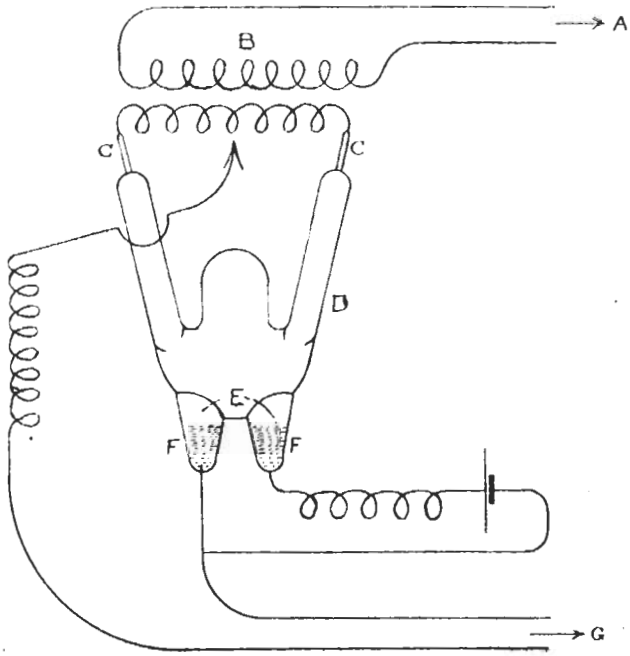
The technical alterations in the Station since last year's report are as follows :—

TRANSMITTING ARRANGEMENTS.

Power.—The cells are now charged through the Cooper-Hewitt rectifiers, mentioned in last year's report. The rectifiers are immersed in oil for insulation purposes, and are connected up as shown in the figure, the small battery of a few cells being to start the arc.

FIG. 9.



Reference.

A = To Alternator.
B = Transformer.
C = Carbon Electrodes.
D = Glass Container in Oil.
E = Arc takes place here.
F = Mercury.
G = To cells.

This arrangement of charging is very much more efficient, and therefore more economical, than the former method of using direct current obtained from dynamos run by the alternators.

Three rectifiers are used in series, each having a capacity of 10 ampères at 500 volts.

The charging does not interfere with signalling.

The current in the aerial, at the earth end, is about 150 ampères when transmitting to Glace Bay.

Spark-Gap.—A new disc spark-gap is in use, the old one, with its own primary oscillator induction, being fitted as a stand by.

The main disc, weighing a ton, is of steel, fitted with 12 copper studs, each with sparking surfaces 3 inches long by 1 inch wide. Intermediate studs can be fitted, if necessary, to increase the number to 24.

The disc rotates inside an aluminium guard at a rate of 1,600 revolutions, driven by a 50-h.p. motor. This motor also rotates the copper side discs, which are connected by worm gearing to the main shaft, at a rate of about 3 revolutions.

The clearance between the side discs and the studs is adjusted to be as small as possible, in fact, when starting up, there was at times a rubbing contact.

Blower.—The blower is a $3\frac{1}{2}$-k.w. machine, but a $7\frac{1}{2}$-k.w. one is shortly to be fitted, so as to have a good reserve of power. The air from the blower is led through metal piping, or rubber tubing where insulation is required, the outlet nozzles above, and inclined at 45 degrees to the direction of the spark. It was said that this inclination had proved more satisfactory than any other.

The air pressure supplied to the spark-gap is $1\frac{1}{2}$ lbs. per square inch. The same blower is used for the key, which was similar to the one in use last year, the pressure being tapped off from the main supply through regulating valves.

Primary of Oscillator.—The primary consists of two turns wound continuously, instead of two separate turns ending in copper plates joined by copper sheeting. In other respects the new primary was made up like the old one, *i.e.*, 7/22 cable with each strand insulated, wound spirally round a wooden tube of 10 inches diameter, $1\frac{1}{4}$ inches thick.

The new primary does not heat up, as was the case with the old one.

Aerial and Earth.—The aerial and earth are as last year, except that the transmitting aerial is now arranged in three sections so that a part of the aerial may continue in use when another portion is damaged. The three-feeder leads are joined to Bradfield insulators fitted with copper rods and with the discs removed, the insulator entering the transmitting house through an earthenware drain pipe filled in with cement. The pipe passes through a slab about 4 feet square, made up of asphalt mixed with 5 per cent. of bitumen. This mixture is made up by heating the asphalt and bitumen in an asbestonite container. The mixture must be well stirred and rammed down, care being taken that the temperature does not rise above that at which the asphalt carbonises.

This mixture forms a most excellent insulating material, and the whole arrangement is more efficient than the ebonite-porcelain insulator formerly used.

Main Choking Coils.—Air-cooled chokers are being substituted for the oil-cooled ones, as being simpler, as efficient, and less expensive.

Receiving Arrangements.

Receiving Instrument.—Carborundum detectors are in use, the valves being fitted as a standby only.

The detector consists of a carborundum crystal, mounted in solder, in contact with a flat steel spring, and when tested during the visit, this detector was far more sensitive than the valve. A potentiometer is essential for sensitiveness, and its adjustment was very critical.

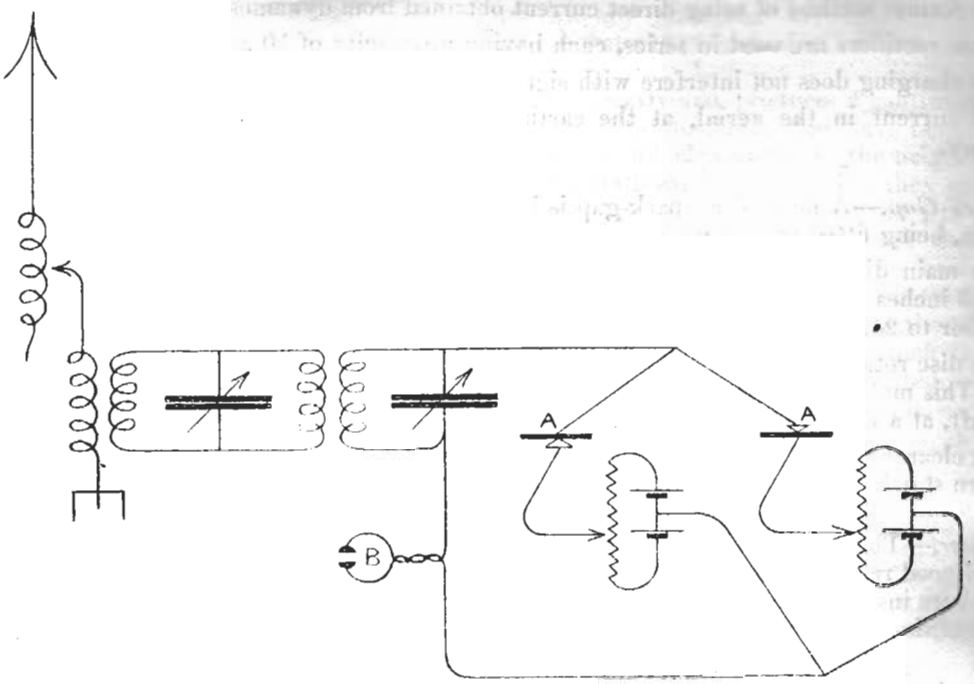
The amount of tension on the spring seemed immaterial.

It was said that the crystals are stable, but less stable than valves, and that the point of contact was not varied, once a good piece of crystal had been selected by test.

Great importance is attached to the selection of good crystals by trial, the green and grey variety of carborundum being the best for the purpose.

The circuit in use was that given in the Company's Patent, No. 20441, of August 1911, and is shown in the figure, a switch being fitted to connect up the opposition crystal circuit for atmospheric stopping. There were no atmospherics during the visit, but it was noticed that the opposition crystal circuit weakened signals very considerably, but as signals from Glace Bay are usually very strong, it was said that the circuit was of great assistance in reading through atmospherics.

FIG. 10.



Reference.

A = Detectors. B = Telephone.

The potentiometers are used as shown, owing to the fact that some crystals require positive potential and others negative.

Mercury Oscillation Valve.—This receiver, described in last year's report, has been discarded, as its sensitiveness decreased so rapidly that it was of little practical value. Experiments were carried out for some time, but this difficulty was not overcome.

Inker Record.—This instrument has been discarded as no use was found for an automatic record of signals sent.

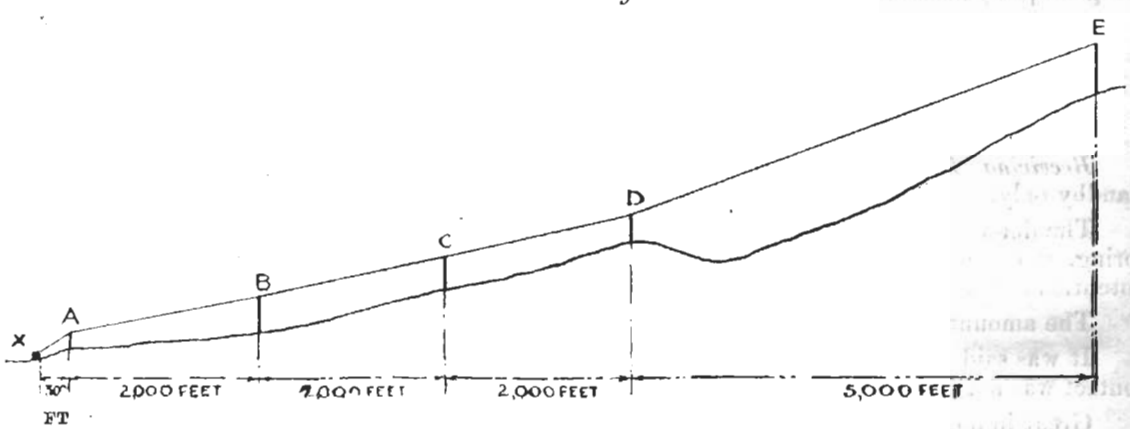
EXPERIMENTS IN PROGRESS.

Duplex Working.—This is still in the experimental stage, but no experiments have been carried out recently, pending Mr. Marconi's next visit to the station, when it is expected that he will make the final tests prior to arranging the installation for commercial working.

The Letterfrack station has been moved about half a mile from the position described last year, and the aerial, &c., shown in figure has been erected, with the exception of the 300-ft. mast which is now being fitted up.

FIG. 11.

Aerial at Letterfrack.



Reference.

Masts.		Height of Masts.	Height of Ground above Sea-Level.	Masts.		Height of Masts.	Height of Ground above Sea-Level.
A	=	120 feet.	50 feet.	D	=	160 feet.	780 feet.
B	=	200 ,,	190 ,,	E	=	300 ,,	1,700 ,,
C	=	200 ,,	450 ,,				

× Galvanised Iron Hut.

This aerial is directional for Glace Bay, and consists of a single wire carried on steel masts.

The aerial directional for Clifden is a single wire, 6,000 feet long, at an average height of 25 feet.

It is intended to transfer all the receiving apparatus and the transmitting Morse key to the Letterfrack station.

Tape Recorded Messages.—Experiments with regard to automatically recording received messages on photographic films are still in progress, but are now being carried out at Chelmsford.

No information as to the technical results obtained was available at Clifden, but it was said that successful results were confidentially expected, as the matter had now been seriously taken up, as high-speed working would soon be an absolute necessity owing to the increasing traffic. The present transmitting arrangements at Clifden are considered adaptable to high-speed working with the simple addition of a Wheatstone High-Speed Signalling Apparatus.

It was noticed that the speed of signalling during the visit was up to about 20 words per minute.

Information obtained in Conversation.—High-speed working with the duplex system is the line along which advance may be looked for in the near future, as the traffic, now 40,000 to 50,000 words exchanged per week, is getting cumbersome. Owing to this increased traffic there is no time for experimental work at Clifden, any spare time being occupied with repairs and upkeep. It was thought that Coltano and Poldhu might take on some experimental work later on.

It is probable that Glace Bay's wave-length will be increased to 24,000 feet. No immediate change in Clifden's wave is anticipated. Coltano's wave-length is about 18,000 feet, and her work at present is principally with Tripoli and Massowa.

Atmospherics are much worse at Glace Bay than at Clifden.

The Engineer-in-Charge, Mr. George, said that he had no doubt that with a tighter coupling than that used, 3 per cent., the two waves transmitted could be measured on a wavemeter. This is of interest because last year it was understood from Mr. Marconi that he considered Clifden's wave to be single in the same sense as that transmitted from a quenched-spark system.

Experiments formerly carried out at Clifden seemed to show that air under pressure in a transmitting air condenser was of advantage if the pressure were raised to about 150 lbs. per square inch, but that the advantage was not great and did not increase with an increase of pressure.

The staff at the station consists normally of 7 engineers and 13 operators, but in view of the new high-power station contract, there have recently been a few more attached for the purpose of gaining experience.

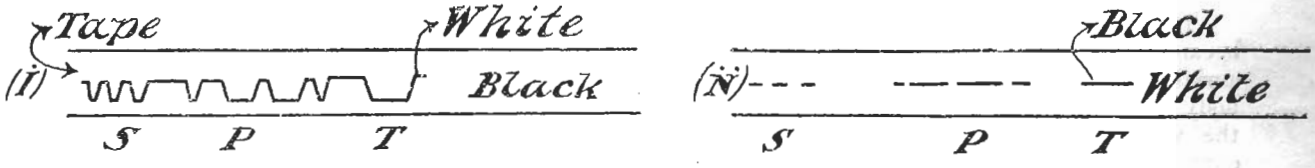
REPORT ON A DEMONSTRATION OF HIGH-SPEED RECEPTION AT MESSRS. MARCONI COMPANY'S WORKS. 30.9.12.

The receiver is very similar to the one shown by the Poulsen Company and reported on in the Annual Report of 1909. It consists of a string galvanometer, the pole pieces, excited by 80 volts, being placed horizontally, and the gold "string" vertically. A powerful arc light throws a beam of light through holes in the pole pieces, passing the "string" on the way. An optical condenser is arranged to focus the beam. The shadow of the "string" is thrown into a large box, which contains the tape and its moving mechanism, also the developing bath and fixing bath. The tape is of sensitised paper.

The receiving circuit is of the Marconi Company's standard pattern, using Fleming's oscillation valve. In place of the usual telephone is a relay, and the "string" is joined across the relay, where the telephone would be normally.

The tape being started up, before signals come in, the shadow of the "string" comes out as a white line in the middle of the black tape. Signals cause this white line to be displaced, and the tape has the appearance of white longs and shorts on a black ground, but these longs and shorts are the spaces, not the signs, as in Fig. 12.

FIG. 12.



By putting a brass sheet with a fine vertical slot in it, in front of the tape, the signals can be made to come out as black signs on a white ground. The shadow of the string blocks up the fine slip and the tape is not acted on, and comes out white. Signals deflect the string and the light illuminates the paper marking it black.

Signals were received from Poldhu at 54½ words a minute. The Marconi Company have worked up to 60 words a minute, and hope to work faster still. At the half hours Cleethorpes

was jamming, which made the tape more or less unreadable. To get over this, a "Dictaphone" was used. A slightly different circuit is used with this instrument, signals being stepped up in a single telephone receiver by three telephone relays. The telephone receiver is placed over the Dictaphone, and a record cut. The Dictaphone is then read off at any slow speed desired, and the required signal is read over the interference or atmospherics. The reading, of course, being repeated as many times as necessary.

When using the tape, the shadow of the string is visible and it can be seen at once when signals are coming through. The time taken for the tape to come out in a developed condition, after being acted on, is about one minute, that is working at 50 words a minute.

The telephone relays used were locked up in boxes, and on inquiry the Company's representative stated that they had been specially made for them. These relays had been working for three months without being touched. No extraneous noises seemed to be recorded, and there were a number of people moving about in the same room.

The Company's representatives stated that the instrument had worked across the Atlantic at the same speed.

Signals when being recorded on the Dictaphone were easily heard all over the room.

H.M.S. "GOOD HOPE" STRUCK BY LIGHTNING.

On 3rd February 1912, H.M.S. "Good Hope," lying at Arosa Bay, was struck by lightning. The discharge struck the foremost lightning conductor. A part of it passed by a 20-feet spark to the aerial wire, which was earthed, and went to earth through the earthing clip. Another portion passed by a 30-feet spark to the mainmast lightning conductor and thence to earth.

The portion of the discharge which went to earth through the earthing clip caused the whole office and aerial to illuminate, and shook it severely. Two telegraphists who were standing in the doorway of the W.T. Office experienced no shock, but were unable to see distinctly for about 20 minutes owing to the glare.

The earthing clip was slightly burnt at the contact. Some of the discharge "brushed" down the aerial and mutual coils, burning the paper of the breakdown fuze. A portion of this discharge passed the tuner, which was to zero, discharged across the No. 2 condenser lightning arresters, and passed to earth through the red plug, which was in. The arresters and red plug were slightly damaged.

The discharge must have been at very high frequency, as the skin effect, especially on the red plug, was most marked. No insulation was damaged, and no harm resulted beyond that mentioned above.

WIRELESS TELEGRAPHY IN AIRCRAFT.

Considerable advance has been made during the past year in wireless telegraphy in aircraft, further experiments are taking place both in aircraft and aeroplanes.

Aeroplanes.

Experiments were carrried out during the early part of 1912 at Eastchurch with a destroyer's harbour exercise set, using dry cells as the power supply.

This set was fitted in a hydroplane on the plain aerial system, the antenna consisting of three wires stretched across the wings. The wave-length used was 850 feet. Signals by this means were received at a distance of 8 to 10 miles.

The spark was not good and got weaker as the aeroplane rose higher.

These preliminary experiments were of value in showing that radiation was good, but it became evident that a more reliable source of power was necessary as also a more efficient form of aerial. Several experiments were carried out to test whether or no it would be possible to use the body of the machine as earth, but these experiments showed that the electrical connection between the various metallic parts of an aeroplane is bad and that the capacity is very unstable in consequence.

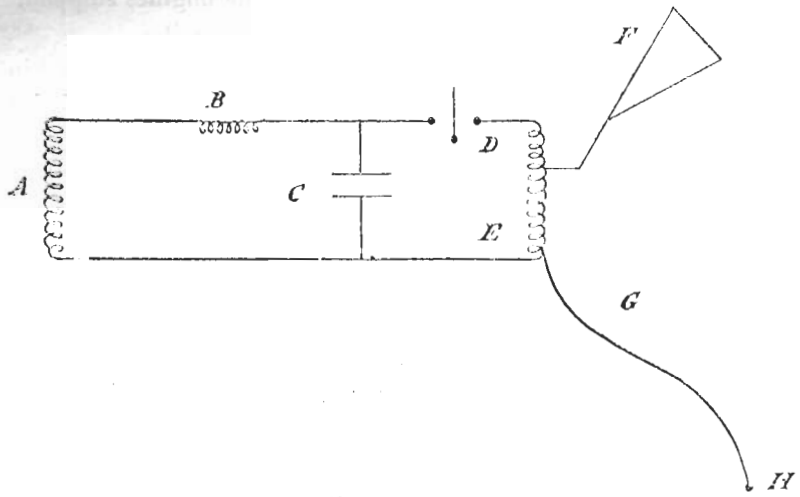
A very light set of French (Rouzet) apparatus was ordered in September 1912, consisting of a specially wound transformer and generator combined with a synchronous rotating spark-gap, this set was delivered during the first week in November.

The generator was of $\frac{1}{4}$ k.w. power driven off the main engines of the aeroplane. Revolution of generator 3,100, giving 140 volts, dropping to 110 volts on a long.

The total weight of the set is 70 lbs., including all circuits and aerial wire.

The circuit is as follows:—

FIG. 13.



Reference.

A = Secondary of transformer, stepping up to 30,000 volts.
B = Impedance.
C = Moschiki jar ·0018 microfarads.
D = Rotating spark gap.
E = Primary inductance.
F = Balancing aerial, single wire stretched across wings of aeroplane and insulated therefrom.
G = Trailing aerial.
H = 7-oz. weight.

The set was fitted to a triple tractor biplane at Eastchurch in a week, the generator and transformer being mounted close to the after engine just outside fusilage. The key and clutch to engine pulley were fitted in reach of the observer, as also the reel for reeling and unreeling the aerial wire. An ampèremeter was placed in the aerial circuit and mounted in front of observer.

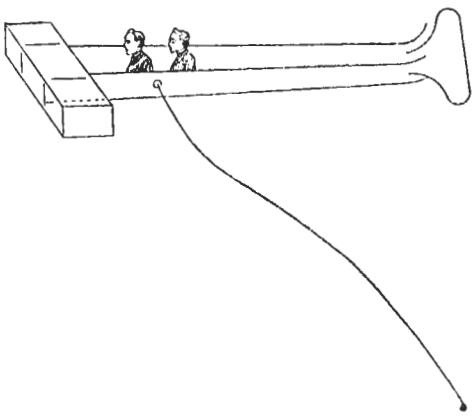
The first trial gave promising results, and the second (a trip to Dover and back) confirmed them.

Signals were clear and musical at 30 miles, using 450-foot wave.

Experiments are now being carried out to determine the best coupling and wave-length, and a considerable increase on 30 miles range is anticipated.

The behaviour of the trailing aerial was of interest; 160 feet of wire was trailed with a 7-oz. weight at the end. At 50 miles an hour the aerial trailed perfectly steadily as shown in following diagram. This length of wire could be reeled up in 15 seconds or cut at will.

Fig. 14.



A small 1-h.p. petrol engine has been purchased, weight 22 lbs., and is being fitted to drive the aeroplane set independent of the main engines.

Four more sets of Rouzet apparatus will be delivered shortly, and experiments will also be carried out with other apparatus.

AIRSHIPS.

Wireless telegraphy was tried during the Army Manœuvres of 1912 in the "Gamma," with considerable success.

The set consisted of an 80-watt magneto specially fitted to give an alternating current. The usual service circuit was used. The aerial consisted of a double trailer 200 feet long, which could

be wound up or unwound at will. The balancing aerial consisted of 611 wire, triced up by insulators to the bows and stern of the gas bag, and taken round the car but insulated therefrom.

Reception was also tried and found to be very good with the engines stopped.

Wave-length used was 900 feet. Range, strong signals at 35 miles.

A ¾ k.w. set of Rouzet apparatus has been ordered for the naval airship and should be delivered in February 1913, this set is to be capable of transmitting any wave-length between 150 and 700 metres and is expected to have a range of at least 150 miles.

Kites.

Experiments have recently been carried out at Portsmouth with a view to ascertaining:—

(*a*) What use could be made of kites in H.M. Service for receiving purposes.
(*b*) What form of kite is the most suitable.

Three different sorts of kites were experimented with, and sketches of these are shown below:—

Fig. 15.

Patt. A. "Pilot Kite."

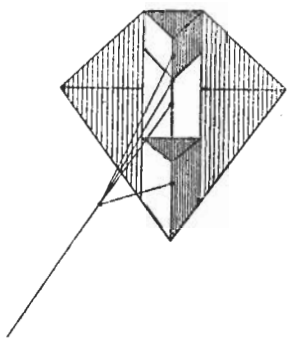
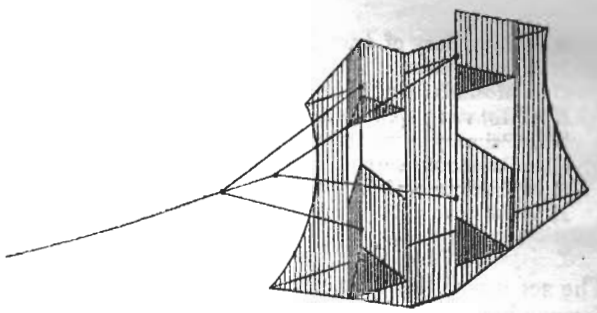


Fig. 16.

Patt. B. "Double Box Kite."

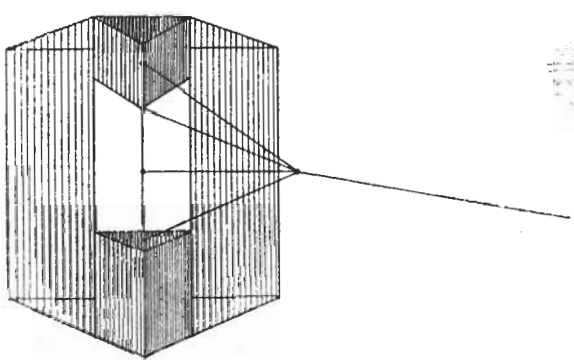


Pattern A.—"Pilot kite" has a spread of 5 feet 11 inches by 5 feet 5 inches, and a supporting area of 8¼ square feet.

Pattern B.—Double box kite has a spread of 7 feet 7 inches by 4 feet 11 inches, and a supporting area of 24 square feet.

Fig. 17.

Patt. C. "Single Box Kite."



Pattern C.—Single box kite has a spread of 6 feet 9 inches by 6 feet, and a supporting area of 29¾ square feet.

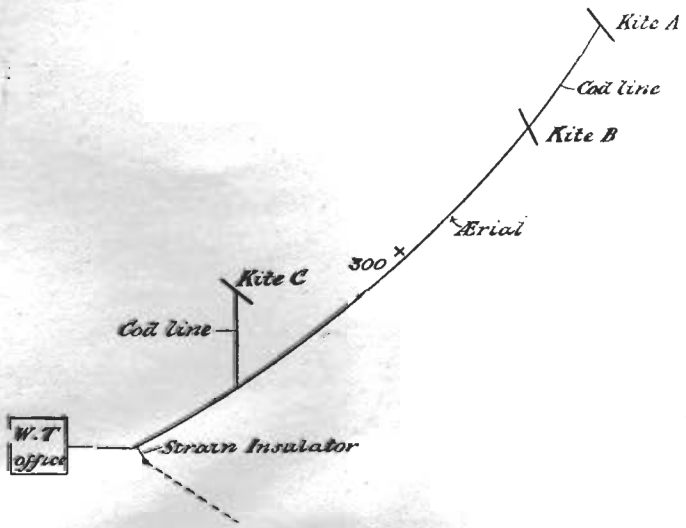
All three patterns can be easily shaken and stowed away in a similar manner to a gig's sails.

Difficulty was experienced in getting one of these large kites, such as Pattern B, to fly singly. One of the Pattern A kites was therefore flown with a light line to a height of 200 to 300 feet, when Kite B was attached to the line, and the aerial (Pattern 519) fastened direct to the lower kite.

The upper kite was then allowed to lift the lower one to such a height, that it supported about 1,200 feet of wire (weight 3 lbs.).

In addition to assisting to raise the lower kite, Kite A had a steadying effect on the other while actual flying.

FIG. 18.



In a light breeze it was found desirable to attach Kite C some distance down the aerial to support the bight of the wire.

Results.—Clifden and Coltano which normally were about strength 3–4 were received strength 10–12.

For transmitting purposes it was found that the natural wave-length of the aerial was four times the length of the aerial.

Thus to transmit "S" tune, roughly 265 yards of aerial wire would have to be supported by the kite.

It is considered that considerable use might be made of this inexpensive method of increasing range of reception for—

(*a*) Long-distance reception by a cruiser on outlying trade routes.
(*b*) Long-distance reception by a T.B.D.
(*c*) As a means of supporting a good receptive aerial after a ship action.
(*d*) For use with portable sets ashore and afloat.