lake, the receiving house is not yet completely equipped, and nothing has been done yet in the way of fitting up the duplex working apparatus. Receiving house.

The Einthoven galvanometer has been giving trouble, and it has not been possible yet to obtain its guaranteed sensitiveness; the makers say that this is owing to the quartz dividing line not being fine enough, and they are sending a further supply; it appears that these are extremely awkward to manufacture, they are almost invisible when made, and then have to be silver plated.

The magnetic detector was not in use at the time of the visit, the operators preferring the oscillation valve.

General Remarks.

News messages for Atlantic liners start about 12 midnight and generally finish about 3 a.m.

The chief thing noticeable is the absence of all safety arrangements. All machinery is started up from the operating room 1 minute before a message is sent off, and the fact of the revolving disc getting under way is at present the only warning for labourers to clear out of the transmitting house.

It is hoped that all machinery will be installed and the station opened for Post Office trans-Atlantic work by the second week in September.

Pay of an operator is 2*l.* 15*s.* a week, with quarters for himself and an allowance of 1*l.* a week towards messing.

There is one ex-Naval torpedo instructor on the staff (not an operator).

Poldhu.

Poldhu W.T. station has been shut down since March 1908 for want of funds, and the staff was reduced in August 1908 to—

1 operator (in charge of station).
1 watchman.
1 carpenter.
1 rigger.
1 labourer.

The station is chiefly interesting and instructive in showing the various apparatus and experiments which have led up to the final installation at Clifden.

All machinery is kept in excellent order, and, in fact, the whole station inside and out has been well looked after and would be a credit to any Coastguard station.

The machinery plant consists of— Machinery plant.

(1) A 35-H.P. Hornsby Ackroyd oil engine, which drives a 10-Kw. dynamo, which charges up the accumulators at 250 volts.

(2) A double-cylinder horizontal engine of 150 B.H.P., which drives a 150-Kw. alternator, giving 2,000 volts and 75 amps.— belt driven, fly wheel of engine weighing 10 tons.

There are four transformers, step up 2,000–40,000 volts, and nine transformers step up 2,000-30,000 volts.

The four large towers are each 215 feet high, and with the mast on top, a total height of 250 feet is obtained.

It is proposed to bring Poldhu and the W.T. station at Cape Cod up into line with Clifden and Glace Bay as soon as the latter stations are in continuous working order and when money becomes available. Thus besides duplicating the plant and machinery at each of the stations there will be an entirely alternative route in the event of either station being unable to cope with the work in hand. General remarks.

It is stated that orders received lately by the Marconi Telegraph Company from the Argentine, Portuguese, and Greek Governments, &c., amount at this date to over 140,000*l.*, and that, moreover, about half this sum has been prepaid.

Interference with Naval Signalling by Marconi High Power Stations.

Considerable interference from Clifden high power station has been experienced at one time and another, *e.g.*, it is reported that parts of Admiralty messages from Cleethorpes were missed during manœuvres, due to interference from Clifden, and communication between Horsea and Gibraltar has been interrupted by the same station.

This interference was apparently due to several causes, viz. :—

(*a*) The use at Clifden of various experimental wave lengths other than those for which the station is licensed.

(*b*) The very tight couplings used.

(*c*) The spark gap used in the earth lead of the transmitting aerial.

As a result of representations made to him by the Admiralty Mr. Marconi has now adopted two waves of about 14,500 feet and 20,000 feet for Clifden, and has agreed to limit the coupling to 3 per cent. and abolish the spark gap in the aerial.

For Poldhu he will use a wave length of between 8,500 feet and 9,000 feet, with similar couplings.

During November 1909 Clifden and Poldhu sent with various waves of about these lengths, at prearranged times, in order that tests might be carried out and the most suitable wave selected.

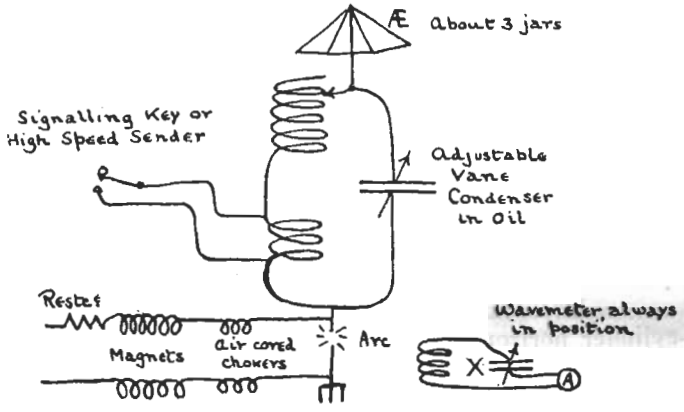
As a result of observations made at Horsea, in "Vernon," and by other ships, certain waves of the lengths indicated above were selected for future use by the Marconi stations, and these waves should not interfere seriously with Naval signalling.

REPORT ON DEMONSTRATION OF HIGH SPEED RECEIVING APPARATUS AT CULLERCOATS W.T. STATION.

Antenna. The antenna is of the umbrella type, supported on a single 220 feet mast, and is the same as that used at the station for previous demonstrations. Ebonite insulators are used at the corners of the "umbrella," and five porcelain insulators in series are used at the apex. Two feeders are brought down well apart to a leading-in insulator.

Sending gear. The sending gear at Cullercoats is of the ordinary Poulsen type with an arc taking about 3¼ Kw., and putting about 800 watts into the aerial. An ammeter at the base of the aerial registered a current of about 8 ampères. The arc seemed to keep very steady, was quickly put into oscillation and required very little attention. The circuit now used is shown in Fig. 1.

FIG. 1.



The advantage claimed is, that to alter the wave emitted, only one inductance has to be altered, as this affects equally both the primary and aerial circuits. The aerial is said to have a capacity of about three jars, and it will be noticed that the aerial is practically directly across the arc.

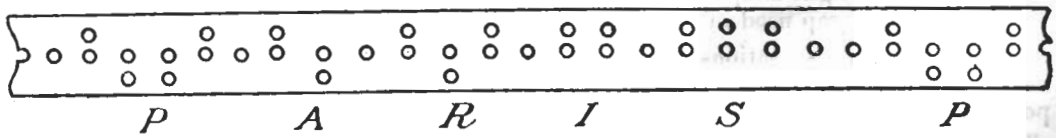
The circuit X is a wavemeter, and consists of a large inductance and a capacity, forming a closed circuit on an ammeter. The capacity is an adjustable air vane one, and the tuning, by putting the inductance near the generator, is extremely critical, reading of ½ divisions on a 180 degree scale of the positions of the vanes being reliably obtained.

The wave length of the sending circuit was changed from 1,700 metres to 1,600 metres by the signalling key, the shorter one being the wave recorded by the receiver at Lyngby.

The sending arrangements at Lyngby were said to be the same as at Cullercoats, except that the antenna is of a different shape, being hung between two masts; the power used was 10 Kw. instead of 3½, and the automatic high speed sending arrangement took the place of the signalling key.

The automatic sending gear, of which photographs and tapes were shewn, required that the message should be punched in a tape similar to that used with the "Wheatstone's Automatic Sender," except that one dot above the middle line is a short, and one below is a long, unlike the arrangement of the Wheatstone instrument. The appearance of the sending tape is shewn in Fig. 2.

FIG. 2.

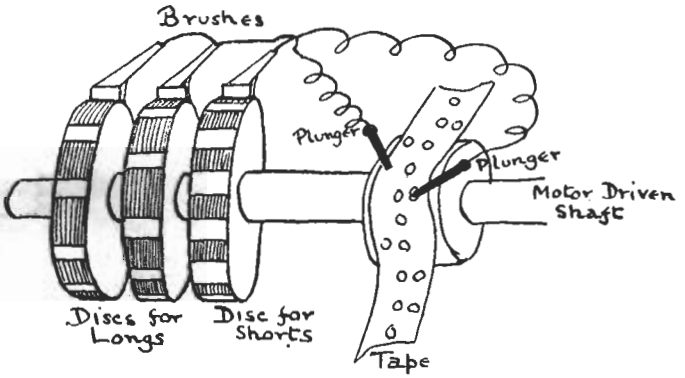


The middle row of holes is to guide the tape.

The punched tape is led over a roller (lettered A in sketch below) under plungers which make the contact through the holes when they occur. The circuit from these plungers leads to the revolving disc B for making a dot, and to the discs C or D to make a long.

Alternations of red fibre and brass segments make up these discs as shewn in Fig. 3. It will be seen that two discs are required to make the longs alternately, otherwise the spacing would not be made correctly. The object of the rotating discs in series with the plungers is to take all sparking from the former. It was understood that this arrangement was placed in the same position as the signalling key occupied at Cullercoats.

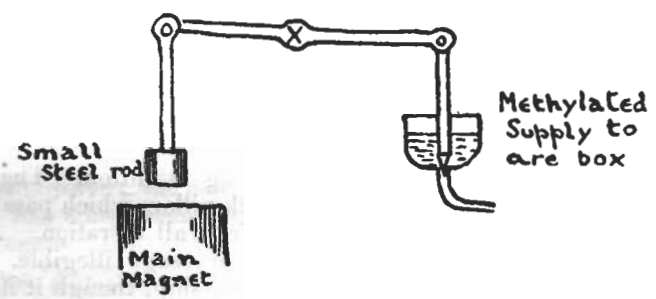
FIG. 3.



The sending arc is supplied with direct current at 480 volts, and a drip supply of methylated spirit is arranged. An automatic drip starter is fitted as shewn in Fig. 4.

When the main magnets are energised they suck down the small piece of steel attached to the drip feed and start the drip, the speed of which is regulated by hand.

FIG. 4.



A starter operated by a solenoid from the receiving room is used in connection with a De Forest spark set at the station. This starter is used to start an 8-horse power motor, occupying 15 seconds in doing so. It seems to work perfectly easily and smoothly, and is said to have given no trouble and to have required no adjustment whatever.

For ordinary commercial work this spark set is used, and watch is kept on an electrolytic detector.

Receiving instruments.

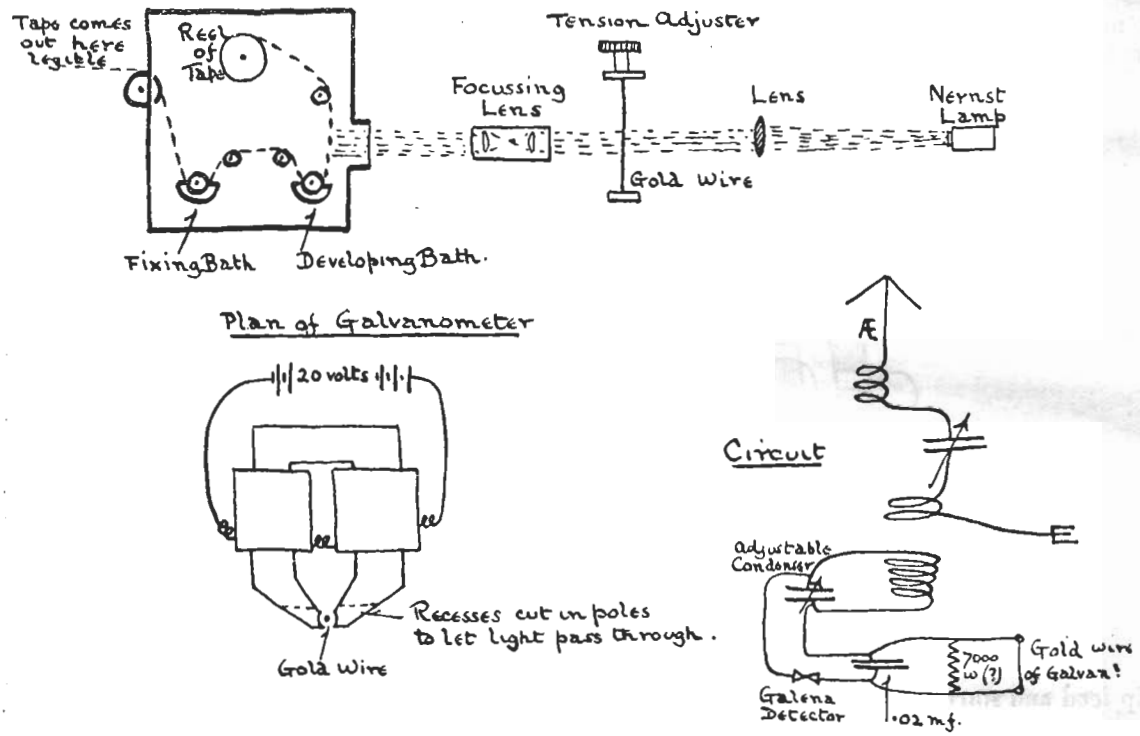
For receiving the continuous waves, the "ticker" is used when sending at ordinary speeds by hand, and for receiving the high speed signals a special form of photographic recorder is employed. Signals on "ticker" from Lyngby were "Good Signals" (service notation). The sketches illustrating this instrument are shown on the next page.

The apparatus consists of a loosely coupled receiving circuit of the ordinary type acting upon a detector formed by a contact of graphite and galena.

The detector itself was rather crudely made and required considerable adjustment. Instead of the telephones usually employed, a delicate string galvanometer was placed in series with the detector. It consists of a very fine gold wire about four inches long, held vertically between insulated supports and with adjustable tension. The resistance of this fine strip was said to be about 100 ohms. It is placed in a strong magnetic field, the magnet being energised by a 20-volt supply from accumulators. The passage of the faint detector currents through the gold wire cause it to be deflected by the magnetic field. The wire is placed in a strong beam of light, from a Nernst filament lamp, passing through lenses in a small metal camera. Through this camera a tape is drawn by a small motor, belt-driving the rollers carrying the tape. The tape is sensitised with bromide on one side, and as it unreels from the reel in the camera it passes in front of the lens and receives the shadow of the galvanometer wire on it, then passes though a developing bath, and a fixing bath, coming out with a record like that of a syphon recorder. The tape requires further fixing if it is to be kept as a record, also washing. For a test, the word "Paris" was sent

60 times a minute from Lyngby and recorded on the tape. The word was clearly legible, though at one or two points an extra short appeared. This was said to be due to the sending tape being carelessly punched.

FIG. 5.



As far as can be judged the apparatus is a practical one for use on shore. It will probably be useful in cases where long press messages or despatches are required to be sent quickly. It has the disadvantage from the Naval point of view that it is only successful in receiving continuous waves, as the cumulative effect is necessary to give good deflections of the wire. It was distinctly stated that it was no use with spark transmission, but that it appeared to work with very slightly damped waves, waves such as those used by Lepel, being presumably referred to.

The apparatus required careful supervision in its present form when working, the focus, tension of the wire, and the adjustment of the detector all requiring attention. The table on which the instruments are carried is specially supported on solid brick pillars which pass through holes in the floor without touching it, so as to isolate the instruments from all vibration. A slight shake of the table is at once recorded by the tape, and renders the message illegible. It is consequently submitted that the receiver is not suitable for work on board ship, though it may be of use in very special cases in shore stations, and may very possibly find a place in commercial stations where long messages for press, &c., are required to be transmitted. Messages have been successfully transmitted from Lyngby to Cullercoats at 125 words per minute. Further developments of the apparatus appear to be necessary before it can be considered to have emerged from the experimental stage.

Wireless telephony.

The use of the arc for wireless telephony has been discontinued, owing, it was said, to the difficulty of reliable transmission of anything except ordinary spoken words. It was found impossible to transmit code or cypher messages without endless mistakes in letters of similar sound, and it has been found much quicker to transmit all signals by morse code, even using ordinary slow speed hand transmission.

DIRECTIVE WIRELESS TELEGRAPHY. EXPERIMENTS WITH THE BELLINI-TOSI SYSTEM.

Experiments with the Bellini-Tosi directive system of W.T. have been carried out at the Post Office stations at Hunstanton and Skegness.

The arrangements at Skegness were confined to the use of the system for transmitting purposes, the utility of the method for receiving was investigated at Hunstanton.

The main conclusions arrived at may be summarised thus :—

(1) The complete system, though highly ingenious, is of too complex a nature to give promise of practical utility, and is of the nature of a delicate scientific appliance rather than a useful working method.

(2) The simplified directional system for fixed stations communicating between two points has inherent possibilities of success as a working method and is entirely free from any complexity or special skill in operating.

(3) The system is only suitable for relatively short waves, and has a very limited useful range of wave lengths. For a fixed line of communication this is rather an advantage than otherwise.

(4) The system may be secured to obtain a high degree of immunity from being disturbed or from producing disturbance both by reason of its well-marked directive qualities and its limited range of effective wave lengths.