WIRELESS TELEGRAPHY APPENDIX, 1911.

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GENERAL SUMMARY OF WIRELESS TELEGRAPHY PROGRESS DURING THE YEAR 1911.

The number of officers and men instructed in Wireless Telegraphy in the Schools shows a marked increase over the previous year, viz., from 199 to 390.

The number of Telegraphist Ratings at sea has increased from 851 to 1,018.

The organisation of wave lengths has been modified in accordance with the proposals put forward at the Wireless Conference held at Torbay in 1910 (*vide* Annual Report of 1910).

A handbook of Wireless Telegraphy for Telegraphists, and a revised edition of the Wireless Manual are being printed.

Wick and Scarborough Stations are completed and working, Bunbeg will be completed by June 1912.

Quenched Spark apparatus for large power Ships Installations is now approaching a final form. It is hoped that several Mark II. sets will be converted during 1912. The new High Power Station at Malta will be installed as a Quenched Spark Station.

It has been decided to instal separate Short Distance Installations in all the later Battleship and Armoured Cruisers of the 1st and 2nd Division H. F. The Battleships of the 1st and 2nd Divisions will be fitted immediately with a slightly improved form of the existing set, and the Cruisers later on with an improved set having a range of at least 20 miles.

Experimental and design work is in progress in connection with an improved form of receiving circuit.

A radiation gauge has been introduced, to indicate the current in the aerial, detect any fault in the transmitting apparatus, and assist in tuning.

The "Type C" receiving set has been issued to all ships.

Other improvements introduced include an improved form of feeder, a buzzer repeater for repeating signals on the fore bridge, &c. as they are made, and a method of efficiently transmitting short waves from large aerials.

Serious difficulties have been experienced due to the inaccuracy of the wave-meters now at sea. In this connection a considerable amount of research work has been carried out, both in "Vernon" and at the National Physical Laboratory, and it has been decided that all Service wave-meters must be recalibrated as soon as possible. Special apparatus for this purpose has been set up in "Vernon," and in order to hasten matters as much as possible the work of recalibration is being divided between "Vernon" and the N.P.L. A new form of wave-meter is being introduced.

A small tuned testing set, for testing receiving circuits in position at any moment, is being introduced.

A new method of preventing interference, known as the "Differential Interference Preventer," has been installed in the shore stations; most promising results have been obtained, and its application to the sea service is being considered.

A further demonstration of the Poulsen system between Lyngby and Cullercoats was witnessed in October 1911 by representatives of the Admiralty and other Government Departments. Experiments with this system are being undertaken on a considerable scale.

A mechanical cypher, worked electrically at considerable speed, is being constructed and tried in "Vernon." It is not considered desirable to publish details at present.

The information given under the heading of "Foreign W.T." is abstracted from Official Reports received in "Vernon" which have not at the time of writing been included in W.T. British and Foreign.

In future Annual Reports it will be possible to omit, or at any rate largely reduce, this section, as corrections to W.T. British and Foreign are now published frequently.

INSTRUCTIONAL REPORT.

The following are the numbers of Officers and other ratings who have been instructed in Wireless Telegraphy in the "Vernon" between 1st January and 31st December 1911 :—

Senior Officers	23
Qualifying Lieutenants (T.)	20
" " (S.)	7
Marine Officers "Special Course"	5
" " New Commissions	3
Other Officers' specially arranged courses	4
Gunners (T.), Scout course	13
Qualifying Gunners (T.)	37
" Warrant Telegraphists	7
Other Warrant Officers	5
Qualifying P.O. Telegraphists	55
Armourers and Electricians	32
Requalifying P.O. Telegraphists	14
Total	225

Report from "Defiance."

The following ratings have received Wireless Telegraphy Instruction in "Defiance" during the period 1st January to 16th October, 1911 :—

Gunners (T.)	9	
" (G.)	9	
P.O. Telegraphists Qualified	14	
" " Requalified	9	
Leading Telegraphists Qualified	1	(failed)
" " Requalified	nil	
Telegraphists received for instruction	9	
Armourers	20	
Electricians Qualified	28	
" Requalified	32	
Coast Guard ratings	24	(20 qual.) (4 failed)
	155	

TELEGRAPHIST BRANCH.

The numbers of Telegraphist ratings in the Service on the 1st November 1911 were as follows :—

C.P.O. Telegraphists	24
P.O. Telegraphists	202
Leading Telegraphists	154
Telegraphists and Ordinary Telegraphists	468
Boy Telegraphists (at sea)	170
Total	1,018

The second class of candidates for promotion to the rank of Warrant Telegraphist completed their course on the 27th March 1911. All the seven candidates passed the final examination. The next class will commence on the 8th January 1912. In order to minimise as far as possible the block which is bound to occur in promotion to this rank in the future, it has been decided that only three candidates are to be allowed to undergo the course in 1912.

ORGANISATION OF WAVE-LENGTHS AND WIRELESS SIGNAL BOOKS.

Experience has shown that the Wireless and Long-Distance Signal Code requires considerable revision, more especially in the case of the emergency table and in the provision of an efficient index, which frequently does not fulfil the requirements for reporting the first sight of the enemy. The book is at present under revision by a special committee.

Horsea high power station is still being used as an experimental station in connection with the "Vernon," and is not yet available in peace time to take its place in the organisation.

This station, however, now carries out the duties of Cleethorpes for one day in each week.

In accordance with the report of the Wireless Conference (*vide* Annual Report, 1910), the organisation has been modified so as to enable Admiralty messages to be transmitted by Cleethorpes and North Front at more frequent intervals, and a system of answering signals addressed by the Admiralty to Fleets has been introduced.

The proofs of this book are now being corrected, and it is expected that the book will be ready for publication early in 1912. It is of a non-confidential nature, and will be issued to all telegraphist ratings except Boy Telegraphists.

The book is intended to enable Officers and men to gain a good insight into the subject for all ordinary purposes without going too deeply into the theory.

The more advanced theory and confidential matter will be dealt with in the revised edition of the Wireless Manual which is now being prepared.

REPORT ON THE DEMONSTRATION OF THE POULSEN SYSTEM, OCTOBER 1911.

The demonstration was witnessed at both the Lyngby and Cullercoats Stations (560 miles apart) by representatives from the Admiralty, War Office, and Post Office, on October 3rd, 4th, 5th, and 6th. The working of the apparatus at Cullercoats was further investigated by representatives of Admiralty and Post Office on October 11th.

All representatives were particularly impressed with the straightforward manner in which the demonstration was conducted by the representatives of the Company. There appeared to be no attempt to exaggerate any of their results or to lay claim to anything which they could not substantiate.

2. The working of the following were shown :—

(*a*) Poulsen arc.
(*b*) Poulsen ticker.
(*c*) The tone sender.
(*d*) The high-speed transmitter, working up to 200 words per minute.
(*e*) The high-speed receiver.
(*f*) The working of two arcs in series, utilising their aggregate power. This was explained to all representatives by Professors Poulsen and Pedersen, and was demonstrated, after the Admiralty representatives had left, before the War Office and Post Office representative.

3. It is not considered necessary at present to investigate further the high-speed system for Admiralty purposes, but the Poulsen continuous wave system is well worth further expenditure and investigation.*

Short description of the various instruments, &c. mentioned in paragraph 2.

(*a*) The Poulsen Arc Transmitting System. This is, in essential, the same as previously supplied to and tried by the Admiralty. Certain improvements conducive to increased practicability have been introduced. It has not yet reached a stage which renders it more suitable for men of war than existing installation. The inventors state that 32 K.W. have been utilised in a single arc, that 50 K.W. could be utilised in a single arc, and 100 K.W. using two arcs in series.

(*b*) The Poulsen Ticker is claimed to be the most sensitive device for receiving continuous waves yet produced. Much improved since last investigated, but possessing various inherent disadvantages, the principal one being that it does not permit of the individuality of signals being recognised. Also, the sensitiveness does not appear to remain very constant.

(*c*) The Tone Sender consists of an interrupting commutator for breaking the otherwise continuous oscillations into a musical note, suitable for reception by receiving system designed for spark telegraphy. This worked satisfactorily, and has the advantage of rendering it possible to easily vary the tone of signals almost indefinitely. It has the effect of reducing the strength of signals (as against continnous wave signals received by ticker) by about 50 per cent., which reduces the effective range to approximately that of a spark system of similar power.

(*d*) The High Speed Transmitter. This is operated by a punched tape similar to that used for a Wheatstone Telegraph Transmitter. It appears to be a very practical instrument, which is capable of considerable development and of application to any powers of both continuous and spark systems. Practical demonstration up to 200 words per minute was shown. The power required for signalling increases rapidly with the signalling speed used. This piece of apparatus could be used on board ship, but its practical application is prevented by the nature of receiving device.

(*e*) The High Speed Receiver. Consists essentially of a string galvanometer, which replaces a telephone in the receiving circuit, and a photographic recorder. The demonstration suffered from the fact that the photographic recorder was of a temporary form, suitable for demonstration purposes only. It is understood that there are at present on the market other photographic recorders which would meet all requirements for shore station work. The high speed receiving device is unsuitable for ship use, and it is not anticipated that it could be made so on the existing principles. It is suitable for spark reception. It appears to suffer seriously from interference, and, if used, would require very selective receiving circuits.

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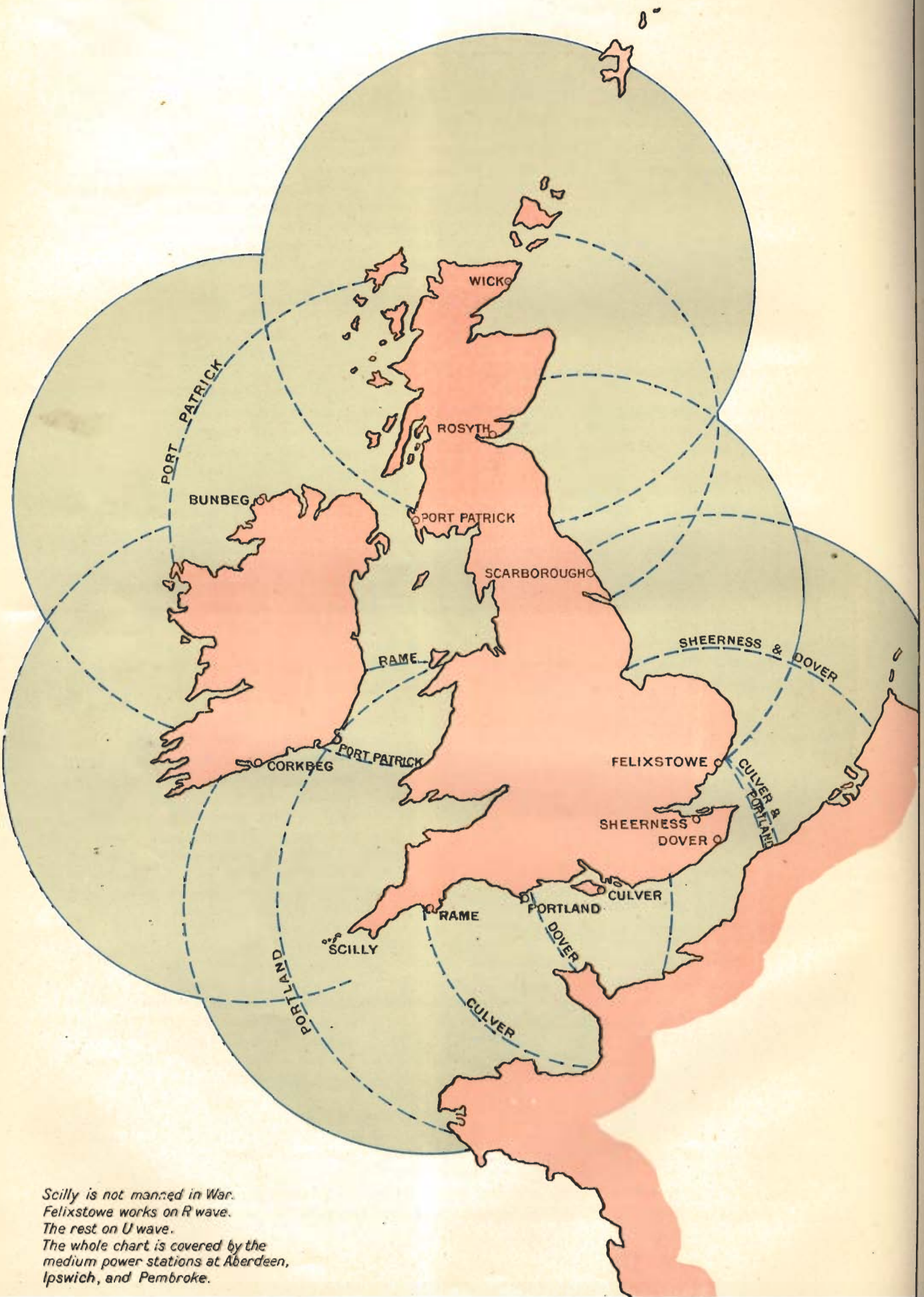
* Experiments with the Poulsen system are being undertaken on a considerable scale.

W/T LOW POWER SHORE STATIONS

(CIRCLES SHOW RANGE WITH A FIRST CLASS SHIP)



Scilly is not manned in War.
Felixstowe works on R wave.
The rest on U wave.
The whole chart is covered by the medium power stations at Aberdeen, Ipswich, and Pembroke.

SHORE STATIONS.

General.

The personnel for shore stations under the A.C.R. now consists of 198 operators (excluding Warrant Officers) of whom 94 are now Petty Officer Telegraphists. In addition to their position as operators all these men can drive an oil engine and take care of secondary cells. All the men at the high power stations are capable of starting up and synchronising the machinery.

The new fishery protection vessel, H.M.S. "Watchful," has been fitted with W.T. She has a destroyer installation which has been converted to send "R" wave only. Working with Felixstowe and the other fishery gunboats her sending range is about 100 miles and her receiving range about 150.

All shore stations (except high power) have been fitted with a Differential Interference Preventer, details of which are given on pp. 26–29. It works very well when the correct design of auxiliary aerial has been determined for each station. Interference becomes very rare, even from signals on exactly the same wave length, when once the operators have become thoroughly accustomed to it, but its adjustments are very delicate. Very little experience has as yet been gained in using it against atmospherics, and the results are promising though not as yet completely successful.

Station.	Situated.	Nominal Range.	Usual Wave.	H.P. Engine.	Cable Supply.	Cells.		Dynamo.	Rotary.	Masts. No. and Height.	Type of Aerial.	Main.		Aux.	
						Volts.	Amp.					λ	σ	λ	σ
Cleethorpes	3 miles S. of Grimsby.	1,000	X	300	2,200 (3φ)	—	—	Special.	—	1/180, 4/160, 4/60.	4-part fan	37	15·5	—	—
Horsea	Horsea Island, Portsmouth.	1,000	Y	—	,,	—	—	,,	—	4/160, 8/60	,,	53	13·5	—	—
Whitehall	On roof of Admiralty.	400	V, W, X	—	200 D.C.	—	—	—	Mk. II.	1/180, 2/160	2 cylinders	58	3·1	80	1·5
Aberdeen	5 miles W. of Aberdeen.	500	W	—	6,000 (3φ)	—	—	—	,,	2/180	3 cylinders	40	2·9	80	1·5
Ipswich	Ipswich, near railway station.	500	W	—	440 D.C.	—	—	—	,,	2/180	3 cylinders	41	2·9	82	1 6
Pembroke	Pembroke Dock	500	W	—	220 D.C.	—	—	—	,,	2/180, 2/60	2 cylinders, with tails.	90	2·5	85	1·7
Wick	Wick, near railway station.	300	U	15	—	100	15	10 k.w.	C Tune	2/160	3 cylinders	36	2·2	—	—
Rosyth	½ mile N.W. of Forth Bridge.	200	U	5	—	120	5	C Tune		1/160, 4/60	3-part fan	34	3	—	—
Scarborough	1 mile W. of Scarborough.	300	U	—	2,000 (1φ)	—	—	—	—	2/170	3 cylinders	36	2·2	—	—
Felixstowe*	On beach S. of town	200	R	5	—	65	5	Old 4 pole		1/180, 4/60	2-part fan	58	2	60	·8
Sheerness	Garrison Point Fort	100	U	—	220 D.C.	—	—	—	Mk. I*.	1/130	2 cylinders	43	1	80	·8
Dover	On hill W. of Dover	100	U	5	—	95	5	2 k.w.	T.B.D.	1/160, 2/50	2-part fan	40	2·5	—	—
Culver Cliff	Isle of Wight	100	U	10	—	100	10	6 k.w.	—	1/150, 4/50	3-part fan	49	3·7	—	—
Portland Bill	Near lighthouses	200	U	5	—	120	5	C Tune		1/170, 4/40	,,	50	3·0	—	—
Rame Head	Near extreme point	200	U	5	—	120	5	,,		1/170, 4/50	,,	31	4·5	—	·5
Scilly†	On Telegraph Hill, St. Mary.	200	U	5	—	120	5	,,		2/150	,,	40	1·9	—	—
Cork Beg	E. side of Cork Harbour entrance.	200	U	5	—	120	5	,,		1/160, 4/50	3 cylinders	45	3.5	108	1·1
Bunbeg	15 miles S. of Bloody Foreland.	300	U	15	—	100	15	10 k.w.	C Tune	2/160	3-part fan	36	2·2	—	—
Port Patrick	On cliff N. of Port Patrick.	200	U	5	—	120	5	C Tune		1/160, 4/40	2-part fan	65	3	—	—

The nominal ranges given can be exceeded when working with a first-class ship by day, and can, generally speaking, be doubled at night. Care is taken to make the various sections of each aerial symmetrical.

* Has also a small D set.

† Not manned in war.

Low Power Stations.

These work well and give no trouble from a technical point of view. Details of fittings are given in the table shown above.

In most stations the old Poldhu jars have been replaced by C Tune condensers, and C Tune rotaries have been adapted for shore station use.

Rosyth, Felixstowe, Sheerness, Dover, Culver, Rame Head, Portland, and Cork Beg are fitted with motor buzzers which are capable of about 50 miles range.

Alderney will be closed as a naval station in 1912, and all three Channel Island stations will then be worked by the Post Office for the military instead of by the Admiralty.

Medium Power Stations.

Whitehall and the three medium power stations, Aberdeen, Ipswich, and Pembroke, continue to do their work very well and satisfactorily.

High Power Stations.

These have given satisfactory running results though the half-hourly sending has allowed but little opportunity for minor adjustments.

The new pattern spark plugs have greatly improved the note, but they burn away rapidly. If the spark is adjusted to 8 mms. at the beginning of a long signal it burns away to 9 mm. at the end.

Horsea.—This station is still reserved for experimental work, but takes over the duties of Cleethorpes for one complete 24 hours in each week to allow of adjustments, &c., and it is available at any time to take its proper place in the organisation.

The improvements and alterations referred to on page 11 of the W.T. Appendix to the Annual Report for 1910, and other improvements, have been proceeded with.

1. *Wedge-shaped Plugs.*—These plugs have now been standardised and have been assigned the pattern Number 2459; they have been supplied to Gibraltar and Cleethorpes, but the same improvement in note has not been obtained with them at these stations as at Horsea; this is ascribed to the lower voltage, the auto-transformers not having been yet supplied.

2. *Auto-transformer.*—This machine has continued to give very good results at Horsea; similar tranformers were designed and ordered for the two other high power stations and were duly delivered; unfortunately they failed to pass the specified tests and have been rejected.

3. *Magnetic Key.*—The old type of magnetic key is still in use, the Marconi Company having met with considerable and unanticipated difficulty in meeting all the requirements of "Vernon" in their new key.

There is promise now of all difficulties being surmounted, and it is probable that new keys will be installed early in 1912.

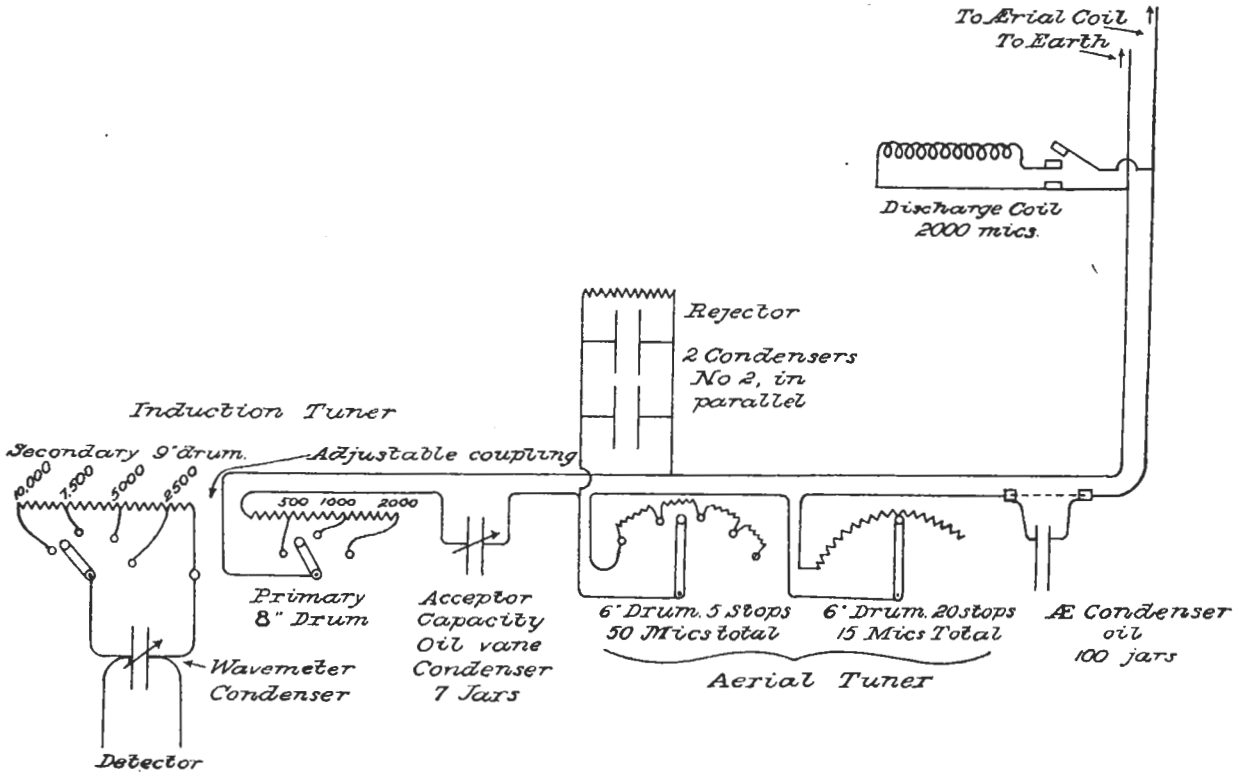
4. *Transmitting Coils.*—No improvements have been effected in the primary or mutual coils, but these experiments have been in abeyance pending the introduction of quenched spark.

5. *Aerial and Earth Ring in Tower.*—The archway at the foot of the aerial tower has been widened considerably to increase the sparking distance to earth, while the aerial and earth rings have been much improved; connection to the latter is now made by 40 wires which spread fan-wise from a connection at the bottom of the mutual coil. A Mark II. operating switch has been adapted for use across the aerial and earth rings, but entirely satisfactory results are obtained by a C Tune Key, which is worked as a simple aerial and earth make-and-break; it necessitates a cessation of signalling and lifting the pedal switch in order to listen for any signals while sending.

6. *Receiving Circuit.*—A special design of receiving circuit, suited for the reception of long waves on a large aerial has recently been fitted and gives promising results, but more experience is yet necessary. A diagram of the circuit is given in Fig. 1.

Fig. 1.

Horsea Experimental Receiving Gear.



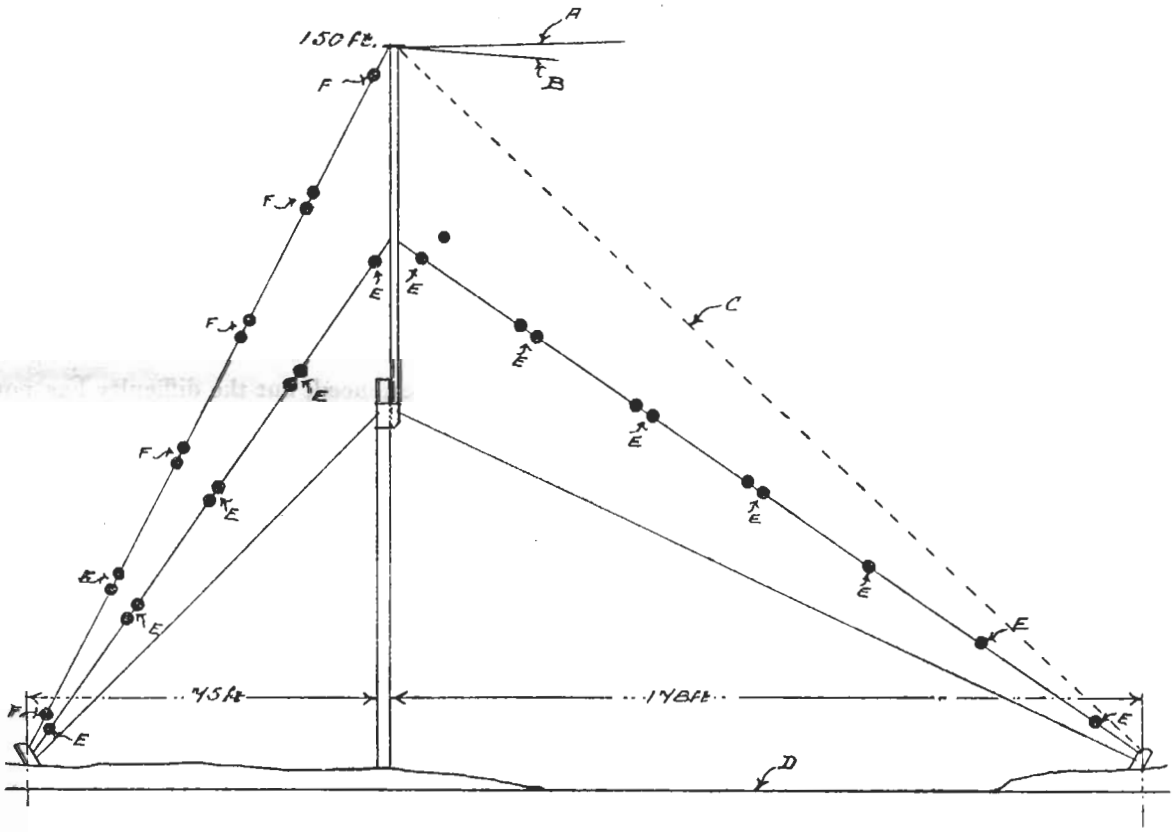
7. *Deck Insulator.*—Much trouble has been experienced with deck insulators at Cleethorpes, and additional insulation has been devised by the officer in charge: the new arrangement gives quite satisfactory results, and a design of similar nature has been prepared, and the gear is now on order, for Horsea. The original insulator fitting has given no trouble at Horsea with X and Y tunes, but the factor of safety would be insufficient when using quenched spark gear. Since the design was completed experiments have been carried out with an 18,000-foot wave when the deck insulator gave much trouble, it being found impossible to use anything but a small spark and a moderate coupling.

8. *Rigging.*—The old wire and hemp rigging was replaced by insulated wire rigging in January 1911. Unfortunately the new rigging was found to be insufficiently insulated; the sparking across the insulators was very bad, enabling signals to be read visually at night for over three miles. This bad sparking was partly due to the insulators having been originally blacked over, and though the blacking was afterwards removed, traces of it remained on the surfaces, especially the inside. Also the eyes fitting over the insulators were parcelled and served and treated with paraffin wax; this had the result of greatly reducing the effective insulating surface, and the inflammable materials were ignited and deposited dirt, &c., which further reduced the effective insulation. But above and beyond these contributory causes, there is no doubt that more insulators were required, and accordingly fresh rigging was provided. The topmast stays and the inner royal stays were dispensed with altogether as being unnecessary, and the remainder of the rigging was fitted with a much larger number of insulators than before. At the same time each stay anchor was efficiently earthed by a zinc strip and earth plate.

Fig. 2 shows the present arrangement of insulators for the Horsea masts.

FIG. 2.

Insulation of Horsea Masts.



A = Triatic stay to opposite masts.
B = Jack stay supporting aerial.
C = Light, insulated, portable stay.
D = Lake.
E = Insulators, Patt. No. 996.
F = Insulators, Patt. No. 997.

The refit of the rigging was finally completed in April, and the present arrangement has proved satisfactory; no sparking now takes place with X and Y, though a small amount is observed when transmitting the 18,000-foot wave with a tight coupling.

9. *Aerial Feeders and Anti-brushing Gear.*—Multifold feeders will be fitted shortly at Horsea station, and it is proposed to fit one section of the aerial with anti-brushing gear; this will consist of a very similar arrangement of wires and spreaders which will be suspended horizontally from the jackstays between the two big masts and between the two small masts; also short lengths of 20 wire "tubes" will be placed at the edges of the fan, between the small and large masts; the idea is that these "tubes" on the edges of the aerial will absorb and prevent all brushing with its attendant waste of energy.

10. *Long Wave Experiments.*—In September 1911, H.M.S. "Furious" was dispatched on a cruise for the purpose of selecting sites for an Imperial chain of high power W.T. stations, and for experimenting in long-wave transmission. To assist in the latter project Horsea was supplied with temporary primary and mutual coils to enable signals to be sent on an 18,000-foot wave;

the gear was only completed the day before "Furious" sailed for Gibraltar, and signals between the ship and Horsea were not very successful, due to the breakdown of deck insulators at Horsea—two burning out during the first two days and so interrupting the endeavours to find the best adjustments. The "Furious" experienced very bad weather on the way out, and had great difficulty in keeping her aerial feeders clear of stays, &c.; also she was unable to use anything but a very loose coupling, or, with a 7 per cent. coupling anything larger than a 5 mm. spark on account of the heavy brushing and sparking.

A large inductance had to be inserted in the foot of the aerial, with the result that a large proportion of the energy in the aerial was wasted in radiation inside the cage.

"Furious" was not heard by Horsea outside a 200-mile range, and Horsea's signals were not received over 650 miles. The special primary at Horsea consisted of 8 parts of Pattern 600 wire wound flat (3 turns) on an octagonal former 4 feet in diameter across sides, and the mutual was 14 turns of 4 parts of Pattern 611, the 4 parts being laid up as a hawser and wound closely on a former 3 feet in diameter. With these coils very tight couplings could be obtained, but signalling with a tighter coupling than 6 or 7 per cent. and a 7 mm. spark was found to cause very heavy sparking at the deck insulator and occasional sparking across the stay insulators. After a burn-out with the second deck insulator, the deck plate was removed, and two slabs of ebonite, 1½ inches thick, substituted; the insulator was secured on top of these slabs—upside down. It was reversed in this way because the heaviest sparking occurred at the bottom of the insulator, and each punctured through the ebonite just below the porcelain, the spark going across to the cement top of the tower; by reversing the insulator, a greater length of porcelain was brought opposite the cement. This arrangement has been found to be satisfactory, and there appears to be no gain in strength of signals when using the tighter couplings while the note is certainly not so steady; the current taken from the alternator as the coupling is loosened increasing (with voltage and spark length kept the same) to a marked extent.

After "Furious" passed out of range Horsea sent a programme each day and night for three weeks to Gibraltar to determine the best adjustments; these appeared to be, with 18,000-foot wave, 6 mm. spark, 20 inch coupling (about 6 per cent.), and 470 volts from alternator (*i.e.*, with auto, 530 volts in primary of main transformer), which takes 730 ampères from alternator. This appears satisfactory by night and day with practically no difference in strength for light or darkness; indeed, with all adjustments tried for this long wave it has appeared that signals are equal in strength by day and night. The note is good and, though Clifden was using a wave not very different in length, Gibraltar appeared to have no difficulty in reading Horsea over Clifden.

11. *Quench Spark Experiments.*—A temporary iron shed has been erected at Horsea for the accommodation of quenched experimental gear; stores are now on order which, when delivered, will enable an experimental set to be erected and also a gap-testing set. The experimental set will approximate to one-twelfth of a full power set for the station.

Cleethorpes.—Trouble with deck insulators has been experienced, but the difficulty has now been quite overcome, extra insulation having been designed by the officer in charge; the extra insulation is obtained by raising the deck plate on four 6-inch porcelain pillars, and closing it in with weather screens of glass.

An engine and dynamo will be installed at Cleethorpes during 1912, which will be capable of working the station at full power if the cable should fail from any cause.

Both sets of alternators at the station had to be lined up in February; the fault lay in the original erection of the sets.

Most valuable results have been obtained by the use of the camera.

Gibraltar.—The Governor of Gibraltar has expressed the opinion that the North Front station is in an exposed position and could not be adequately defended, and he is desirous of moving the station either to the galleries or to the top of the Rock. The latter scheme would be very costly and perhaps inefficient; moving the station to the galleries would be costly, too, and not as efficient as the present position. It is, however, desired to duplicate the power supply for North Front, and it is therefore recommended to leave the present station intact, and to erect a new transmitting plant (independent of the dockyard) in a bomb-proof shelter close to the lower aerial moorings. It is also recommended to place a machine gun and searchlight emplacement to defend the lower stay anchors, which can be further protected by wire entanglements.

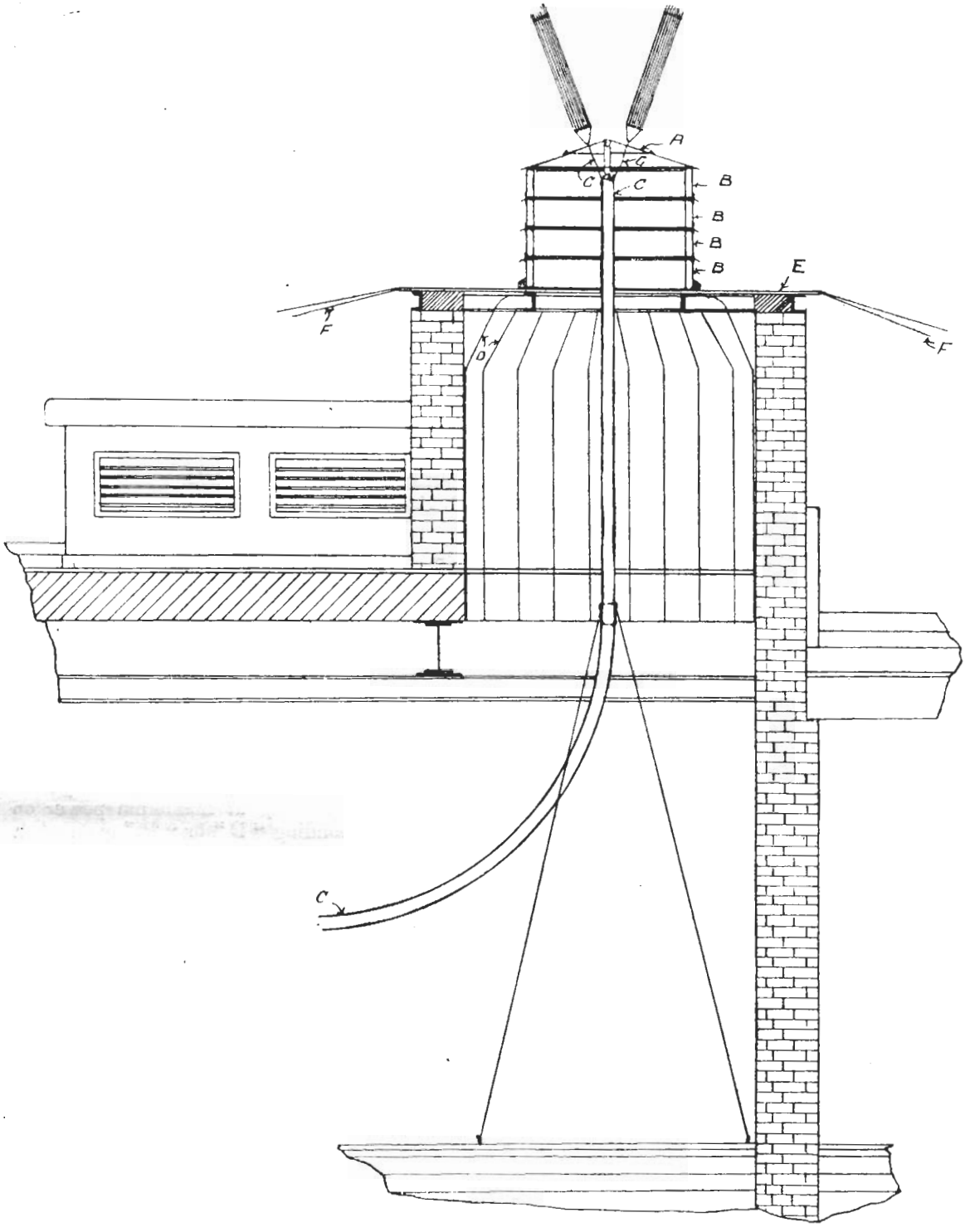
Aerial insulators, type 7, have not proved satisfactory at Gibraltar, where the aerial is quite different to those at the other high power stations, and therefore a special insulator has been designed; it is similar to the type 7 but longer, stronger, and with increased insulating surface.

It is also found that with the great length of aerial used at North Front station, turns occur in the wires, thus bringing an unfair strain on the insulators, and therefore swivels have been supplied for insertion in each wire of the aerial.

Malta.—Although the work in connection with Malta high power station has well advanced during the year, the station will not be ready, complete, and in working order, until 1912. Pressure of work in H.M.S. "Vernon" has been primarily responsible for this delay. The station will be as described in the Wireless Telegraphy Appendix, A.R., 1910, with the exception that the quenched spark apparatus will be installed from the commencement. A new type of roof insulator has been designed for the station, and is shown in Fig. 3.

FIG. 3.

Aerial and Earth Connections, Malta High Power Station.



A = Phosphor-bronze cap, carrying aerial feeder fittings.
B = Four sections of stoneware tubing, each bedded on lead.
C = Copper tube connection to aerial coil.
D = Earth connections.
E = Steel roof forming part of earth connection.
F = Earth wires radiating from roof.
G = Receiving connection from aerial to copper tube.