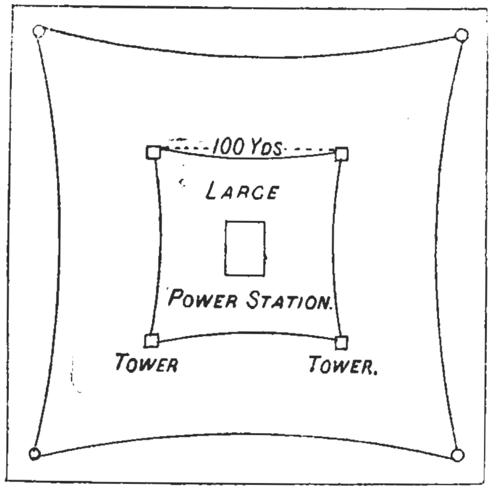
Large Power Station, Poldhu, Cornwall.

Poldhu is about eight miles from Helston Railway Station, G.W.R. It overlooks the cliffs on the east side of Mullion Cove. There is a good hotel, called the "Poldhu" Hotel, whose grounds adjoined those of the large power station. The station stands in the centre of four wooden towers, each 214 feet high, which form the corners of an imaginary square, whose side is 100 yards in length.

It is built of wood; contains the whole plant necessary for signalling.

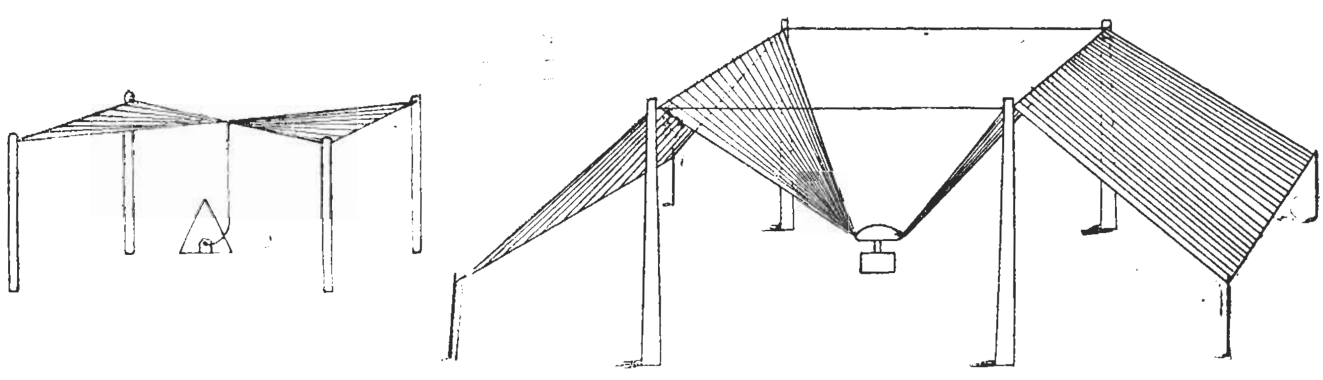
Plan of Station Grounds and Stays for Spreading Aerial.



The station contains a boiler room with three boilers (two are sufficient for working at full power, and one spare), a dynamo room with two alternators, a workshop, a room for alternator transmitters, a large room in which the condensers, transmitting jigger, choking coils, water resistances, signalling key, spark box, &c., are kept, and a small room for the receiving apparatus.

The aerial wires (made of 7-stranded 20 S.W.G. copper) consists of 400 parts, each 500 feet in length, giving a total length of 38 miles. They are all forked into a stout wire ring at the end leading into the station, and insulate from one another by hemp lanyards at the other ends.

FIG. 13.



The form of aerial is as shown in Fig. 13, two sections are only shown for the sake of clearness.

Each section consists of 100 wires, all of equal length.

The method of leading this and other aerials into the office consists in having a copper bar with terminals top and bottom, led through a solid ebonite tube, in lieu of the cowtail fitting as used in our Shore Stations. It is especially suitable for bare aerials.

The "earth" consists of thin galvanised iron plates in the form of a +, the centre of which is close to the station. Each arm is 140 feet by 2 feet; total surface 2,240 square feet, buried 18 inches in the ground.

Mr. Enwthistle, electrical engineer, is in charge of the establishment. His staff consists of:—

Two stokers.

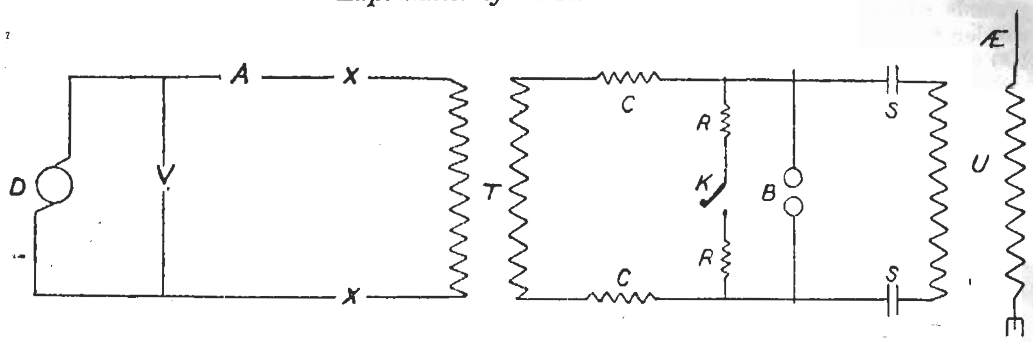
Two electricians.

One skilled operator.

Two artificers.

Fifteen working hands (mostly old sailors, for storekeepers and riggers).

Explanation of the Circuit used.



D is the alternator.

V and A voltmeter and ammeter.

X Switches.

T Transformers, stop-up 10 to 1.

C Inductances and R water resistances in series with the signalling key.

B Spark gap.

S Condensers.

J Transmitting jigger.

Taking them separately.

The alternator has an output of 30 Kilo-Watts, 27–50 reversals per second, 600 to 2,000 volts at 50 reversals.

Transformers are contained in cast iron cylinders, insulated from E, and are of the ordinary commercial type.

Choking coils are kept in oil baths.

Inductances in signalling key circuit consist of insulated copper wire 19 S.W.G. wound on long cylindrical formers.

Water Resistance contained in Bent Glass Tubes.

Signalling key double chopper contacts.

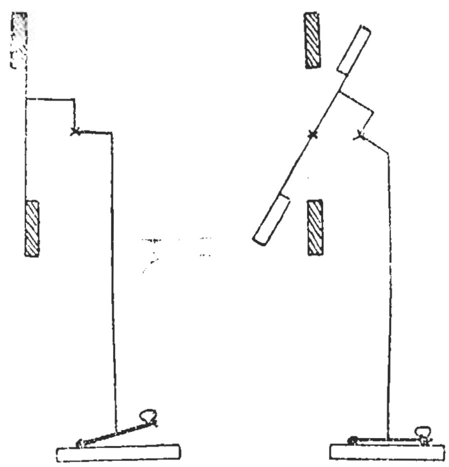
When signalling key is pressed, key circuit is broken, allowing condensers S to discharge across spark gap.

Condensers, glass and tinfoil.

Two inch clearance between edge of glass all round, except at lug.

Glass $\frac{3}{16}$ inch thick.

The stone containers which hold the condenser plates are filled with vaseline oil to prevent moisture settling on the glass di-electric and short-circuiting the tinfoil plates.



Capacity of each condenser ·055 microfarad.

There are 100 of these condensers used, arranged 6 in series and 17 in parallel.

Total capacity ·15 microfarad.

Transmitting jigger.

This is wound on a 13 inch square former and kept immersed in oil.

Primary consists of one turn (three parts in parallel).

Wire used seven strands 16 S.W.G. india-rubber insulation.

Secondary seven parts single same pattern wire.

Spark balls.

Cast iron flanged wheels.

The spark takes place at X, and in order to prevent the edges from becoming pitted, the whole are revolved by small motors. Maximum length of spark used $1\frac{3}{4}$ inches.

The primary circuit of the transmitting jigger is tuned to the aerial and secondary of T jigger by inserting a hot wire voltmeter in the aerial circuit between E and secondary, and noting the deflection.

The capacity of primary is varied by altering the arrangement of condensers until a maximum deflection is obtained. The circuits are then in tune with one another. To prevent fusing the voltmeter, a low resistance shunt is placed across the terminals of the instrument.

By calculation, taking the inductance of leads as 1,000 Ohms and capacity ·15 microfarad =130,000 cms, the frequency comes to 300,000, or the wave length equals ·6 of a mile.

The practical signalling range with this arrangement may be considered as 2,000 miles, when receiving station has a similar aerial and magnetic detector.

If the number of parts of receiving aerial is reduced, the signalling range falls off, so that for a ship which has an aerial of, say 4 parts about 500 feet long, the signal range from the station would only be about 500 miles.

The chief among the minor difficulties in practical working has been with the signalling key. Many forms and many applications of scientific principles have been applied to overcome the difficulty of making and breaking a high tension circuit of large capacity. The most satisfactory form recently tried is the breaking of high resistance inductive shunt across the spark gap by means of light quickly moving 8-break key, worked magnetically by Morse signal key, the break taking place under oil. This has made the sparking at contacts practically negligible, whereas previously continuous signalling could not be carried on for more than 10 minutes at a time on account of the contacts fusing away.

The receiving jiggers when using a coherer are similar to those for "B" tune, and are wound on a $2\frac{1}{2}$-in. diameter cardboard cylinder; the only difference is in the increased length of primary and secondary windings.

Magnetic detector has specially been wound from experiments, and no theory can at present be deduced as to the effect of different ratios of primary and secondary windings. At present the resistance of secondary is made approximately the same as that of the telephone used.

Lizard Station.

Fitted with "A" and "B" Tunes, the former is in general use for commercial signalling, "B" Tune is only used occasionally for communication with Niton, Isle of Wight. Old pattern Marconi gear used similar to type in H.M. Service.

A dynamo is supplied for charging the accumulators and lighting the station, it is driven by a $1\frac{1}{2}$-h.p. oil engine.

There are 4 operators at this station; they keep a continual look-out for passing vessels and their status corresponds with that of an ordinary telegraph clerk.

Niton.

Close to St. Catherine's, Isle of Wight. This station is fitted with "A" and "B" Tunes and the latest type of Marconi apparatus; no dynamo is yet fitted. The station is used for both commercial and experimental purposes. One skilled telegraphist is in charge, with one assistant. A continuous look-out is not kept.

A list of sailings and probable arrivals of ships fitted with Marconi apparatus is supplied to all Shore Stations.

A 180-feet single aerial is used for A Tune and a 180-feet four-fold aerial for B Tune. The method of tuning the oscillators at this station, is to keep the primary circuit constant and to alter the number of turns on secondary of oscillators until a maximum spark is obtained from top of the aerial.

The greater part of the details noted down in this Appendix were gathered in the course of conversation with the Company's experts, though many of them were actually examined by ourselves.

(Signed) H. B. Jackson, Captain H.M.S. "Cæsar."
C. R. Payne Lieut. (T.) H.M.S. "Vernon."
E. G. Loring, Lieut. (T.) Naval Reserves.

INSTRUCTIONS FOR MUIRHEAD'S AUTOMATIC SENDING APPARATUS.

This instrument mechanically works the signalling key, and thus greatly minimises the errors due to incorrect spacing. At the same time it increases the mechanical complications, consequently its merit will depend on whether it is easier to obtain good signallers or competent mechanics on board ship.

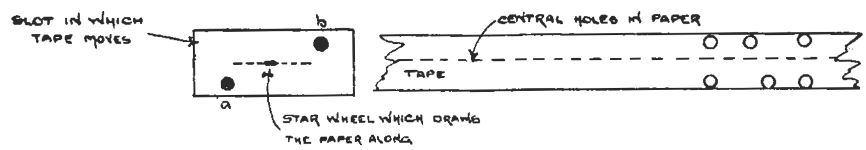
Eight instruments are now passing into the Service for trial.

The principle of the instrument consists in making levers move up or down according as they are or are not opposite holes in a piece of "tape," which is pulled by a motor across them, and making the levers work a relay which operates a key for closing the coil circuit.

In Fig. 1, Plate IV., "*a*" and "*b*" are these levers: they are pivoted at the points O, springs tend to keep their lower ends to the left, but when the paper presses down on the upper ends the lower ends are forced to the right. When, therefore, a hole in the tape is opposite a lever, the spring can assert itself and drive the lower end to the left; whilst when a blank in the paper is opposite the lever the lower is kept to the right.

Fig. 2, Plate IV., only shows the lever "*a*"; the lever "*b*" is behind "*a*," and their left-hand top ends protrude through ZZ; also *b* is to the right of *a* as seen from the top.

The view looking down from on top is therefore—



W (Fig. 2) keeps the paper pressed against the levers and against a star wheel which draws the paper along by engaging in a series of central holes in the paper.

The star wheel is revolved by a motor M.

The resistance S (Fig. 1) regulates the speed, and the contact blocks are numbered to show approximately the number of five-letter words a minute being sent.

C and D are the terminals which are placed in parallel with the ordinary key contacts, and A and B are the terminals to which a 10-volt pressure is applied for operating the relays, &c.

The relay tongue *p* is attracted to the right or left by the magnets m_2 and m_1, and the bias wheel *q*, Fig. 2, has to be adjusted so that *p* will remain at either side indifferently, according to how last acted upon.

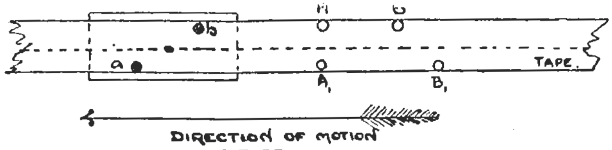
Action :—

Fig. 1 shows that when *p* touches *f*, K is energised and attracts *T*, thus closing the coil circuit. So :—

Key up when m_2 is energised, which happens when
hole in paper opposite *a*.
hole or blank „ *b*.

Key down when m_1 is energised, which happens when
hole in paper opposite *b*.
blank „ „ *a*.

Key up or down (according to how *last* acted on) when
blank in paper opposite *b*.
„ „ „ *a*.



Now suppose two holes, A and A_1 to have been punched as shown, and to be on the point of brushing past the levers.

Before they arrive, *b* and *a* are down.
When A arrives, *b* goes up, *a* remains down.
After A has left, *b* and *a* are down.
When A_1 arrives, *b* remains down and *a* goes up.
When both have past, *b* and *a* are down.

And supposing the neutral position to have been key up before either A or A_1 arrived, the table shows this gives a spark, whose length varies with the lateral distance between *b* and *a*.

Similarly, if two holes BB_1 arrive, another spark of greater length takes place.

Therefore the relative lengths between shorts and longs is the ratio :—

$$\frac{\text{distance between } b \text{ and } a.}{\text{distance between } b \text{ and } a + \text{distance between B and } B_1.}$$

Now the distances A, A_1, and B, B_1, are unalterable except by the makers, whilst distance between b and a can be altered by moving b by a screw at side.

Therefore :—You *diminish* the ratio $\frac{\text{shorts}}{\text{longs}}$ by *increasing* distance between b and a, whilst the absolute time interval of a long or short depends as well on the speed of the tape.

Consequently for the clearest possible signalling a and b should be close together and the speed should be slow enough to ensure proper sparks ; whilst the fastest possible signalling (at the expense of clearness perhaps) is obtained by making the distance a b long and then again finding the fastest speed (greater than before) which ensures proper sparks.

The Puncher.—A view is shown in Plate V., of the instrument which punches the holes, but the details of the mechanism must be studied from the actual instrument.

Notes.—(1) If the tape is cut thus (A), then when it is inserted in the sender it will make a

continual "long" until the first "short" or "long" arrives, which will be missed ; after which everything will be correct, whereas if the tape is cut as at (B) the instrument will *not* miss the first short or long.

The reason can be easily thought out.

(2) The relay contact f (Plate IV., Fig. 2) often requires cleaning, after which the bias wheel q requires readjusting.

(3) To start the paper in the puncher, pull back L (Plate V.), reeve paper in slot and release L. Now with the thumb and forefinger of the left hand press the paper against the "drawing" wheel Q, and whilst giving it a slight forward pressure as well, punch hard on the centre punch.

This will start the first hole, after which the paper ought to advance by itself whenever a punch is operated. (This is simple enough to do, though difficult to describe.)

(4) Punch *hard*. After the first few moments one begins to try and go *too fast*, which really means the punches are not *sent home*. This is the cause of 90 per cent. of the stickings.

A good operator can do 30 words per minute punching.

(5) Should the holes appear ragged and oblong, it is a sign the punches want shifting.

(6) Boxes of spare parts are supplied, which ought to enable all repairs to be done on board.

(7) Should the tape persistently refuse to work through puncher, try tightening up the spring G (Plate V.).

(8) The apparatus is designed for a maximum speed of 18 words per minute, but unless very carefully adjusted, shorts are apt to be missed at over 15 words per minute, and the present order is being passed in "Vernon" if 16 words per minute are obtained.

(9) *Signalling.*—Until great proficiency has been obtained, the procedure to be followed is to be :—

(*a*) Punch out the message. Examine it and see it is correct.

(*b*) Call up the other ship by hand.

(*c*) As soon as you obtain the answer, start the motor at 10 words per minute.

(*d*) Insert the message and let it run through.

(*e*) Important messages should be sent slowly.