DESTROYER INSTALLATION.

"Swift."

It has been decided to fit 43 destroyers with W.T. instruments. These destroyers will all be equipped on the same lines, with the exception of the "Swift."

Requirements for destroyer set.

The space available in the "Swift" has allowed of her being fitted with "Service Mark I.," and she will be similar in all W.T. respects to ships fitted with that gear.

Before deciding on the type of gear to be supplied to destroyers, exhaustive experiments were carried out on board the "Usk" to determine on the best way of fulfilling the following requirements:—

(1) To provide for communication between destroyers.
(2) To provide for communication between a destroyer and another ship.
(3) To prevent destroyers interfering with, or being interfered by, ships or shore stations.
(4) To obtain a signalling distance between destroyers of 50 miles by day, under average conditions of weather.

The first four requirements are dependent on the wave-length, and the one chosen is 700 feet long, known as "D" wave-length, corresponding to an L.S. value of 11·5 mic-jars.

A shorter wave-length than this could not be used to obtain the required signalling distance between destroyers by day.

Experiments on wave-lengths.

During the "Usk" experiments, three other wave-lengths were tried, *e.g.*, 820, 1,300, and 1,400 feet, the shortest wave proving strongest and most free from interference. This was further reduced to 700 feet, so as not to interfere with a Battle Fleet, whose wave-lengths normally range between 2,000 and 5,000 feet, and also to prevent interference from, or with, the commercial wave-lengths of 300 metres (1,000 feet approximately) and 600 metres (2,000 feet approximately).

It was decided to design a set capable of transmitting "D" wave-length only, and to supply a receiving set consisting of a special tuner and ordinary Mark II. tuned shunts, whereby any wave-length up to about 8,300 feet might be received.

W.T. office.

This consists of a large silent cabinet, and contains all the instruments for sending and receiving, with the exception of the rotary.

Position of office.

Further experiments were carried out to determine on the most suitable position for the W.T. office. Owing to the losses caused by smoke and funnel gases playing on the aerial, it was found necessary to place the office between the mast and the foremost funnel, in which position the feeders would go up clear of the smoke.

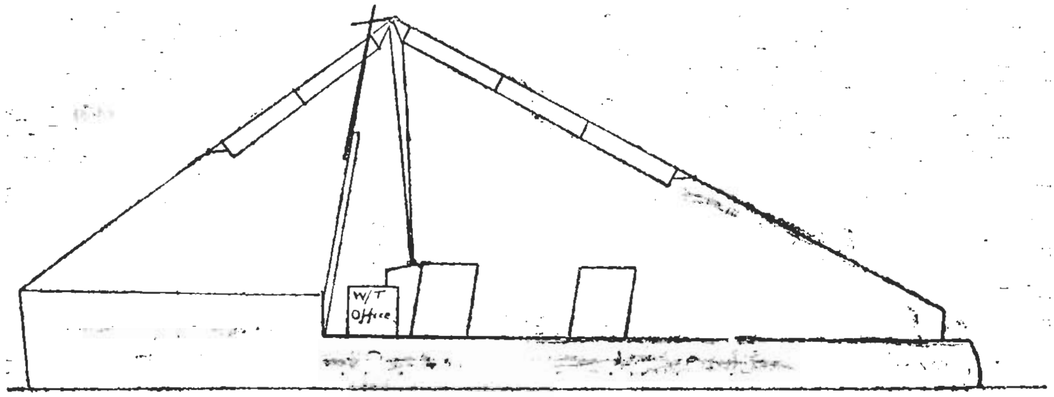
On account of the already rather limited space available for the men's quarters, and the noise of the spark when signalling, the offices will not be built below the upper deck.

Wherever the structural design of the boat will permit, the office will be built between the mast and foremost funnel in order to keep the additional weight as low down as possible, but in those cases where it would interfere with the working of the derrick, it has been placed on the bridge, abaft the chart house, which in some cases has been modified to allow of this being done.

The aerial.

The original aerial tried in the "Usk" consisted of four parts of wire in a square section at each yard arm.

This was found rather cumbersome, and another one was designed which gave equally good results when sending and when receiving short waves. For longer waves the signals were not quite so strong. It has therefore been decided to adopt this one as the standard aerial for destroyers, and a full description of it will be found in the Destroyer Handbook.



SKETCH OF DESTROYER SHOWING ONE SECTION OF AERIAL.

Special arrangements for after ends of aerial.

In the "Afridi" and "Amazon" classes, owing to the increased height of the funnels, it has been necessary to support the after ends of the aerial at a greater height than that attainable from awning stanchions, in order to clear the funnel gases.

In the "Afridi" class the after ends are brought down to a 20-foot spar, each side abreast the after torpedo davit, and in the "Amazon" class, to a small mainmast carrying a yard 12 feet long, at a height of 40 feet above the deck.

Masts lengthened.

The mast of each destroyer has been lengthened so as to carry a 12-foot yard at a height of 60 feet above the water-line.

Destroyer Handbook.

A full description of the instruments supplied to destroyers, and the method of fitting them, will be found in the Destroyer Handbook.

Land effect.

Neither the land effect, nor the direction effect, was very marked, but signals were considerably weaker by day than by night, due to the short wave in use. Experiments between Portsmouth and Portland showed that with a 4-mm. spark, signals were strength 8 by night, and 6 by day.

Distance trials.

Distance trials were carried out with the "Usk" at sea, and in Portland, to determine the working distances.

The "Usk" steamed at 20 knots, using her foremost stokehold, which is directly under the office, and a considerable amount of spray was coming over. These experiments showed that the following results should be obtained by day over 50 miles of water, even with a little land (the Isle of Wight made no difference to signals) :—

Wave-length.	Strength of Signals sent by Large Ship.	Strength of Signals sent by Scout.
R	8	6
S	7	6
T	7	5
U	6	5

Signals from a destroyer should be strength 6 in either a large ship or scout, also between destroyers.

Effect on compasses.

Experiments to determine the necessity for insulating the rigging to avoid affecting the compasses, showed that by insulating the rigging the compasses were not affected, and that it improved both the sending and receiving.

The rigging will therefore be insulated.

The transformer and choking coil were specially designed with closed magnetic fields, thus preventing any stray magnetic field and corresponding effect on the compasses.

Supply of operators. One P.O. telegraphist will be allowed to each destroyer fitted with W.T.

LIST OF DESTROYERS TO BE FITTED, SHOWING VARIOUS DIFFERENCES IN ARRANGEMENTS.

Destroyers.	Position of W.T. Office.	Method of securing After Ends of Aerial.
"Liffey," "Foyle," "Arun," "Ouse," "Itchen," "Moy," "Blackwater."	On bridge; extended chart house.	Awning station.
"Chelmer," "Colne," "Jed," "Kennet," "Wear," "Rother," "Ure," "Exe," "Swale," "Erne," "Ettrick," "Dee," "Cherwell," "Nith," "Ness."	Ditto	Ditto.
"Waveney," "Doon," "Boyne," "Kale," "Derwent," "Eden"	Ditto	Ditto.
"Afridi," "Cossack," "Tartar," "Mohawk"	Upper deck between mast and F. funnel	20-foot spar each side.
"Ghurka"	Extension of chart house	Ditto.
"Welland," "Gala," "Ribble," "Teviot," "Garry," "Usk"	Upper deck between mast and F. funnel.	Awning station.
"Velox"	Upper deck underneath bridge.	Ditto.
"Amazon"	Upper deck between mast and F. funnel.	40-foot mast.
"Saracen"	Extension of chart house	Ditto.

Note.—In all cases the deck insulator is vertical in upper deck offices, and horizontal in bridge offices.

PROPOSED DESTROYER ORGANISATION OF WAVE-LENGTHS.

"D" wave-length. When the policy of fitting destroyers with W.T. instruments was decided on, one of the principal objects to be obtained was to prevent interference with the main lines of communication with the Battle Fleet. This led to the adoption of a 700-foot wave, called "D" wave-length, and since destroyers will only be able to transmit this one wave, it has been found practicable to design a simple and compact installation which can be easily manipulated and maintained in an efficient state by one operator.

Limitation of destroyer set. At the same time, it follows from the above that a destroyer will be unable to attract the attention of a ship or shore station, unless arrangements are made for her to be looked out for.

As regards a destroyer's receiving instruments, they are capable of adjustment in a similar manner to other ships, so that she is not limited in this respect.

W.T. watch. Owing to the fact that under most circumstances destroyers cruise in company, the periods of W.T. watch should be distributed evenly throughout the flotilla, and when there is a parent ship in charge of the flotilla she should relieve the destroyers from keeping W.T. watch so long as they are within visual signalling distance of her.

W.T. duties of destroyers. The chief duty of a destroyer fitted with W.T. is to be able to receive orders when separated from her base, and to acknowledge them.

The secondary object is for her to be able to make reports to her parent ship, or ship specially detailed to look out for her.

And lastly, to be able to communicate amongst themselves when out of touch with their parent ship, or base. For instance, when spread they would be able to inform one another of the whereabouts of the enemy, if one of them has discovered him.

Organisations "A" and "B." Two proposed general organisations, termed "A" and "B" respectively, are here given as a guide in the formation of subsequent organisations.

Organisation "A."

Parent ship (and destroyers, if necessary). } Look out on "U," and send on "D."

Destroyers do not communicate with one another.

This is the general organisation, and is always to be assumed when destroyers are not spread.

Note.—Parent ship can arrange her transmitting circuit to send "D" wave-length from her ordinary aerial, as explained on pages 47 and 48.

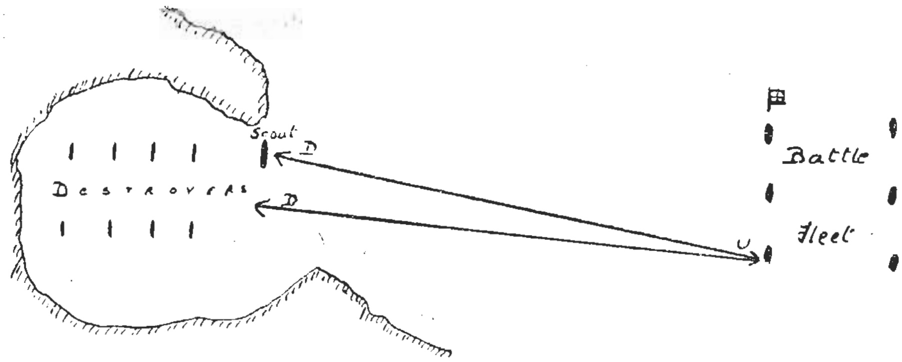


FIG. (*a*).

It is assumed that the destroyers are lying at their base awaiting orders from the Battle Fleet, and also that they are attended by a parent ship, as, for instance, a scout.

The parent ship would look out on " U " and send on " D " wave-length. She is therefore always in touch with the Fleet at any time, and would keep constant W.T. watch.

Fig. (*a*) shows the destroyers at their base with their parent ship.

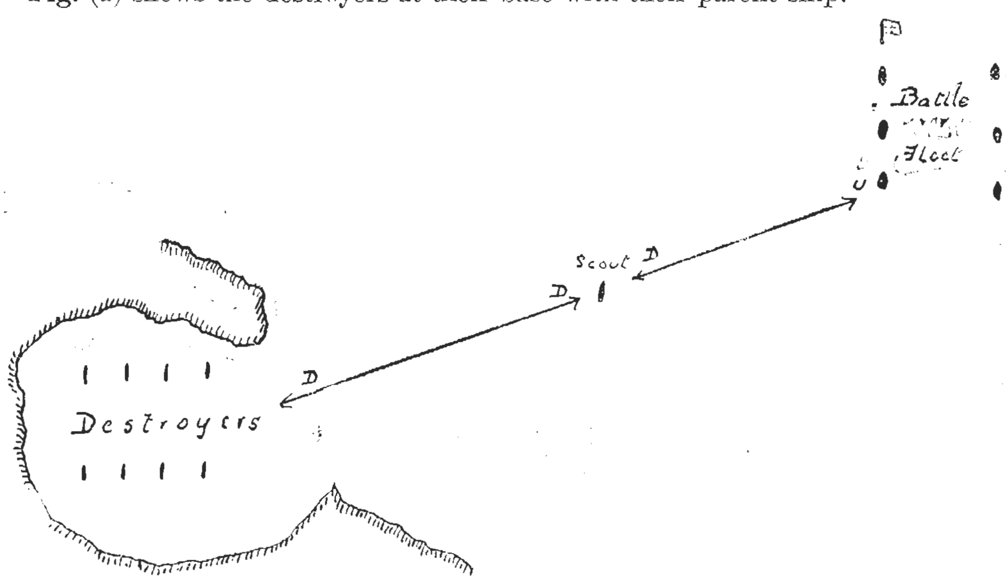


FIG. (*b*).

Destroyers would, if necessary, keep watch in rotation amongst themselves, thus being enabled to receive any signal made to them on " U " wave-length.

This would be necessary if the parent ship were to leave the base in order to keep in touch with the Battle Fleet (*see* Fig. (*b*)), in which case the parent ship must be prepared to receive on " U " and also on " D," though the former would be the more important.

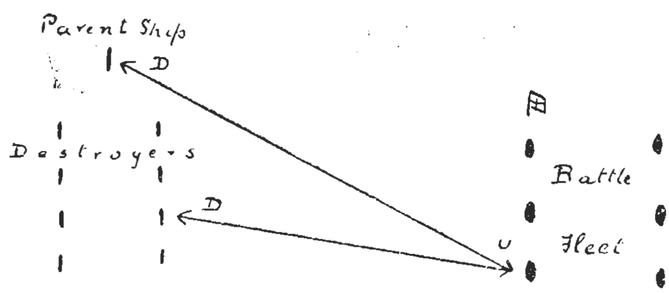


FIG. (*c*).

Organisation " B."

Fig. (*c*) shows the application of Organisation " B " to a flotilla when cruising with or without a parent ship.

Parent Ship and Destroyers. } Look out and send on " D " wave-length. Parent ships will, in addition, look out for signals from the Battle Fleet on " U " wave-length at stated times, say, for 5 minutes every half hour.

This organisation will be always assumed when the destroyers are ordered to spread. Should the order refer to part of the flotilla only, that part assumes Organisation " B," the others remain on Organisation " A."

It is probable that all necessary orders will be given to destroyers before they are ordered to spread for the purpose of attacking the enemy's fleet or base, so that it is necessary to devise an organisation by which, when spread, they will be able to receive orders and to reply to their parent ship. In case of the necessity for fresh orders to be given from the Battle Fleet, the organisation has to allow of this being done.

Destroyers are not to communicate with one another except when they are out of range of their parent ship.

W.T. operators. As already pointed out, the single operator should not be unnecessarily subjected to too long a period of W.T. watch, therefore organisation "B" is only suitable for short periods, *e.g.*, when destroyers are spread for an attack.

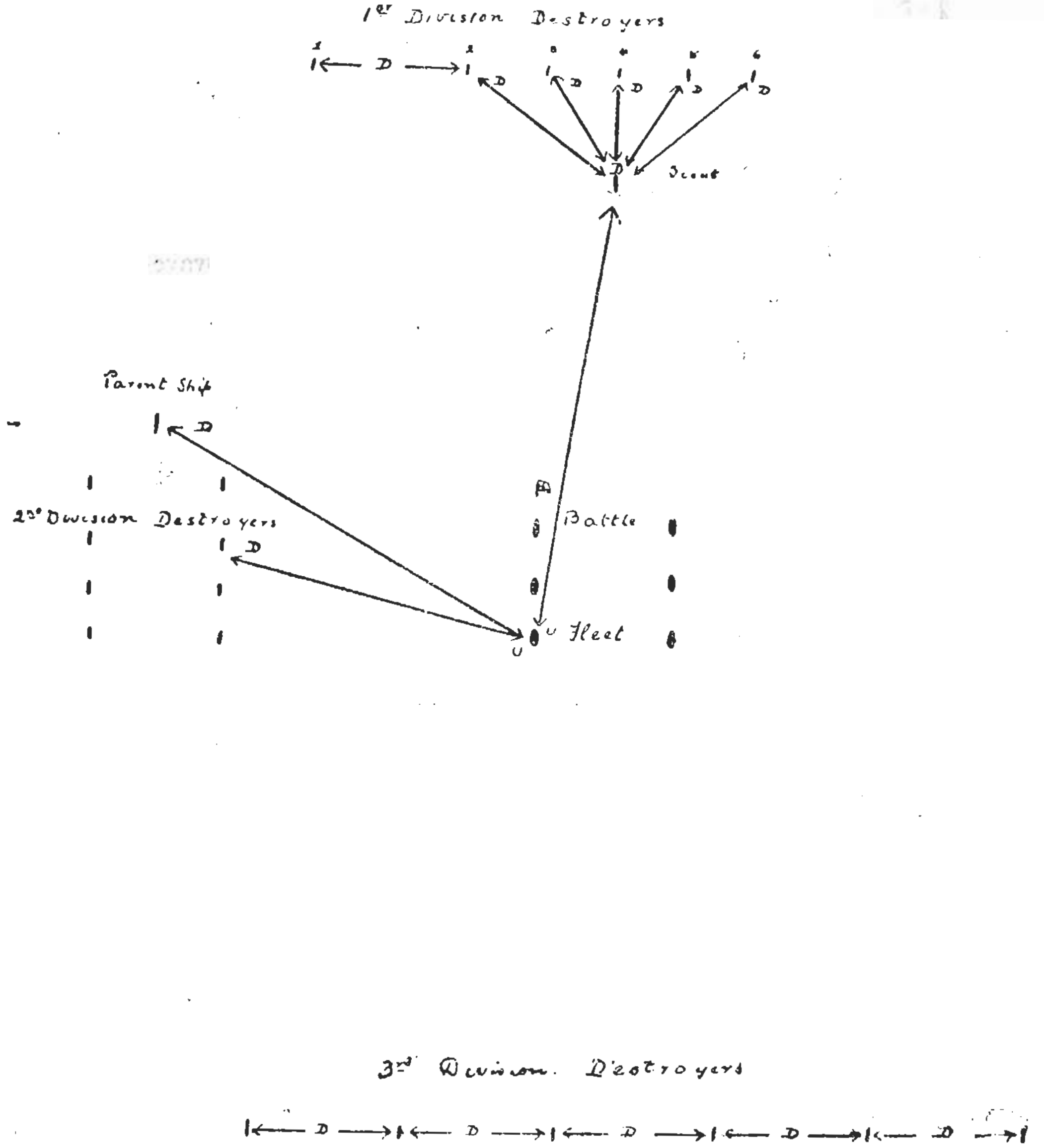


FIG. (*d*).

Fig. (*d*) shows how these organisations might be employed in practice.

Here the flotilla is supposed to consist of three divisions, containing six destroyers each, and two parent ships.

The 1st Division is assumed to be spread in touch with one another, and the parent ship in touch with the Battle Fleet.

No. 1 destroyer is shown as being out of touch with her parent ship. Therefore she passes all signals through No. 2.

The parent ship looks out for "U" from the Battle Fleet for 5 minutes every half hour.

The 2nd Division is supposed not to be spread, and is therefore on Organisation "A."

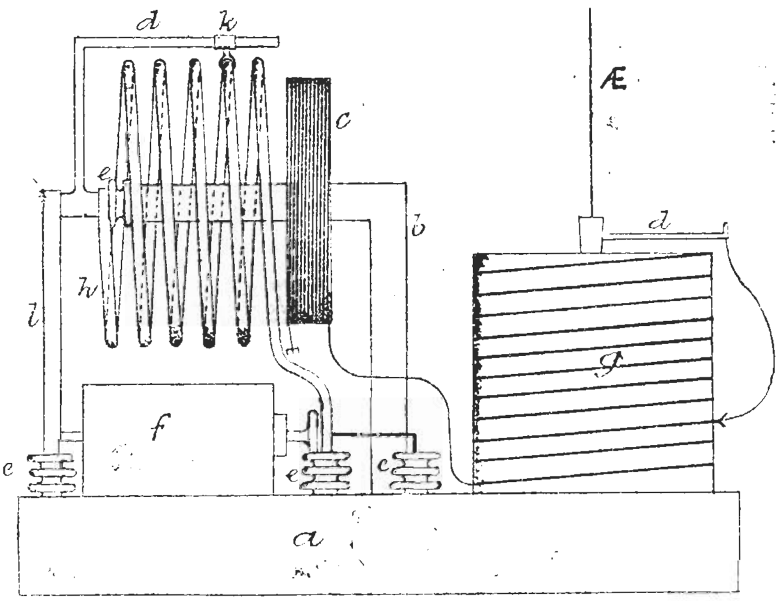
The 3rd Division is spread, but out of touch with the Battle Fleet. They therefore communicate amongst themselves.

PROPOSED IMPROVEMENTS IN THE SERVICE MARK I. TRANSMITTING CIRCUIT.

Necessity for improvements. Notwithstanding the introduction of the larger power installations into the Service, it is considered that there will still be many small ships and scouts fitted with small power; experiments have therefore been carried out with a view to effecting improvements in the Service Mark I.

Size of instruments A new form of condenser, an oscillator primary and secondary have been designed. The installation is suitable for a scout where the bench space is only 3 feet 3 inches by 2 feet 10 inches.

Wave lengths. It will be arranged that all wave-lengths between 700 feet and 6,500 feet can be sent out, but the ordinary ranges of adjustment will be between 1,000 feet and 6,500 feet.



a. Condenser.
b. Wooden support.
c. Secondary mutual.
d. Revolving arms.
e. Insulators.
f. Spark gap.
g. Aerial tuner.
h. Primary.
k. Spring clip.
l. Metal support carrying revolving arm.

Primary. The primary consists of five turns of ½-inch copper piping wound in a spiral 14 inches in diameter, one end of which is connected to the condenser, the other end, which also forms a support, being connected to the spark gap. An arm fitted with a brush connection is mounted so that it is capable of being revolved and connection made to any part of any turn as shown in diagram. The circuit is completed by connecting the other end of the spark gap and condenser by a short lead. The rings are supported by spokes attached to a wooden spindle. One end of this spindle fits on to an insulator, the other end being supported by two wooden legs.

Secondary. On this spindle is placed the secondary mutual, which consists of four turns of wire wound on a small drum the distance from the primary, and thus the coupling being adjustable. One end of the mutual is connected to earth and the other to the bottom of the tuner, the latter is wound with 42 turns, giving "U" tune with an aerial $\sigma = 1$ or above.

If it is desired to send out a very long or short wave, special arrangements must be fitted up for the aerial and secondary.

Condenser. The condenser is contained in a flat tank about 38 inches by 18 inches by 5 inches, and is fitted with four terminals and a series parallel arrangement so as to give 70 or 17·5 jars for the 1,000-foot wave. The condenser is designed to stand 5 mms. with the parallel arrangement and 10 mms. with the series.

Resonance. Using such a large capacity as 70 jars, to obtain resonance it is necessary to use two 4-layer coils in parallel; a 4-mm. spark can then be obtained at 70 cycles; with this arrangement there is no heating of the coils. It is found that two 4-layer coils in parallel contain less inductance than two 3-layer, due to the step up in the former case being less (*see* W.T. Manual, p. 61, sections 55 and 56).

Capacity.	3-layer Primaries.		4-layer Primaries.	
	Secondaries.		Secondaries.	
	Parallel.	Series.	Parallel.	Series.
21	70 cycles 5 mms.	67 cycles 10 mms.	97 cycles 5 mms.	70 cycles 10 mms.
70	No spark.		76 ,, 3½ ,,	

It will be seen from the above table that when the number of jars is increased much advantage is gained by using 4-layer coils.

Arrangements have been made for all new coils and coils sent in for repair to be so wound.

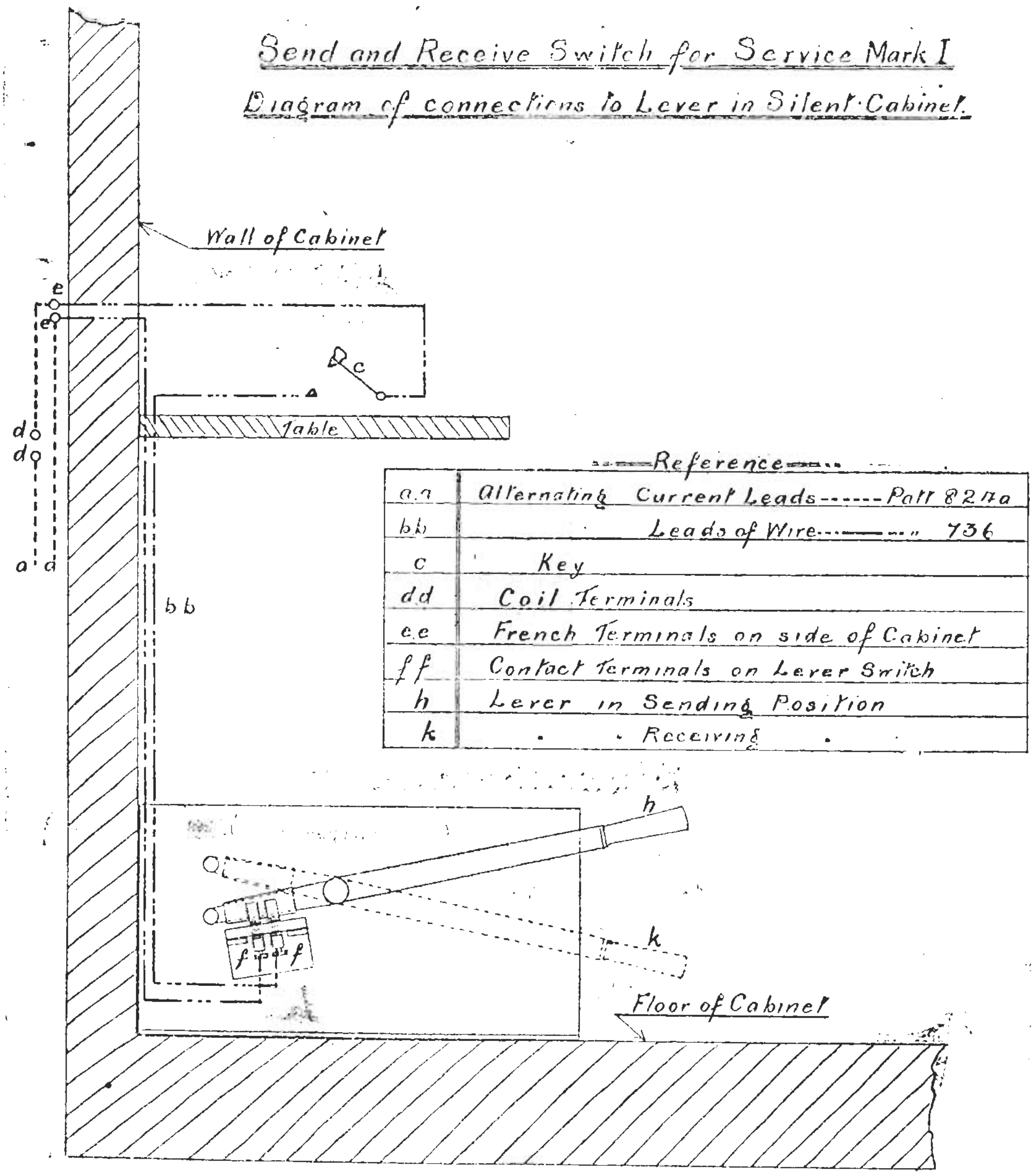
Spark gap.

The Service B type spark gap is used fitted with larger spark balls to prevent heating due to the larger current from the increased capacity. Copper balls are found to wear better than cadmium.

The instruments are arranged to fit into a framework secured to the top of the tank, and can thus all be lifted off together if the condenser terminals are disconnected.

Results obtained.

Good results have been obtained with Scilly by day on S, T, and U, distance 220 miles, using a double 8-fold aerial. Signals have been exchanged by day with the "Furious" in the North Sea, distance 300 miles.



Additional safety arrangement for Service Mark I. installation.

An extra safety arrangement has been introduced in the Service Mark I. transmitting circuit, consisting of a break in the alternating current circuit, at the lever of the send and receive switch, as shown in sketch.

Possible Faults in Receiving Apparatus.

Damage during transport.

A certain number of receiving instruments have been found defective, due to damage during transport. The system of packing for despatch from the Dockyard has been carefully revised, and improved methods have been introduced, since when no defects due to this have been reported.

Separate cases for all receiving instruments.

All instruments supplied from the makers are now delivered in fitted wooden boxes. These boxes will be supplied to ships with the instruments, which should never be transported without them.

Magnetic detectors.

After considerable use these are liable to become noisy. This is due either to lack of lubrication of the spring, or wear of the worm drive of the air beater.

An oiling arrangement for the spring is fitted in all the later instruments, but in the older pattern it is necessary to remove the clockwork. A few drops of oil (not too much) should then be applied to the main spindle with the clockwork run down. At the same time the worm should be coated with vaseline.

Position of magnets.

The magnets are adjusted on all instruments, when being passed in "Vernon," to the most sensitive position; in this position the inductance of the primary is between 70 and 80 mics.

It should be noted that any alteration in the position of the magnets causes an alteration of the primary inductance, which may amount to 30 per cent., thus causing the best adjustment of the acceptor condenser to be altered.

Primary and secondary windings.

A fault has occasionally been found due to the end of one winding touching the terminal lug of the other winding. This has been guarded against in all later pattern instruments.

The primary and secondary windings should balance to *about* 5·7 and 135 ohms respectively.

Spare primaries and secondaries complete are supplied in the spare part box.

Tuners.

Care should be taken that the check nuts on the switch arms do not work slack. One or two cases have occurred of a connection to the under side of a stop being broken. Should this be suspected, it can readily be determined with the tuner in position by means of a Wheatstone bridge.

Balancing tuners.

Starting with all three switches to the left, the small drum should increase stop by stop to not more than $\frac{1}{10}$ ohm, the medium drum to not more than ·3 ohm, and the large drum to not more than 4·5 ohms.

Care should be taken that no dust or dirt lodges between the stops, otherwise the corresponding coils are partially short-circuited, causing a diminution in the strength of signals whenever the short-circuited coils are in circuit.

A feather brush is allowed in the establishment for dusting the faces of receiving instruments.

Lightning arresters.

It is important that no dirt, emery powder, or other foreign matter should lodge between the points of the lightning arresters. An insulation resistance of 1,000 ohms at the lightning arrester will render the tuner useless.

This can be readily tested by placing a piece of paper under the point of one of the switch arms, when the resistance between the terminals should balance to infinity.

Receiving condensers.

Condenser No. 1, Mark II. (acceptor).
Condenser No. 3 (aerial).
Condenser No. 4.

Method of testing plunger contact.

The left-hand terminal is connected to the moving vanes through a plunger contact. The following directions are given for testing this in a seagoing ship, as the only part which may be considered liable to failure, although no cases have yet been discovered in those returned for survey:—

(1) Place the condenser on a bench with the terminals to the front. Join one of the test leads from a Wheatstone bridge to the left-hand terminal.

(2) Remove the pointer, take off the ebonite cover, and at once replace the pointer in the same position (this should prevent any possibility of the pointer being replaced on the wrong square).

(3) The upper pair of copper vanes will now be visible, also the brass contact strip in the base for the plunger contact.

(4) The left-hand vane is connected to the brass case, which is in turn connected to the right-hand terminal.

The right-hand vane is connected to the plunger, which bears on to the contact strip, and the contact strip is in turn connected to the left-hand terminal.

(5) Hold the other test lead on to the right-hand vane and balance. The resistance should be very low. Still holding the test lead on to the vane, turn the outer brass case round so that the contact travels along the strip and back again. See that the resistance does not increase at any point.

(6) After bringing the condenser back to the zero position, replace the cover and pointer.

Insulation of condensers.

All receiving condensers should balance to at least half a megohm. If they fail to do so, the fault is probably in the lightning arrester. If no fault is visible there, leave the condenser in a warm dry atmosphere for a few hours and re-test.

Circular regulating switch.

The noise of the circulator sometimes heard inside the cabinet appears to be conducted in by the leads to the circulator regulating switch. It is therefore recommended that the lead be removed and the switch mounted in a convenient position on the outside of the silent cabinet.

REMARKS ON TUNING.

General remarks.

If the primary circuit of an oscillator and the secondary circuit, including the aerial, be independently tuned to the same L.S. value, and the primary circuit then used to influence the above-mentioned secondary circuit, it will be found that there are two distinct waves being radiated from the aerial, and that the L.S. value to which each of the above circuits had been independently tuned will be exactly half way between the L.S. values of two waves radiated.

Conversely, if the primary circuit of an oscillator be tuned to a certain L.S. value, and if it is used to influence the secondary circuit, and if the L.S. values of the resultant waves sent out from the aerial come exactly equal amounts on either side of the original primary L.S. value, then the primary and secondary circuits are in tune with one another.

Coupling.

Now, besides getting the two circuits accurately in tune with one another, there is another factor, termed the coupling, which needs special consideration, as on it depends not only the distance the resultant waves will be separated from one another, but also the form that the waves will assume.

Loose coupling.

Referring to Fig. 1, it will be seen that with the secondary placed at some distance from the primary, comparatively few of the lines of force generated by the primary will thread through the secondary. In this case the energy is taken from the primary slowly and although the current in the secondary gradually works up to a maximum, this maximum is comparatively small on account of the radiation of energy from the aerial during the time taken to reach the maximum.

The reaction of the secondary on the primary is therefore small, and consequently the damping is small.

FIG. 1.

LOOSE COUPLING.

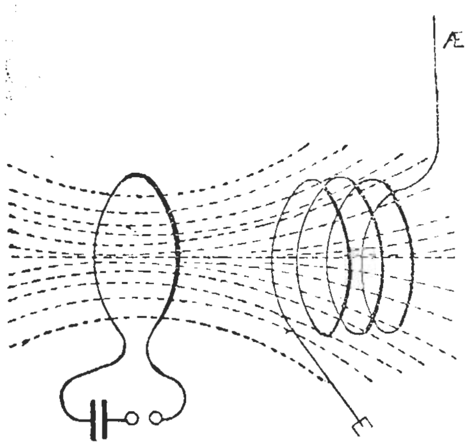
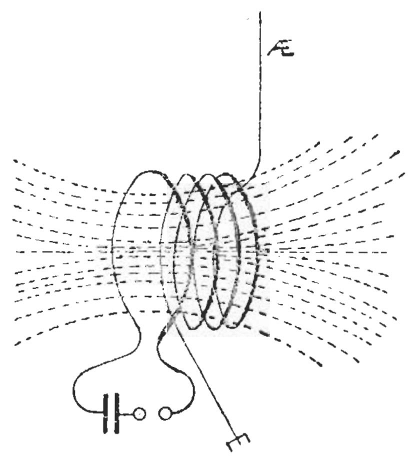
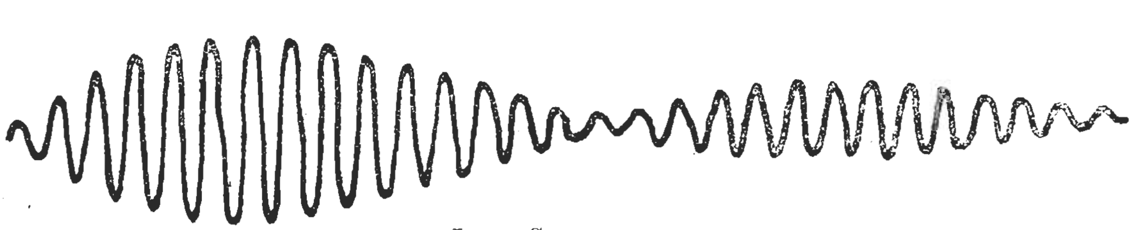


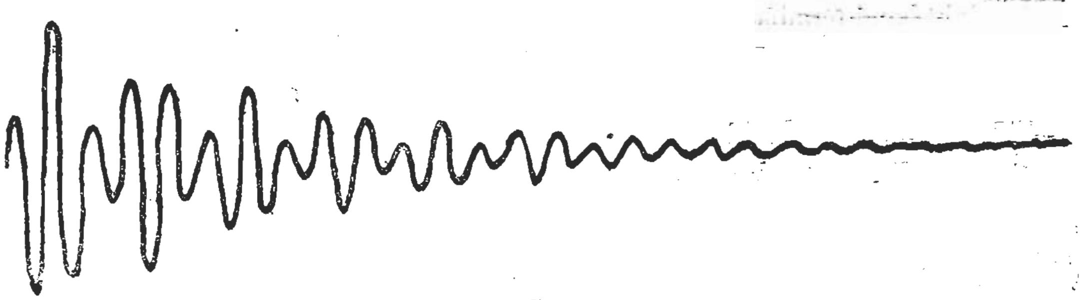
FIG. 2.

TIGHT COUPLING.





LOOSE COUPLING.



TIGHT COUPLING.

Tight coupling.

Referring to Fig. 2, it will be seen that with the secondary placed close up to the primary, nearly all the lines of force generated by the primary will thread through the secondary, the result is that the energy will be taken quickly from the primary and the maximum current worked up in the aerial in a very short interval of time, *i.e.*, after but one or two oscillations.

This maximum attains a large value due to only a small amount of energy being radiated from the aerial before the maximum swing is obtained. In this case the reaction of the secondary on the primary is great, and consequently the damping is great.

From these considerations the following questions arise :—

(*a*) How does the coupling affect the range?

(*b*) How is the coupling to be measured?

(*c*) What is the best coupling to use?

As regards (*a*), it is apparent that the receiving circuit must be taken into account, and the answer to this question can be expressed as follows :—

Best coupling for range. The coupling which will give the best range is that which sends out the form of wave to which the receiving circuit is best able to respond.

Persistency of receiving circuits. A receiving circuit possesses a definite persistency of its own, and besides being in tune with one of the incoming waves, requires a wave of persistency similar to its own to produce the maximum effect.

It follows from this that if the persistency of the receiving circuit is unaltered, whilst that of the transmitting circuit is altered by varying the coupling, the receiving circuit will no longer be under the most favourable conditions, and signals will be weakened.

Similarly, if the coupling of the transmitting circuit is arranged so as to produce the best effect on a receiving circuit, and the persistency of the latter circuit is altered, then the receiving circuit will not be working under the most suitable conditions. This is well known to be the case with the Service receiving apparatus, where the coupling of the transmitting circuit which gives the best results when using tuned shunts is by no means the best when the receiving circuit is adjusted for simple resonance.

Re (*b*), couplings are measured as follows :—

Measurement of couplings. The difference in length between the resultant waves as compared with the length of the wave tuned to. Thus, suppose the circuits are tuned to a wave-length of 1,000 feet, and the difference between the lengths of the resultant waves is 100 feet, then the coupling is said to be 10 per cent.

It must be remembered that the resultant waves cannot be 950 and 1,050 feet if the circuits are in tune for a 1,000-foot wave, as the tuning depends on the L.S. values of the resultants being equally on either side of the L.S. value of the 1,000-foot wave, and the wave-length varies as the square root of the L.S. value.

Best coupling for Service receiving circuit. As regards Question (*c*), experience has shown that 7 or 8 per cent. is the best coupling for use with the Service receiving circuit and tuned shunts, if the aerial is not overloaded, that is to say, has not commenced to brush, but it must be remembered that the tighter the coupling the more will the aerial tend to brush. It is the brushing of the feeders, therefore, that sets the limit to the permissible tightness of coupling.

Hence it may happen that the best coupling to use is less than 7 per cent. if there is a reserve of power available. This is explained on page 22 with reference to the Service Mark II. installation, and it is important to note the advantages of using the looser coupling in such cases.

The following methods of tuning will generally be found best under the following circumstances :—

Tuning Service Mark I. Primary circuit. *Service Mark I.*—Tune primary to the required L.S., using about three-quarter turn on B tuner for R and S, and one turn on B tuner for T and U. For Q tune about a quarter turn will be required.

Secondary circuit. Ship a small spark gap between the bottom of the B tuner and earth, get a small plain spark with hammer make-and-break and roughly tune aerial to requisite L.S., the primary circuit being entirely disconnected. The mutual will probably have to tap off the earth lead. Remove the spark gap in the earth lead, measure the outgoing waves, shift the secondary till their L.S. values are exactly equal amounts from the primary, which should be checked with the same mutual used in the same place as the outgoing waves are measured from.

Common turns on B tuner. The amount of common turns on the B tuner must be altered if necessary to keep the lengths of the outgoing waves between the limits of 7 per cent. and 8 per cent. apart.

It will generally be found that one position can be found for R and S and another for T and U, which will keep the resultant waves within the limits of 7 to 8 per cent. The actual number of common turns required varies with different aerials.

Tuning Service Mark II. and C tune. Secondary circuit. *Service Mark II. and C Tune Sets.*—Tune the aerial as nearly as possible to the required wave-lengths with a plain spark from a hammer make-and-break, taking care to bring in as few errors due to lead from plain spark gap to earth and so forth as possible.

Primary circuit.

Tune the primaries to the same L.S. as were obtained for the aerial.

Outgoing waves.

Measure the outgoing waves, and make slight alterations in the primary to get the outgoing L.S. values exactly equally spaced from the primary L.S.

Check the primary L.S. with the same mutual as is used to measure the outgoing waves.

The final primary L.S. must be as near as possible to the required L.S.

Position of mutual of wavemeter.

When nearly in tune it will be found that by placing the mutual lead of the wavemeter nearer to the primary the deflection of the galvanometer needle due to shorter wave will be increased, and for the longer wave the mutual lead should be placed nearer to the secondary.

Destroyer Sets.—First measure the primary L.S. as a check on the wavemeter. The primaries are all accurately set in "Vernon." The mutual terminals can be short-circuited, and the wavemeter put near the oscillator.

Tuning destroyer sets.

Then join up the aerial and look for the two waves, shifting the wavemeter about the bench till a suitable position is found.

It will not be possible to find the two till the aerial is nearly right, but if the wave which is found is just shorter than the primary, the L.S. of the aerial needs reducing.

Unwind the aerial turn by turn, bighting up the slack non-inductively, and note the resulting wave each time.

It will be found that the final adjustment is a matter of inches.

Move the oscillator up and down by its adjusting screws till the required coupling of $7\frac{1}{2}$ per cent. is obtained.

Measuring outgoing waves.

In the case of only one resultant being found differing considerably from the primary, say, the long one, it is due to the L.S. of the aerial being considerably too great. For instance, primary L.S. = 11·5, resultants 11 and the other not found—then L.S. of aerial is slightly too long; if the resultant found is about 15 or more, the L.S. of the aerial is considerably too great. In this latter case it may be necessary to reduce the size of the aerial.