Tuning "C" Tune, Mark II.

Tuning aerial and secondary.

1. Tune the secondary of the oscillator by the plain aerial method, connecting the bottom of the oscillator through a spark gap to earth. As the secondary can only be adjusted to the nearest half turn, the nearest positions to the LS values 290, 476, and 712 must be obtained and labelled.

Tuning primary to "S," "T" and "U" tunes.

2. Tune the primary with the aerial disconnected to exactly the same values as those obtained for the secondary. For both these operations an induction coil should be used, a small spark can be obtained on 80 jars with one coil. In 2 the mutual can be placed parallel to one of the primary rings.

Measuring outgoing waves.

3. Measuring outgoing waves. To check the above results, join up primary and secondary to adjustments already found and measure the outgoing waves, using the rotary. In this case the wavemeter can be outside the screen and the mutual of insulated wire led through the wire screen, so that none of the safety arrangements are short-circuited.

Plain aerial spark.

It might be useful to note that a good steady plain aerial spark for tuning can be obtained with two coils, using the primary of one coil only and the secondaries in series, the secondary of the idle coil forming a choker. Should the ends of the primary of the idle coil spark excessively they may be joined together.

Instructions for Filling Tanks.

Filling oil tanks.

All tanks are to be kept completely filled with Wakefield's vaseline insulating oil, flash point = 290° F. In filling, care must be taken that the oil is quite free from dirt or grit. An inclining test of 45° will be carried out.

Contents of tanks:—

	Gallons.
Condensers (22½ gallons each)	45
Choking coils	17
Transformer	13
Total	75

Oil will be supplied in 5-gallon drums, 13 of these to each "C" tune, Mark II., set.

Oil-Expansion Arrangements.

Oil expansion arrangements.

To ensure the tanks always remaining full, oil expansion is allowed for by placing a small copper container over each tank, connection being made by a spiral pipe. The top of the container is closed by two layers of copper gauze to prevent the oil splashing out at sea; when working, the oil becomes heated and expands up the pipe, on cooling it returns to the tank, which is thus kept full.

Experiments carried out by H.M.S. "Furious."

Summary of Results given in Lieut. Crawley's Report of Experiments carried out with a view to ascertaining the Shortest Range at which Poldhu Sending could be cut out whilst Signals were received on Tuned Shunts from Rame Head.

Interference experiments May 1906.

At 5 miles from Poldhu, signals were received on "Q" tune on board "Furious" from Rame Head (50 miles) using 4-mm. spark and hammer make-and-break. Poldhu sending usual noon message did not interfere.

At 13 miles from Poldhu signals were received from Rame Head (40 miles) on "Q" "R" and "S." Inferior results were obtained with "T" and "U" tunes, due probably to inaccurate tuning of transmitter at Rame Head.

Long-distance high-power experiments, December 1906.

At the time at which this report is being compiled, long-distance experiments are being carried out between "Furious" and "Vernon" with high power, using a motor alternator giving a frequency of about 250 cycles, with the object of obtaining a musical note.

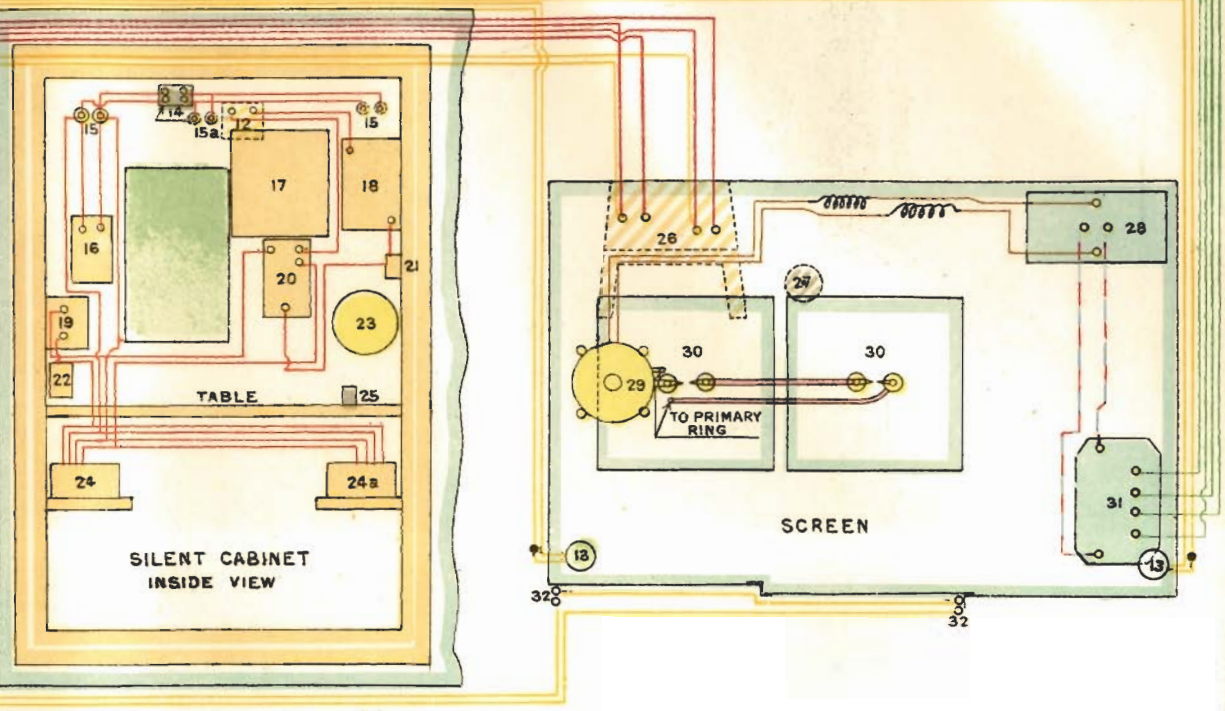
Experiments with Atlantic Fleet.

Directional W.T.

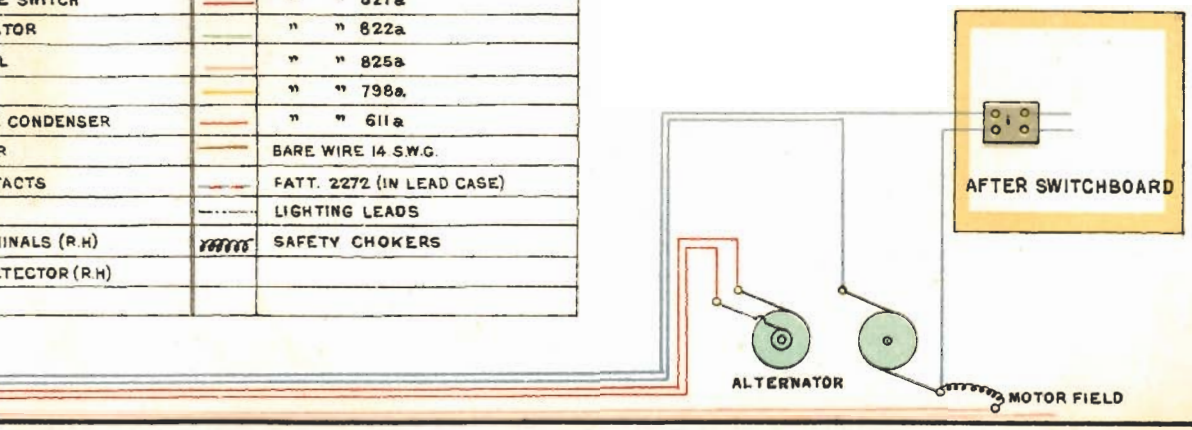
Some interesting experiments were carried out between "Vernon" and Atlantic Fleet during the month of May, when the Fleet were on a passage from Gibraltar to Madeira. It was found that at night, when the ships turned so as to bring their sterns in the direction of Portsmouth, messages could be received at a distance of 1,100 miles on board "Vernon," though nothing could be received except when the ships pointed in this direction. Signals were also received by "Vernon" from "Prince of Wales" off Pantellaria at night; in this case the ship was heading towards Portsmouth. The above tends to prove that the present roof aerials are best for sending ahead or astern.

UNE Mk II.

OFFICE AND SILENT CABINET.

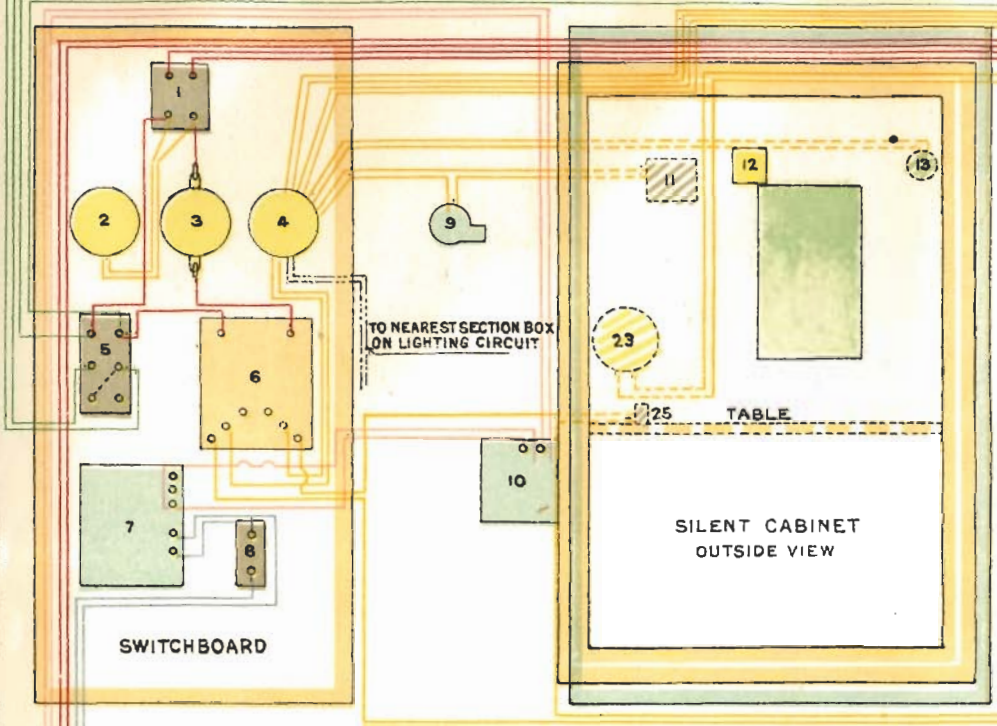


		PATT. Nº 819a
E SWITCH		" " 821a
TOR		" " 822a
L		" " 825a
		" " 798a
CONDENSER		" " 611a
R		BARE WIRE 14 S.W.G.
TACTS		PATT. 2272 (IN LEAD CASE)
		LIGHTING LEADS
INALS (R.H)		SAFETY CHOKERS
TECTOR (R.H)		



"C" TU

DIAGRAM OF WIRING OF



REFERENCE.

1	DOUBLE POLE CUT OUT	13	LAMP	25	KEY
2	VOLT METER	14	DOUBLE POLE SWITCH	26	SEND RECEIV
3	AMMETER	15	FRENCH TERMINALS (L.H)	27	DECK INSUL
4	DISTRIBUTING BOX	16	TELEPHONE CONDENSER	28	CHOKING CO
5	DOUBLE POLE 2 WAY SWITCH	17	REJECTOR INDUCTANCE	29	SPARK GAP
6	MAGNETIC KEY	18	TUNER	30	GLASS PLATI
7	MOTOR STARTER	19	ACCEPTOR CONDENSER Nº1.	31	TRANSFORME
8	CUT-OUT	20	REJECTOR INDUCTANCE CONDENSER Nº2.	32	SAFETY CON
9	CIRCULATOR	21	AERIAL CONDENSER Nº3.	a	SWITCH
10	FIELD REGULATOR	22	SMALL ACCEPTOR CONDENSER	15a	FRENCH TERI
11	CIRCULATING REGULATING SWITCH	23	FREQUENCY METER	24a	MAGNETIC D
12	AERIAL AND EARTH TERMINALS	24	MAGNETIC DETECTOR (L.H)		

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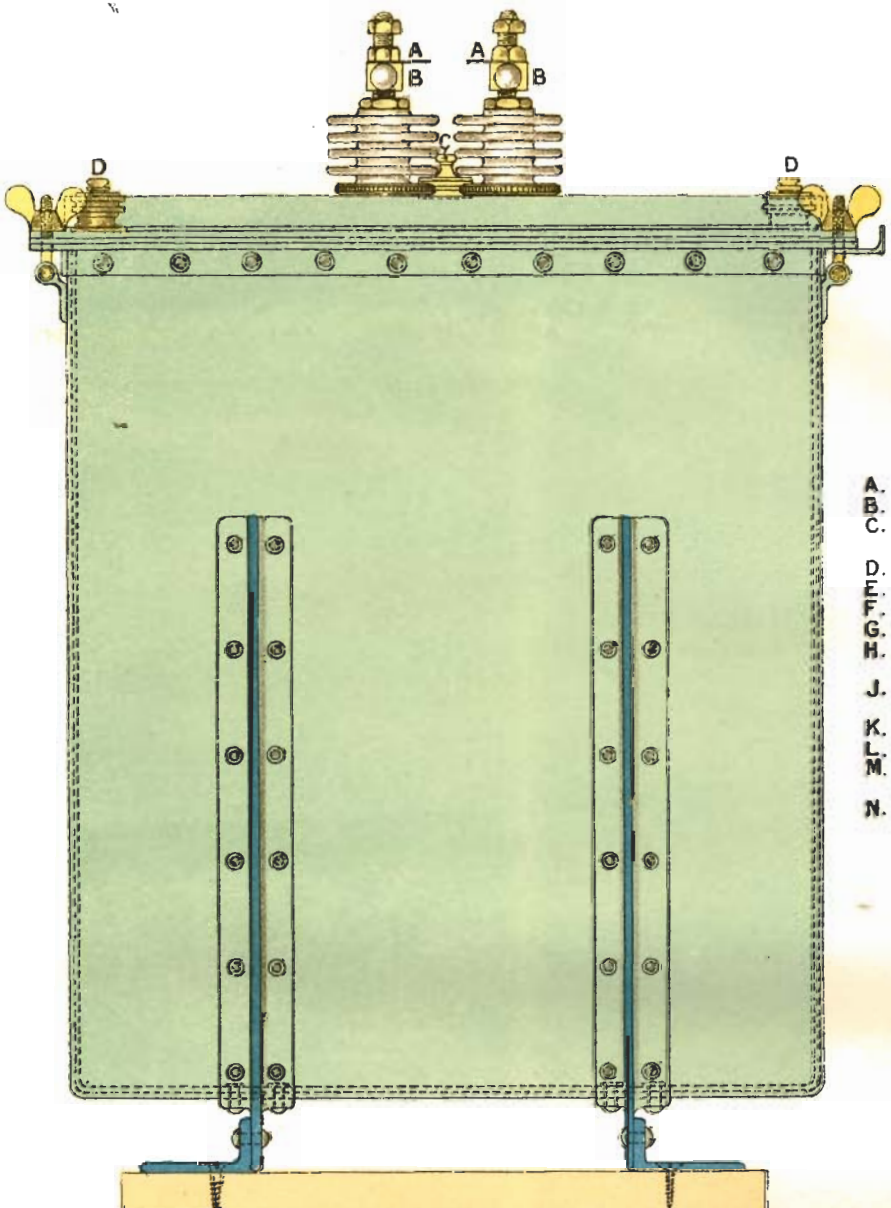
GLASS PLATE CONDENSER, 80 PLATES. (SCALE 3/16THS FULL SIZE)

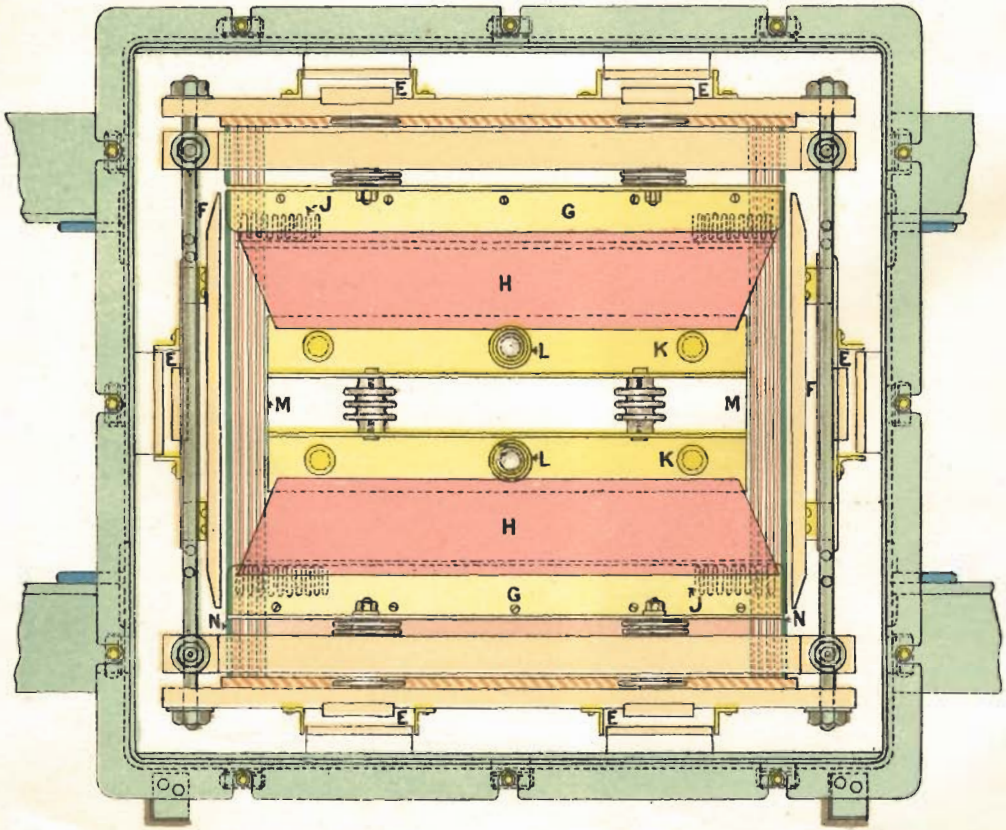
ELEVATION



REFERENCE.

- A. SAFETY SPARK POINTS.
- B. TERMINAL PIECES.
- C. SCREWED GLAND AND COVER OVER AIR HOLE.
- D. Do Do OVER SYPHON HOLE.
- E. SPACES FOR VERTICAL WEDGES.
- F. " " HORIZONTAL "
- G. GRIPPING PIECE.
- H. COPPER SHEET CONNECTING G TO K.
- J. SLOTS TO TAKE TABS IN TAB HOLDER.
- K. CONTACT PIECES.
- L. TERMINALS.
- M. GLASS PLATES SEPARATED BY CORK STRIPS.
- N. PLATE GLASS SHEETS.

PLAN (COVER REMOVED)



814.

To face page 29.

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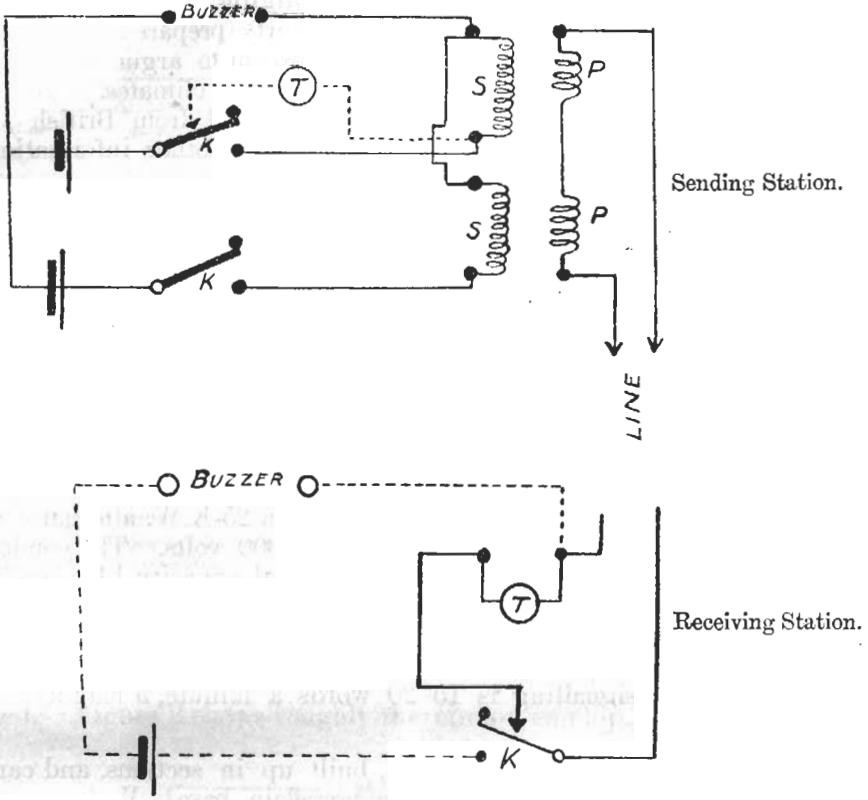
The most interesting experiments carried out in the Fleet as regards direction were those of Lieut. Ryan, in his destroyer. The results of these experiments were forwarded by him before he had any knowledge of Mr. Marconi's experiments referred to in the Manual of Wireless Telegraphy. Directional W.T.

The large power station at Clifden (Ireland) which is now being erected by Marconi Company will be fitted with a directional aerial for communication with America; the proportion of length to height will be approximately 10 to 1.

Lieutenant im Thurm has suggested the following apparatus for carrying out instructional exercises with buzzer. It has the advantage that exercises of an advanced character can be carried out with it. Instruction of operators in reception.



P P.—Primaries of a "B" tune jigger, joined in series.
S S.—Secondary of "B" jigger, one half of each leg removed.
K K K.—Morse Keys.
T T.—Telephone receivers.

Method of Working.—A separate key is placed in each half of the secondary winding, so that two signals can be proceeding at the same time.

One primary can then be slid along towards the other, thus gradually weakening one signal and strengthening the other at the receiving station, so that reception through partial interruption may be practised.

The dotted lines represent a circuit for use in case it is desired to communicate with the person conducting the exercise.

Experiments were carried out with a view to finding a metal which— Experiments with various metals for spark-gaps.

(*a*) Would not, in a confined space, deposit a conducting film on the inner surface of the silencer, when under the influence of the spark.

(*b*) Would burn away regularly.

(*c*) When raised to a high temperature would remain a good conductor for high-frequency currents.

Many different metals were tried; the most satisfactory was found to be cadmium.

The action appears to be that a cadmium oxide is formed, which is a dry deposit; this deposit can easily be removed by a dry cloth.

The surfaces burn away smoothly, and from practical results, the metal appears to be a good conductor for high-frequency currents.

If the cadmium is allowed to remain in an atmosphere of nitrogen, as is the case if the spark gap is not ventilated, the metal burns away slowly; but if free to the air, it burns away very rapidly.

Spark plugs of this metal will be supplied with "C" tune spark gaps.

Effect of Atmospheric Conditions on Transmitting Distance in Wireless Telegraphy.

Effect of moisture in the atmosphere on W.T. signalling.

A series of experimental observations have been made on this subject at St. Michael, Alaska, by Captain L. D. Wildman, of the U.S. Signal Corps.

From tables prepared by him the conclusion arrived at is that a high wind carrying moisture with it abstracts a certain very definite amount of energy delivered to the aerial, and therefore the strength of signals at the receiving station varies as the wind velocity, and the amount of moisture carried with it.

Captain Wildman used an insulated aerial, and an electrolytic detector of the De Forrest type.

The strength of signals was determined by shunting the telephones with a sliding resistance until signals were just intelligible.

The observations were carried out and charts prepared for a period of one year. If these results are confirmed the facts would seem to argue that a great spread of wires is a bad form of aerial for use in moist, windy climates.

The above is an abstract from report received from British Military Attaché, Washington, on 27th September 1906, and from other information on the same subject.

National Electric Signalling Company's Wireless Telegraphy Station at Machrahanish, Mull of Cantyre.

Abstract from a Report dated 26th May 1906, by Lieutenant Crawley, R.M.A., H.M.S. "Vernon."

Fessenden system.

This station employs the Fessenden system.

Communication is maintained at night time with a similar station at Branford, near New York, distance ovea sea about 3,000 miles, but day communication has not yet been established.

Transmitting arrangements.

The transmitting arrangements consist of a 25-K.W. alternator and transformer in an oil tank, transforming from 1,100 to 25,000 volts. The condensers at present being used are glass plate oil condensers, total capacity 144 jars, but Fessenden's patent compressed air condensers will be used shortly.

The spark gap consisted of 10 plugs made of copper rotating with the armature shaft, each one passing a fixed ball in turn.

The rate of signalling is 15–20 words a minute, a magnetic key with break under oil being used.

Aerial.

The mast is of steel 420 feet high, built up in sections, and carefully insulated at the bottom by being supported in a porcelain base. Various aerials have been tried; it is intended to try a roof aerial, using the mast as a feeder.

Earth.

The earth consists of a network of wires buried a few inches below the surface and stretching out radially about 50 yards with the mast as a centre. Charcoal pits containing metal plates are placed at intervals round the circumference, the ends of the earth wires being connected to the plates.

Wave length.

The wave length has not yet been definitely settled on (October 1906); it has been varied between 5,000 and 10,000 feet.

Receiving instruments.

The receiving arrangements consist of an electrolytic detector or liquid baretter; the circuit is arranged in a similar manner to that given in the Wireless Manual, 1906, p. 173, Fig. 87.

The telephones are similar to the Service Pattern, but were wound for a much higher resistance, about 600 ohms; this was considered to be the best arrangement for use with the electrolytic.

Interference and tuning.

The staff claim to be able to cut out a wave of 3 per cent. difference in wave length, and of the same strength as that which they are receiving; also that the tuning of their transmitting apparatus is very sharp.

Conclusion.

The frequency used is 300 cycles; the successful results obtained are probably due to the use of this high frequency and to the sensitiveness of the electrolytic detector which Mr. Fessenden claims to have invented.

Signalling from this station is generally conducted in American Morse, *vide* Annual Report, 1904, Appendix, p. 27. Signals have recently (October) been read at Gibraltar between 1 and 5 a.m.

THE POULSEN SYSTEM.

Poulsen system.

The following remarks on a system by which Mr. V. Poulsen claims to obtain undamped oscillations will be of interest, though its adaptability to ship work remains to be proved. In 1899, Mr. Duddell discovered that if an AC circuit of suitable LS

value is connected in parallel with a direct current arc, the arc will, under certain conditions, become musical; simultaneously there is produced in the shunt circuit an alternating current having the same frequency as the note produced by the arc.

Mr. Duddell eventually attained undamped oscillations at a frequency of 30 to 40 thousand per second, a rate of oscillation which is too low for W.T. Mr. Poulsen, however, has been able to obtain extremely persistent oscillations at frequencies suitable for W.T. purposes by placing the arc in coal gas or hydrogen, and adjusting it to a certain critical length. Thus, with a 3-mm. arc in hydrogen he obtains a frequency of a million or more. The length of arc requires to be increased with increased current, but has to be shortened when the frequency is increased.

Figure 1 shows diagrammatically the arc employed by Mr. Poulsen.

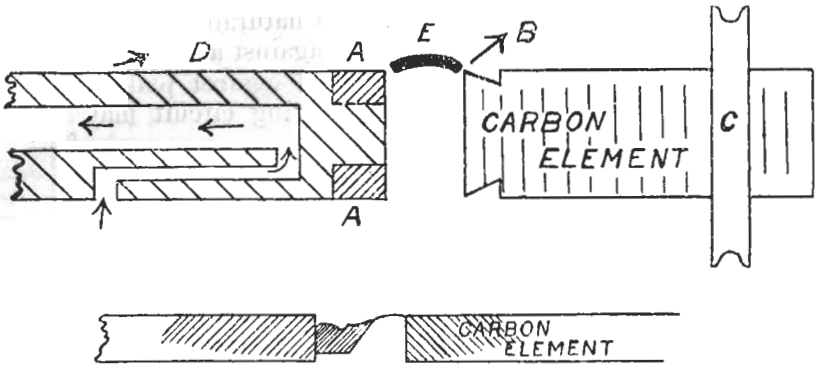


FIG. 1.

A.—Removable ring of red copper.
B.—Edge of carbon element which must be kept sharp.
C.—Pulley, to revolve carbon element.
D.—Water-cooled copper element.
E.—Arc, under the influence of the electro-magnets, causing it to be maintained between the upper edges of the electrodes.

The arrows denote the circulation of the cooling water.

The placing of the arc in a powerful magnetic field is a very important point, as it causes the D.P. across the arc to be very considerable in proportion to the length of arc maintained. Figure 2 shows roughly the circuit employed, and Diagram 3 shows

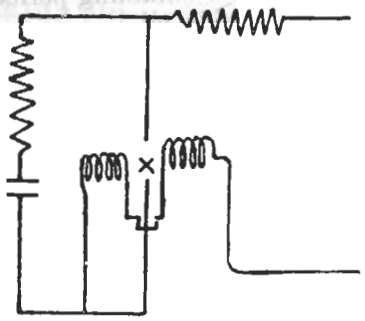


FIG. 2.

the system joined up to an aerial wire for signalling (close coupling).

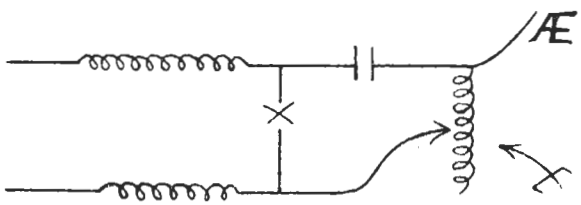


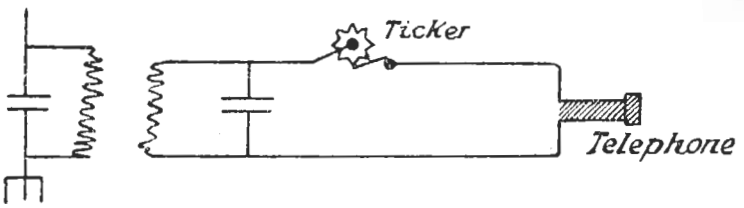
FIG. 3.

The transmission of Morse signals may be accomplished by causing the key to connect and disconnect the aerial and its capacity to the remainder of the system; or by placing the key across a resistance (included in either the generator or antenna circuit) which is large enough to reduce the amplitude. A very close or a very loose coupling must be employed, and tuning is equally sharp with either. The system is quite noiseless and the instruments very compact. A voltage of 440 (direct current) is found most suitable, and with a power of 1 kilowatt, day and night communication has been established between Copenhagen and North Shields, a distance of 530 miles, with a height of mast of 100 feet. It is claimed that the system is not greatly affected by atmospherics.

The tuning is so fine that an error of 3 per cent. completely prevents the reception of signals, while stations which differ in their turning by as little as 1 per cent. will not interfere with each other under certain conditions.

Reception on the Poulsen system.

In order to get the best results from undamped waves, there should be as little damping as possible in the receiving circuit; consequently a loose coupling is preferable. Thanks to the continuity of the waves, which must produce vibrations in the receiver system, the detector can be so arranged as to render its influence on the oscillating circuit intermittent, thus avoiding the damping which would be produced by its permanent inclusion in the circuit; that is to say, the tuned circuit is allowed to vibrate without disturbance and without any kind of detector to damp the vibrations; then suddenly the detector is introduced, and it absorbs the energy accumulated during a moment of time; afterwards the circuit is again free to vibrate, and so on. This alternation, which must naturally be very rapid, is effected by a "ticker," such as cogged wheel rotating against a spring; 100 interruptions per second were used. Gold against gold or gold against platinum gives the most reliable working. The arrangement of the receiving circuit may be as shown in Diagram 4.



Berlin Conference.

An International Conference was held in Berlin in November 1906, with the object of laying down rules as regards wave lengths, shore stations for commercial purposes, &c.

All nationalities agreed in the general principles, which come into operation in July 1908.

Abstract of Report of Wireless Telegraphy in "Defiance."

Service installation, Mark I.

The "B" and "C" tuners have been well soaked in paraffin wax; this has stopped the loosening back of the turns of Pattern 611 wire.

Choking coil in primary circuit.

A variable inductance, made out of an old primary of an induction coil with two extra layers of wire wound on, has been found very useful as a choking coil in the primary alternating circuit for obtaining perfect resonance. The windings are tapped off at intervals and immersed in oil.

Tuned shunts.

A low reading variable inductance to shunt the primary of the magnetic detector has been used when adjusting the tuned shunts to a loud signal and measuring strong incoming waves.

Instructional.

Small aerials have been put up for instructional signalling working tuned shunts and wave meter.

Poldhu.

A circuit on which Poldhu signals are daily received has been laid from the telephone terminals of the magnetic detector; 20 pairs of telephones are worked from one M.D.

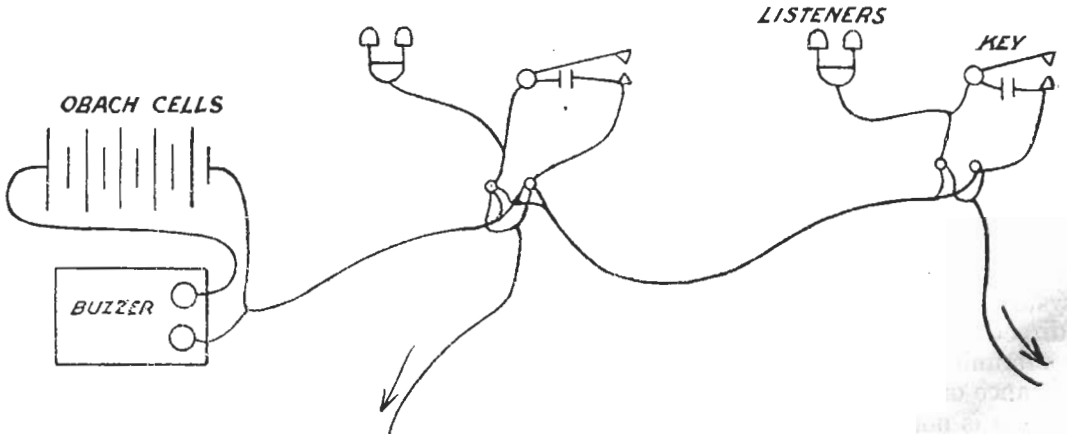
Qualifying Torpedo Instructors are examined in reading the Poldhu signal at the end of their qualifying time in "Defiance." About 20 per cent. obtain full marks.

Buzzer signalling circuit.

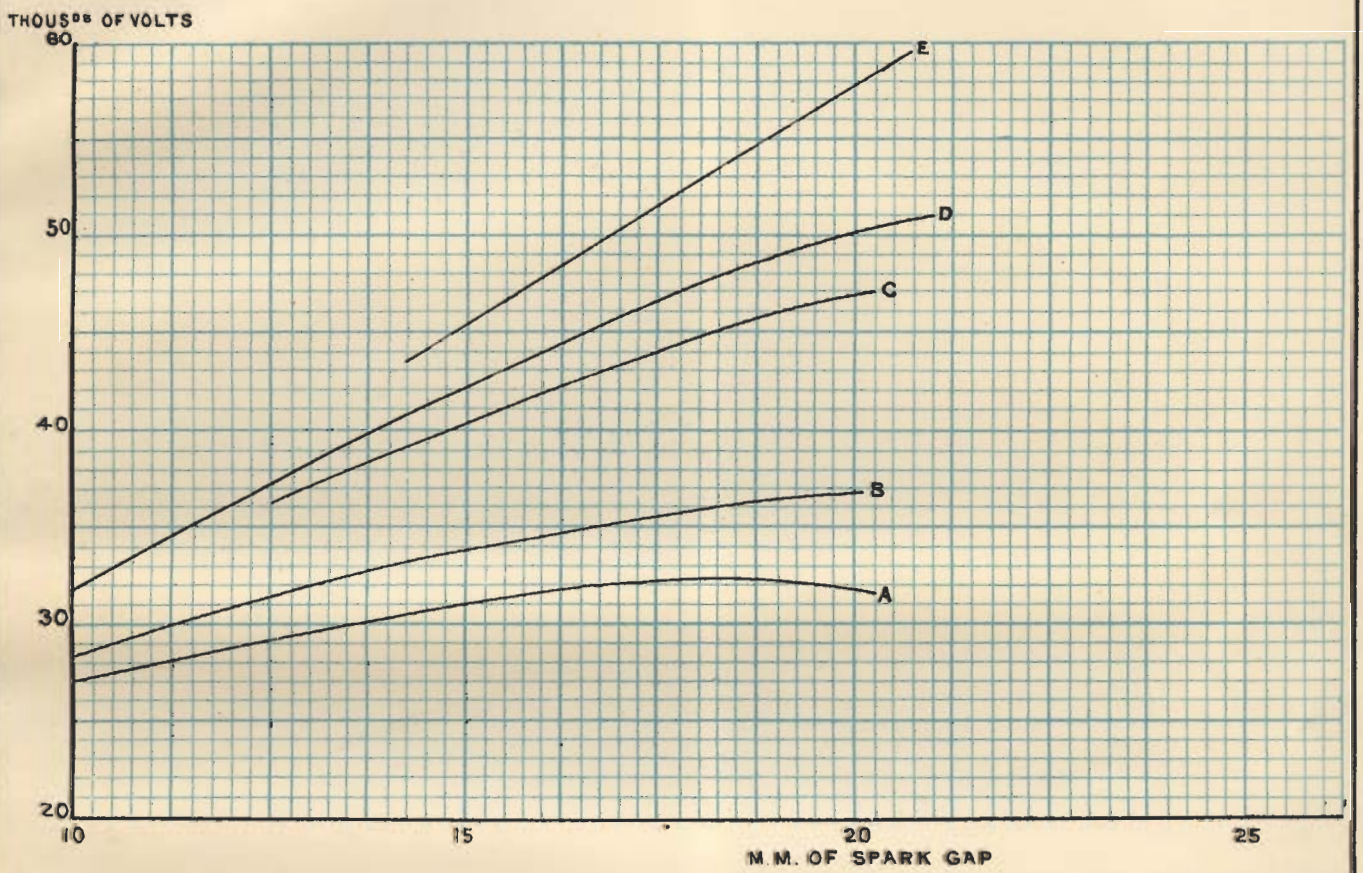
An instructional signalling circuit, having 10 isolated stations, has been fitted up.

The signalling keys must be of the pattern containing condensers.

Circuit as shown in diagram.



VOLTS AND SPARK LENGTHS FOR SPARK BALLS. OF VARIOUS SIZES.



A 10 M.M.

B 13 M.M. (SERVICE INST'N MDL)

C 20 M.M.

D 28 M.M. ("C" TUNE)

E 50 M M

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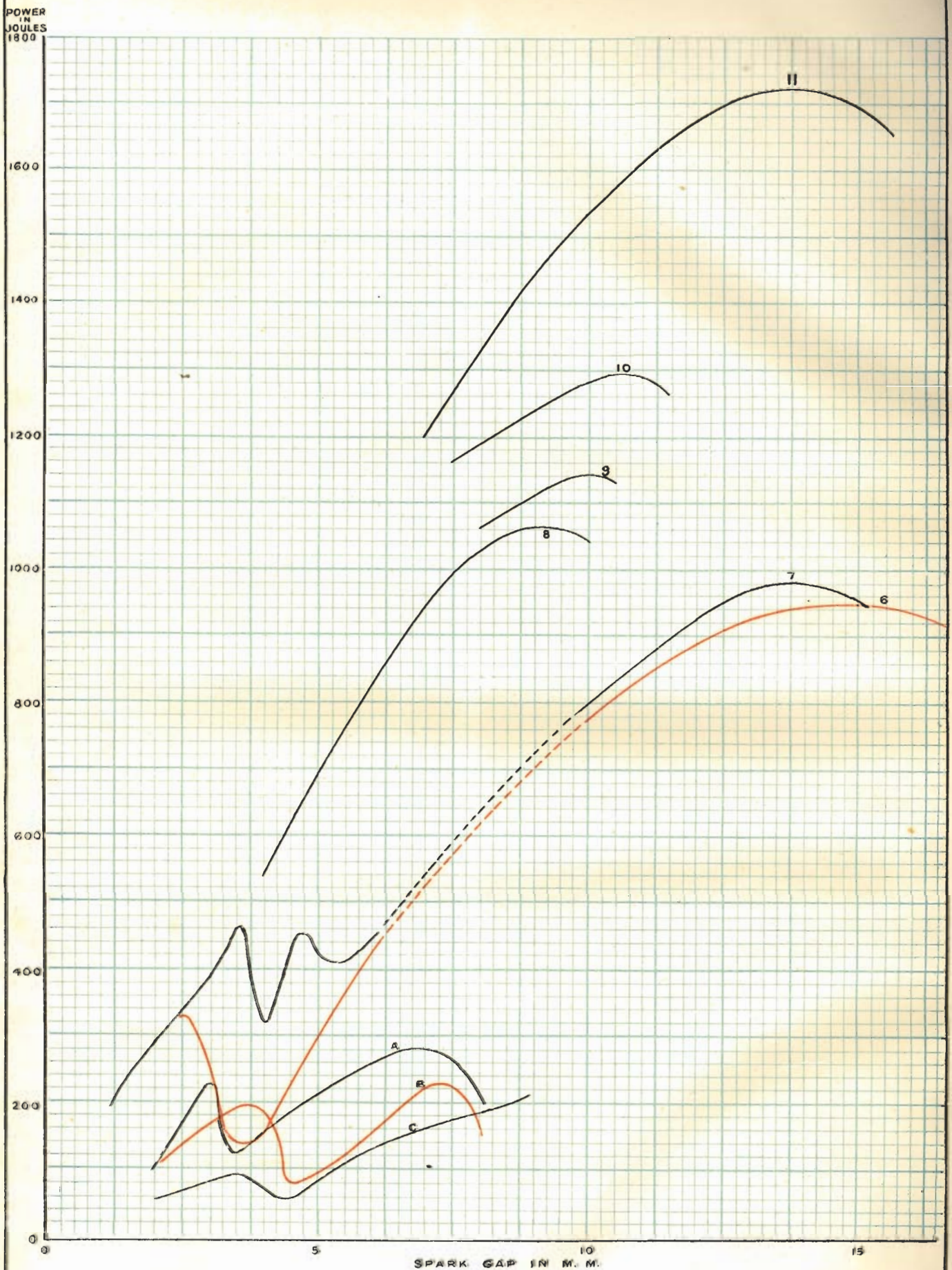
CURVES CONNECTING POWER AND LENGTH OF SPARK.



HAMMER MAKE AND BREAK.

A. SECONDARIES IN PARALLEL
B. " " SERIES
C. " " " {BUT USING ELECTROLYTIC BREAK}

The following report, dated 29th September 1906, on certain experiments carried out on board H.M.S. "Defiance," is of interest.

Experiments carried out on board H.M.S. "Defiance."

The objects of the experiments were :—

(1) To obtain a satisfactory means of approximately measuring the power put into the primary oscillating circuit of any Wireless Telegraphy circuit; and

(2) To ascertain the best adjustments of spark length, speed of alternator, winding of coils, and the various other adjustments that govern the power of the sending current.

2. Lieutenant Nevile F. Usborne, who was temporarily lent to this ship, initiated and carried out the experiments, and it is believed that the information obtained will be of great value in enabling ships to transmit with a maximum amount of power.

3. In calculating the power, the formula :—

$$\text{Power in Joules } \tfrac{1}{2} \text{ N.S.E.}^2, \text{ where } \begin{cases} \text{N} = \text{No. of sparks per sec.} \\ \text{S} = \text{Capacity of circuit in farads.} \\ \text{E} = \text{Voltage of discharge.} \end{cases}$$

A spark counter (similar to that described in Fleming, page 185) was extemporised from an old inker, and worked successfully, the tape passing between spark points; the speed was increased by fitting an enlarged driving roller.

4. The first set of experiments was carried out with the "Argyll's" installation, which has an alternator, as is supplied to ships of the First Cruiser Squadron, two coils in parallel and 13-mm. spark balls.

The Service jars were taken as each being equal to 1·15 jars.

The first set of experiments showed that :—

(1) Any increase of spark gap beyond 16 mm. resulted in a decrease power.

(3) That by slowing the alternator down, greater power could be obtained with less spark gap.

(3) That by using a smaller spark some curious variations of power occurred.

5. Further experiments were carried out to clear up these points:

1st. The alternator was slowed down by putting two shunt coils in parallel. As anticipated (curves 6 and 7), more power was obtained with a smaller spark, *i.e.*, 14 mm., and this and subsequent experiments showed that with many installations there is generally a point beyond which increase of spark does not mean increase of power; and

2ndly, many observations were taken with smaller spark gaps, and the curious results here plotted were obtained. (Curves *a*, *b*, and *c*.)

6. The next experiments were carried out in the "Europa," where the installation comprises an 80-volt shot hoist motor and two coils whose primaries were divided in halves, which can be used normally in series, or parallel if required.

During the first day's experiments they were used in the normal manner, *i.e.*, each coil with its primary complete. The motor was run at its best speed (found experimentally), and the most efficient arrangement of coils was found to be with secondaries in series; 10 mm. was the largest spark obtainable.

The results plotted as curve 8 show that with this smaller spark more power was obtained than in the "Argyll," and with less strain on the jars and less brushing loss; also that this motor is well adapted for the work.

One coil was now disconnected, and the inner half of its primary used. An 18-mm. spark was obtained, but the strain on the motor was such as to almost bring it up in a few seconds. The spark was, therefore, reduced to 10 mm., and this was found to be an efficient spark to work with. A few observations show that with these arrangements the power obtained was far larger than that obtained before, viz., curve 10.

7. A further increase of power could only be obtained in one of the following ways :—

(1) Increasing the spark length; if this were done, and the number of sparks kept constant, the strain on the jars would be too great, and the loss from brushing would also be great.

(2) Increasing the capacity; this would throw out the shorter tunes.

(3) Increasing the number of sparks; with the coils at present in use very little further increase of the number of sparks can be obtained.

"Defiance's" Report.

8. Another arrangement was tried using one motor to one coil and only half its primary. Every possible care was taken to get the speed of the motor right, and the voltage at the terminals of the motor was kept at 79. The results are plotted in curve 11, and show clearly the great advantage of correctly regulating the motor, since this is precisely the same arrangement as that used for curve 10, but the speed of the motor was more carefully regulated.

Abstract of Report of Experiments carried out by H.M.S. "Defiance" with W.T. in Destroyers, dated 9th November 1906.

"Defiance" and W.T. in destroyers.

The W.T. installation in the "Lee" has been developed, transmitting being carried out direct from the dynamo, which has been fitted with slip rings. After carrying out experiments, the best arrangement was found to be :—

Revolutions.	Cycles.	Direct E.M.F.	Alter. E.M.F.	Max. Alter. Current taken.
650	11	95 volts.	60 volts.	36 amps.

A resistance was put in series with the shunt coils of the dynamo to reduce the direct voltage whilst maintaining the speed, and therefore the number of cycles, as high as possible.

Maximum spark was $5\frac{1}{2}$ mm.

The best arrangement of induction coils was with two coils primaries in parallel with a choking coil in series consisting of one layer of the primary of another coil. Secondaries of coils in series with a choking consisting of another complete primary.

Aerial four-fold with single feeder, $\lambda\sigma = 29$. Mast, 56 feet 6 inches truck to W.L. All wire rigging was insulated half way up.

A range of 40–50 miles has been obtained.