Between April 27th and May 8th trials were carried out with this installation between H.M.S. "Vernon" and H.M.S. "Furious." From the results obtained it is considered that a range of 300 miles by day and 500 by night should be obtained in large ships on all tunes Q to W, the power used being 2.4 Kw. In a small ship the above distances would probably be reduced to 200 and 400 miles respectively. Results of trials.

To obtain the best note, the wheel should be run at its maximum speed and the air gap reduced to a minimum; the note then obtained is well reported on as high, clear, and musical. Musical note.

Experiments have been carried out with a view to reducing the noise of the motor, which is at present considerable; a more silent type of motor will be supplied with the later installations. Auxiliary motor.

Due to the high voltage used, sparking is considerable at various points when using a tight coupling; the deck insulator should preferably be on the left above the primary, a clear sparking distance of 8 inches being maintained. Position of deck insulator.

Experiments are in progress with an improved type of aerial insulator with a view to this type superseding the hooded insulators in Mark I*. ships. Aerial insulators.

It has been found necessary to supply "Fittings for Protecting Coils" very similar to those supplied to Mark II. sets, and described on page 13, in order to prevent damage to transformers due to resonance effects. Fittings for protecting coils.

Additional Articles and Spare Parts which will be supplied to Mark I*. Sets.

The following additional articles and spare parts for the Mark I*. installation may be expected to be issued shortly.

Further information on this subject can be obtained from the usual Store Memoranda.

This list is subject to alteration and is not to be considered as authority for demanding the articles herein mentioned.

Patt. No.	Article.	Appropriation.	Remarks.
1,215	Adjustable rheostat - -	1	Auxiliary field regulator for spark gap motor.
—	Tool box - - -	1	Containing tools necessary for parting the instruments. The thickness gauge supplied is for convenience in adjusting the air gap of spark gap.
1,503	Buzzer transmitter for W.T. 80, or 100 volts.	1	An improved form of buzzer to give a musical note and to be suitable for carrying out exercises. *See* page 11.
1,505	Spare bobbins - -	1	
1,507	Armature and spindle -	1	
1,508	Spare spiral steel spring -	1	
1,509	Contact screw - -	1	
1,087	Operating switch - -	1	To supersede the send-receive switch. *See* page 10.
1,088	Bobbin, spare for - -	1	
1,089	Box of spare parts - -	1	
1,325	Cabinet fitting - -	1	
1,326	Earth ring fitting - -	1	
762	Sending pedal - -	1	
763	Spare spring for - -	1	
1,095	Box containing shunt and series resistance and condenser.	1	
1,096	Spare series resistance -	1	
1,097	Spare shunt resistance -	1	
1,098	Spare condenser - -	1	
751	Concentric cable for operating switch.	7 yards	Necessary for wiring of operating switch.
1,090	Fittings for protecting coils -	2 sets	These consist of clamps and carbon rods which are to be shunted across the protecting coil. Until these are received it is very important that the protecting coils be kept permanently short circuited.
—	Strain insulators - -	——	For aerial: experiments are being carried out with a view to providing insulator to replace the present hooded type.
1,008	Condenser tank, spare parts for:—		
337	(1) Insulators with terminal bolts complete.	1 set of 3	To replace broken insulators; one set consists of three insulators with long bolts suitable for terminal connections to spark gap and primary. If the shorter bolts are required they must be cut down.
338	(2) Copper brush contacts for condenser switches.	1 set of 3	2 of large size, 1 of small size; made ·06 inches in thickness so as to be stronger than the present pattern.

Patt. No.	Article.	Appropriation.	Remarks.
538	Adjustable primary, spare parts for :—		
835	(1) Insulators, porcelain, 1¾ inches Pillar, No. 7.	1 box of 4 per ship.	Spare insulators for primary.
836	(2) Contact pieces for connections on revolving arms.	1 pair per ship	To replace certain parts of brush connection.
848	(3) Spare tuning clips	6 per ship	Of ebonite to mark the positions of the various tunes.
1,010 and 1,014	Auxiliary motor - -	——	The following spare parts have already been delivered—armature and shaft, set of field coils, and box of square parts.
839	Spare phosphor bronze bearings for ditto.	1 set	
1,162 and 1,163	Transformer - - -	——	Insulator Pillar, No. 1, Patt. 1,156, can be used as spares for safety horn supports.
840	Large sized insulators -	1	To replace vertical insulators of high tension switch. The supply of other insulators for the transformer is under consideration.
1,009	Spark gap. Spares :—		
842	(1) Spark plugs -	2 pairs	4 in a bundle.
843	(2) Spark wheel -	1	
844	(3) Shaft for wheel -	1	
845	(4) Phosphor bronze bearings.	1 pair	Tied together in pairs.
846	(5) Terminal insulators	1 pair	To replace terminal insulators of spark gap.
1,133	(6) Insulators Pillar, No. 6.	4 in a box	For supporting spark gap.
1,134	(7) Woodite washers -	12 per ship	For insulators supporting spark gap to be placed between insulator and top of tank.
10	(8) Asbestos and india-rubber block, round.	4 yards per ship	To form spare washers for spark gap cover.
1,156	Insulators Pillar, No. 1. 2¼ inches.	6 per ship	As spares for safety horns, protecting coils, and as required.

WIRING OF MARK I*. SETS.

New instruments.

The addition of the operating switch to Mark I*. sets necessitates certain alterations and additions to the existing wiring. The following new instruments will be supplied to Mark I*. ships, and arrangements should be made when altering the wiring to insert these instruments in their correct positions :—

(*a*) Operating switch (*see* page 10).
(*b*) Resistances for operating switch.
(*c*) Cabinet fitting for operating switch.
(*d*) Earth ring fitting for operating switch.
(*e*) Protecting switch (*see* page 37).
(*f*) Pedal for sending.
(*g*) D.C. supply switch.
(*h*) Buzzer transmitter (*see* page 11).
(*i*) Buzzer switch.

The old " pedal and lever for the send-receive switch " are no longer required.

Position of operating switch and of buzzer transmitter.

The operating switch, which is described on page 10, is to be secured up to the deck overhead in a position as near to the silent cabinet, and also as near to the deck insulator, as is practicable. It should be in such a position that it will be easily accessible for adjustment, and on no account should it be fitted on to a bracket secured to the silent cabinet. Care must be taken that the instrument does not come within sparking distance of the deck insulator or other high-tension parts, and that sufficient room is left for running the necessary cables to the various clamps. A convenient position for the buzzer transmitter can generally be found on the side of the silent cabinet just above the field regulator for the rotary converter. The chief points to be noted in this respect are (1) that the buzzer should be readily accessible for purposes of adjustment ; (2) that it should be in such a position that it can be permanently wired in the D.C. circuit; and (3) that the buzzer transmitter terminals should be as near to the spark gap as possible so as to reduce the length of flexible necessary to a minimum. The buzzer switch should preferably be as near as possible to the buzzer itself.

A.R. '09.

w/t Appendix

Plate VI.

REFERENCE.

A	AUXILIARY MOTOR
B	" " STARTER
C	CABINET FITTING
D	CUT OUT DOUBLE POLE
E	EARTH RING FITTING
F	FREQUENCY METER
G	RHEOSTAT ADJUSTABLE FOR AUXY MTR
J	MORSE KEY
L	PEDAL SENDING
M	SWITCH SAFETY
N	SWITCH PROTECTING
O	SWITCH OPERATING
Q	IMPEDENCE COIL
R	RESISTANCE FOR SWITCH OPERA
S	SWITCH SUPPLY D.C
T	BUZZER TRANSMITTER
Z	BUZZER SWITCH
ν	CONDENSER
y	SHUNT RESISTANCE
x	SERIES RESISTANCE

ALTERNATING CURRENT CIRCUIT

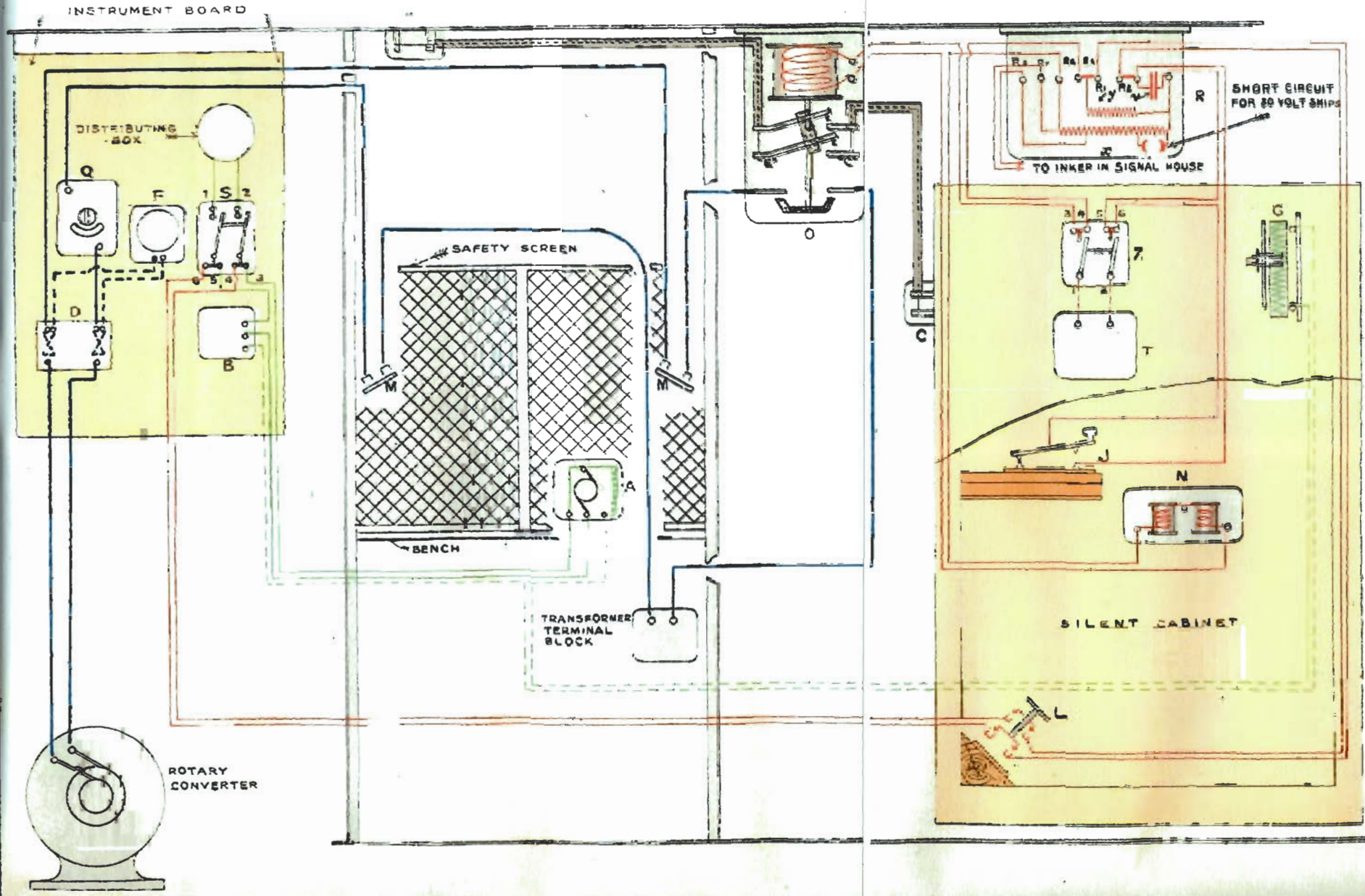
AUXILIARY MOTOR CIRCUIT

OPERATING CIRCUIT

CONCENTRIC CABLE

SERVICE MARK I* WIRELESS INSTALLATION.

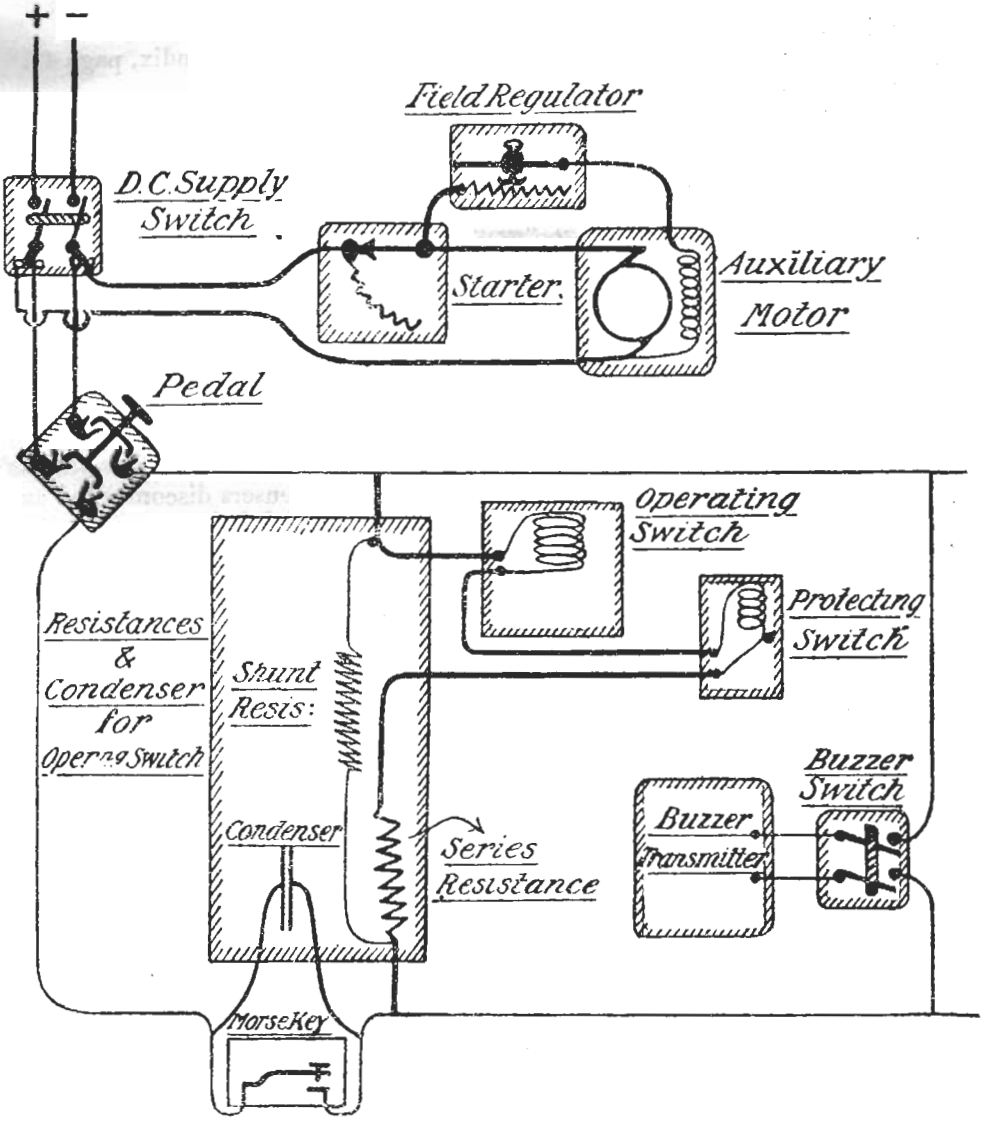
DIAGRAM OF NEW WIRING.



The existing wiring is shown in Plate No. VIII. of W.T. Appendix, Annual Report 1908. The chief alteration, which is absolutely necessary, is to disconnect the two main alternating current leads (which are Pattern 821A cable) from the terminal block on the silent cabinet and to connect these two cables up to the operating switch instead. It would be a great advantage, however, for the new A.C. wiring to be exactly as shown in Plate No. VI. That is to say, the two main A.C. leads from the instrument board should go one to each of the safety switches on the screen doors. The reason for this is so that it will be possible to render the operating switch and the transformer dead by simply opening the safety screen doors. The only other real alteration consists in inserting the "D.C. supply switch" in between the distributing box on the instrument board and the leads for supplying the auxiliary motor. Alteration to existing wiring.

The new wiring, which is shown in red on Plate VI., consists of a complete new direct current circuit worked in parallel with the circuit of the auxiliary motor. It is taken off from the lower terminals of the "D.C. supply switch" which are provided with double cable clamps for this purpose. Parallel circuits are shown dotted on the plate for clearness. The new circuit should be wired with cable, Pattern 798A, or with the newer cable, Pattern 254, which is practically the same size. It will be noticed that the new pedal is wired in such a way that, unless somebody actually has his foot on the pedal, the whole of the D.C. wiring of the operating switch, resistances, &c. for operating switch, protecting switch, buzzer transmitter, and Morse key, are automatically rendered dead. That is to say, the operator can come out of the silent cabinet and adjust the operating switch or the buzzer transmitter without any fear of a shock or a short circuit in the D.C. wiring It should be noted, however, that the alternating current parts of the operating switch will still be alive unless the safety screen doors be opened. Fig. 1 shows a diagrammatic view of the new D.C. circuit. New wiring.

FIG. 1.



Two additional terminals which are not shown in Fig. 1, are provided on the resistances for operating switch, for the purpose of feeding the "inker" in the signal house, if fitted. Two leads should therefore be run from these terminals to the signal house, where the "inker," if supplied, will automatically record all signals sent from the ship (*see* page 12). These inker terminals are shown on Plate No. VI.

A special length of concentric cable (Pattern No. 751) will be supplied to each ship for the purpose of connecting the operating switch, (1) to the "earth ring fitting," and (2) to the Wiring of concentric cable.

"cabinet fitting." The method of fitting up and of wiring these two fittings will be exactly as described for Mark II. sets (*see* pages 19 and 20).

Cable eyes, &c.

For information *re* cable eyes and the earthing of the lead casing of wires, *see* remarks on page 20 which apply equally to Mark I*. sets.

Remarks on new wiring.

It will be noticed that the whole of the circuit for the auxiliary motor, and also the whole of the new circuit for working the operating switch, the protecting switch, and the buzzer transmitter, can be rendered dead by opening the "D.C. supply switch."

When it is required to send with the "buzzer transmitter," it will be necessary (1) to place the "series parallel H.T. switch" for the transformer in the "off" position; (2) to connect up the buzzer flexibles to the terminals of the spark gap; (3) to close the "buzzer switch."

Further information is given about—

The buzzer transmitter on page 11.
The operating switch on page 10.
The protecting switch on page 37.
Inker recorder on page 12.

ARRANGEMENTS FOR TRANSMITTING "D" TUNE.

Experiments have been carried out to ascertain the best arrangements for sending and receiving "D" tune with the Mark II. and Mark I*. sets in order that a suitable selective circuit, easy to tune, might be decided on.

Aerial circuit.

Three methods were tried for the transmitting circuit:—

(*a*) Inserting a small condenser in series.
(*b*) The harmonic method, as described in A.R., 1908, W.T. Appendix, page 41.
(*c*) Using a short aerial.

The following results were obtained:—

Method (*a*).—As stated on page 41 of last year's report, difficulty is experienced in tuning with this arrangement.

Method (*b*).—From observations taken at a range of one mile it appeared that several other wave lengths were also radiated, which would interfere with the organisation of the Fleet.

Method (*c*).—With this arrangement, tuning was easy and the correct waves only were obtained. The aerial used was a vertical four-fold 80 feet long, and the main aerial was earthed.

Primary circuit.

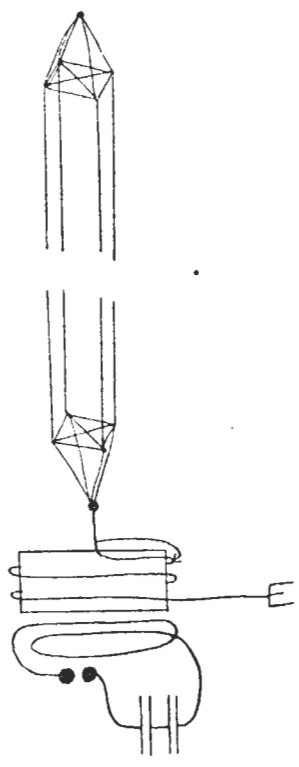
In all cases the primary was tuned to 11·5 L.S.

In Mark I*. ships the auxiliary condensers and primary are used in the ordinary way.

In Mark II. ships where no special apparatus is available, the primary arrangements given in last year's report, page 43, are generally recommended.

The existing primary and spark gap are used, the main condensers disconnected and the jars joined up with short leads 8 in parallel, 2 in series, the 80 foot aerial being taken straight to the mutual coil of which about 4 turns will be required, (*see* Figure 1.) A spark length of 6 m.m. was used.

FIG. 1.



Using the Mark I*. installation the ranges obtained with (*a*) and (*b*) were slightly greater than with (*c*), but with the latter arrangement satisfactory communication was obtained at 60 miles, between H.M.S. "Niger" at Beachy Head and H.M.S. "Vernon," both ships using 80 feet aerials, and, taking into consideration that the M.D. is particularly unsuitable for receiving short waves, this range is considered sufficient. With more sensitive receiving apparatus considerably longer distances should be reached. Conclusions.

Using Mark II. installation the range depends upon the efficiency of the primary arrangements.

DESTROYER INSTALLATIONS.

The following destroyers have been fitted with W.T. apparatus during the year :— Destroyers fitted.

"Kale."	"Ghurka."	"Crusader."
"Colne."	"Amazon."	"Nubian."
"Cossack."	"Saracen."	"Mohawk."
"Tartar."	"Maori."	

A total of 43 Destroyers are now fitted. The installations are working satisfactorily.

Improvements.

Several changes have been introduced into the latest combined spark gap and oscillator. Spark gap and oscillator.

The bayonet jointed rods for holding down the spark gap silencer have been replaced by two rods with butterfly heads and threaded ends which screw into the base of the spark gap. An additional turn of secondary has been wound close down to the bottom of the oscillator to increase the mutual inductance, and the metal lugs for carrying the ebonite oscillator have been replaced by ebonite blocks. A flange of ebonite has been fitted between the primary and the mutual to prevent brushing from the primary through the mutual coil, to earth.

In the earlier instruments the porcelain tops of transmitting condensers have been cracked when endeavouring to get an oil tight joint round the top of the container. The new ebonite tops are less likely to be damaged in this way, and wooden frames are supplied which rest on the edge of the ebonite and take the pull of the clamps, thus distributing the strain more evenly over the ebonite. Porcelain tops of condensers.

A new type of aerial wire for destroyers has been introduced. It consists of seven-stranded galvanised steel wire. It is very much stronger, easier to handle, and more durable than the copper wire, and is not appreciably less efficient. New aerial wire.

SHORT DISTANCE SETS.

Referring to Annual Report Appendix, 1908, pages 23–25, further trials have been carried out with the short distance installation, and 11 of these sets are on order. Appropriation of first sets.

They are appropriated as follows :—

"Dreadnought."	"Bulwark."	"Africa."
"Bellerophon."	"King Edward VII."	"Vernon."
"Lord Nelson."	"Hibernia."	1 set in reserve.
"Agamemnon."	"Dominion."	

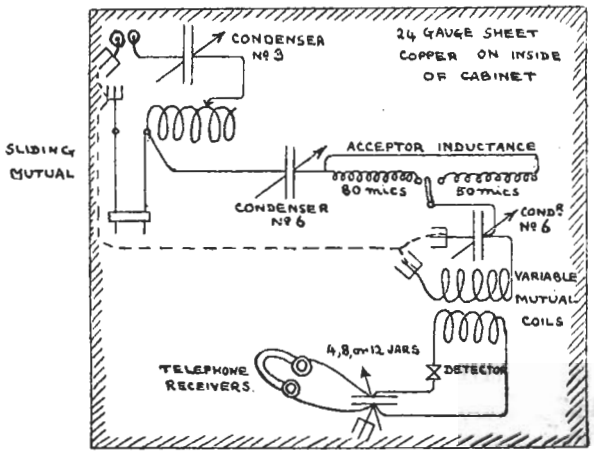
The short distance offices will be built in these ships as they come in for refit. They will be in selected positions behind armour, as nearly below the fore bridge as can be conveniently arranged, having regard to the lead of the aerial and of the trunk between decks. The short distance aerial should not be within 100 feet of the main feeders. Position of office.

The short distance office and transmitting circuit are fully described in A.R. Appendix, 1908, but several modifications have been introduced in the receiving circuit.

Fig. 1 shows the receiving circuit at present in use.

FIG. 1.

SHORT DISTANCE RECEIVING CIRCUIT.



Receiving instruments.

The whole of the receiving instruments are mounted on a sheet of copper, covering two walls of the cabinet above the bench. This copper is connected directly to the earth terminal of the cabinet fitting. The aerial is connected through the operating switch to the aerial condenser, thence to a small inductance, and through a direct mutual, consisting of two brass rods with a slide between them, to the copper strip. This forms the aerial circuit.

Connected to the bottom of the small inductance is an acceptor consisting of a very small adjustable condenser and an inductance of 50 or 80 mics.

In series with this is a rejector of about 0·2 jar and 20 mics., the condenser being adjustable.

The rejector inductance forms the primary of an oscillation transformer, the secondary being connected to the detectors and telephones.

The mutual effect between these two is adjustable by sliding the secondary away from the primary.

The dotted lines show the circuit completed by the wires earthed to the copper plate.

Results obtained.

It will be seen that the direct mutual is common both to aerial and secondary circuits, and by moving the slider it is possible to vary the degree to which the oscillations in the former affect the latter circuit. Experiments have been carried out in the "Vernon" with a short distance set, sending from Horsea, and with this circuit it has been found possible to cut out "Q" tune when sent on Mark II., with 5 per cent. coupling and 14 m.m. spark, sufficiently to read the signals from Horsea easily and reliably. Longer waves can be cut out reliably at full power.

Prevention of interference by harmonics.

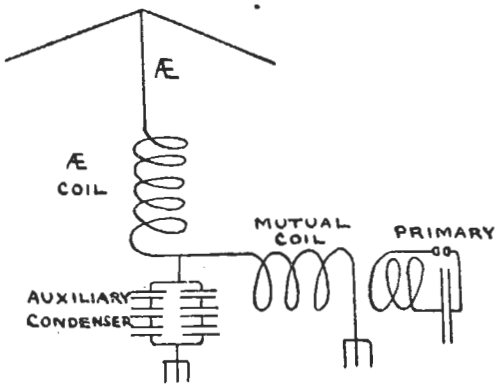
As mentioned in A.R. 1908 Appendix, page 24, it has been necessary to take special means to prevent harmonics in the main aerial from interfering with the reception of short distance signals. This applies also to the main aerial of other ships in very close proximity.

Auxiliary condenser.

This is effected by the use of an auxiliary condenser. If the L.S. value of a harmonic is approximately four, it will interfere with the short distance receiving gear.

The objectionable harmonic can, however, be very much weakened, and also have its wavelength slightly altered, by placing a condenser between the junction of the aerial and mutual coils and earth, as in Fig. 2.

FIG. 2.



The effect of this is to produce another harmonic in the aerial, whose L.S. value is approximately that of the circuit formed by the auxiliary condenser and the mutual coil. If the condenser is of a suitable value, this L.S. can be arranged to fall between the L.S. value of the main wave and that of the objectionable harmonic. Effect of auxiliary condenser.

Now the proportion of energy given to each wave in the aerial decreases rapidly in the shorter harmonics, so the effect of introducing the new wave is to reduce enormously the energy in the objectionable harmonic, because instead of being, say, the fourth wave in the aerial in the order of length, and receiving 1/100th part of the energy, it has now become the fifth wave, and probably receives much less than 1/1,000th part.

In some cases, however, it is a disadvantage to put in the auxiliary condenser, owing to the fact that it alters the wave length of the shorter harmonics, and may bring one of them more in resonance with the short distance circuit. This question is best decided by trial in each ship, and it will be possible to lay down more definite rules when several ships have been fitted. As the condenser very slightly alters all waves emitted, it is advisable to re-tune when it is in circuit.

Six Moschicki condensers, each of capacity about $\frac{1}{2}$ jar, will be supplied to ships fitted with short distance sets for this purpose, and also to battleships which are likely to steam in close order with ships fitted with short distance sets. They will probably be best fitted three in series and two in parallel between the top of the mutual coil and earth. Supply of Moschicki auxiliary condensers.

Further particulars of the use of the auxiliary condenser, and information *re* installing and using the short distance gear, will be found in the "Instructions for fitting short distance sets," which will be issued with the sets now on order. Instructions.

PORTABLE AND HARBOUR DEFENCE SETS.

It has been decided to introduce a certain number of sets of W.T. for land service and for harbour defence. The sets for land service are known as "portable sets," the gear for them being marked "type P." The gear for sets for harbour defence is marked "type H.D." Articles common to both sets are marked "type P.H.D." As a first supply, 9 portable sets and 11 harbour defence sets are now on order. They will probably be ready for issue about May 1910. N.S. 8279/12231 of 28th August 1909.

The appropriation of these sets will be as follows :— Appropriation.

"Harbour defence sets":

Sheerness	3 sets.
Portsmouth	4 sets.
Devonport	3 sets.
"Vernon"	1 set.

"Portable sets":

Two sets for each Senior Flagship of 1st Division, Home Fleet, 2nd Division, Home Fleet. Mediterranean Fleet.
Two sets for Bombay (N.S. 9530/14750).
One set for "Vernon."

The harbour defence sets and the portable sets have a considerable amount of gear in common.

A small two-cylinder $1\frac{1}{2}$ H.P. engine, running on methylated spirit, drives a $\frac{1}{2}$ Kw. alternator with an output of 7 amps. at 70 volts, 80 cycles. In the harbour defence sets this is stepped up by a transformer to 10,000 volts, and an ebonite condenser of about 15 jars, with a spark of about 4 m.m.s maximum, is used. Engine and alternator. Harbour defence transmitting gear.

The condenser and oscillator are contained in one wooden case, the condenser being in an oil-tight container. The whole case is known as the "transmitter." The wave-length is 500 feet, L.S. value 5·86.

For portable sets the two parts of the ebonite condenser which are in series for "type H.D." are joined in parallel, giving a condenser of about 60 jars, and a spark of $1\frac{3}{4}$ m.m.s is employed. Portable transmitting gear.

The transmitter is otherwise identical with "type H.D." The wave-length is 1,000 feet, and the L.S. value 23·5. As the condenser is four times the value of the H.D. condenser, the same primary inductance serves in each case.

The transformer "type P" has a lower step up than the other, only giving 5,000 volts.

The receiving gear is carried complete in a phosphor bronze box, and consists of a circuit practically the same as that of "receiving gear type B," *see* Plate VII., except that the primary of the induction tuner instead of being used in the acceptor circuit of the service receiving gear, is joined directly between aerial and earth and is provided with a variable inductance to put the aerial in tune. Two crystalite detectors are employed. The receiving gear is the same for both portable and harbour defence sets. Receiving gear.

Portable mast and tent.

In the case of portable sets, and also of one harbour defence set at each port, the following additional gear is supplied for using the set on shore :—

1 mast complete with stays, aerial, &c.
1 tent.

Carts.

The portable sets also have two small hand carts, fitted to carry the whole installation.

The two carts will be of as light construction as possible, and will be arranged with detachable wheels, so as to stow compactly on board ship, and also so as to form tables for the gear when in use. One cart will carry the mast, tent, and spare fuel for the engine.

The other will carry the engine and alternator, and the sending and receiving gear.

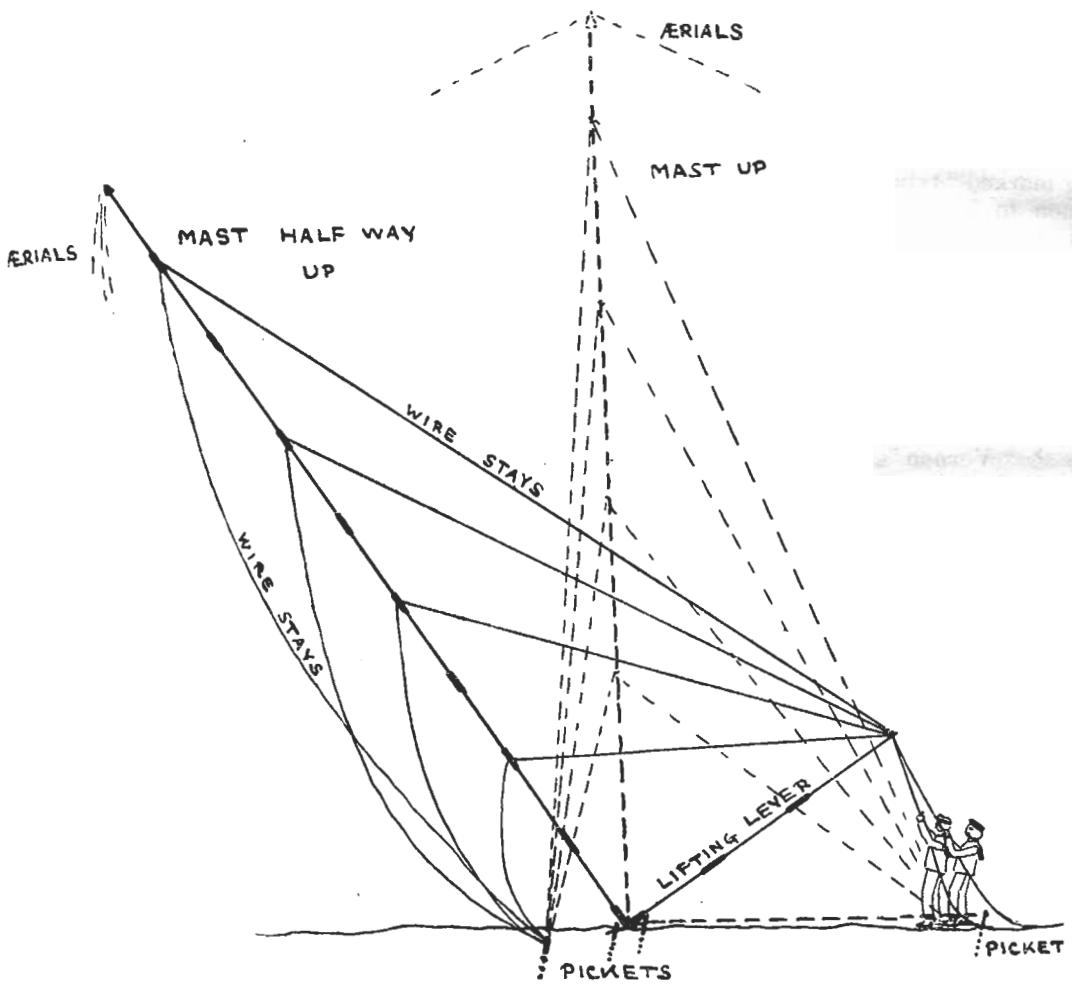
The gear will also be arranged so that it can be carried, in separate parts, by a party of men over rough ground where the carts cannot be used.

Description of mast.

The mast is composed of 6 foot lengths of weldless steel tubing connected by 18-inch steel sleeves. Nine of these lengths form the upright, and three more form the lever for raising and lowering the mast. Fig. 1 shows the method used.

FIG. 1.

ERECTION OF PORTABLE MAST.



Three sets of stays are used, four stays in a set. One set is secured to the end of the lifting lever, the other two sets to pickets driven into the ground on each side. Two pickets are driven into the ground at the heel of the mast, to prevent it slipping while hoisting up. Two men can easily get the mast up and down in less than half a minute, not counting the rigging and unrigging process.

The weight of the mast complete with stays and all accessories is about 120 lbs.

Balanced aerial employed.

Owing to the variable conditions under which portable and shore harbour defence sets may work on shore, it has been decided to employ a "balanced" aerial, without earth connections. The principle of this is shown in Fig. 2.