

between the lead cased and flexible Motor Buzzer leads, and allows of rapid disconnection when required (N.S. 14,036 of 23.6.13).

Instructions for installing, and general information about, the set were promulgated in Torpedo Order No. 60 of 1st August 1913.

Tuning Aerial Circuit with Motor Buzzer.—When tuning the aerial circuit by means of the Motor Buzzer, only one Wave will usually be found. The tuning is far sharper than that obtained when using a spark, also small alternations in the value of the primary circuit will only affect the radiation and not the tuning of the Aerial circuit. This points to some quenching action taking place in the primary, and great accuracy of tuning in the Aerial circuit can consequently be obtained.

Variable Speed of Motor.—The motor starter was designed to give three speeds so that when Ships are working on the "Group System," the groups can be detailed to work on different notes. This only applies to short range work; for full power the maximum speed is required.

MARK II. SETS—SPARK GAPS.

TRIALS CARRIED OUT BY H.M.S. "ALBEMARLE," 10.30 P.M. 28TH JULY 1913.

The object of the trial was to see whether the Mark II. Spark could be improved by using only the vertical air nozzle from the blower instead of all three nozzles. The signals were received by H.M.S. "Glory" approximately 30 miles away, with results shown on attached sheet.

"Vernon" is considering the question of carrying out similar trials and using a higher air pressure.

Nozzles in Use.	Spark.	D.C. Amps.	A.C. Volts.	A.C. Amps.	~	Radiation.	Note in Tuned Buzzer.	Brushing Aloft	Appearance of Spark.	Report by "Glory."
3	3 mm.	120	320	70	345	2.5	Rather rough musical, good for Marconi T.B.	Practically nil.	Fat, low down on plugs.	R. 10. Harsh but musical, occasional arcing.
1 (vertical air pressure).	3 mm.	105	290	65	350	2.5	Clear, musical, very good for Marconi T.B.	Less	Equally distributed apparently less arcing as spark seemed more apparent.	R. 10. Clear, musical. No arcing.

NEW HAND OPERATING KEY.

This key, which is being designated in the Rate Book "Key Types II. and IV., Pattern 310," owing to its being used in both Type II. and Type IV. sets, was described and illustrated on pages 26 and 27 of the last year's Appendix to the Annual Report. It has now been adopted and no further supplies of "Hand Operating Key, Pattern 2483," will be purchased. Since existing "Hand Operating Keys, Pattern 2483," can with comparatively little work be converted into the new Key, it has been decided, in addition to purchasing supplies of the new Key, to also convert all existing Keys from Patt. 2483 to Patt. 310. The work of conversion will be done in Portsmouth Yard. The necessary arrangements for the returning of existing Keys and their conversion are dealt with fully in Store Memorandum, N.S. 3251/8691 of June 11th, 1913.

DESTROYERS' INSTALLATIONS.

During the year, Type IV. Installations have been fitted into 40 Torpedo Boats and Torpedo Boat Destroyers; this brings the total number fitted up to 163.

Destroyer Aerials.—The existing type of Aerial has several objections, and with the increased number of Wave-Lengths now required to be transmitted by Destroyers, it has become necessary to consider the whole question of rig and Aerial fittings of Destroyers. Trials have been carried out at sea with the following types of Aerial; from the analysis of results it will be determined which is the most suitable type for general adoption throughout the Service as a standard Destroyer Aerial.

I. Roof Aerial, recommended by Commander-in-Chief, Mediterranean, consisting of four separate roof wires with separate feeders. Each wire starts from a spreader forward, is hitched to an insulator on the foreside of the Aerial Yard, dips under the Yard, is hitched to an insulator on the afterside of the Yard, and is hauled out to a spreader on the mizzen mast, 20 feet above the deck.

II. Double Cylindrical Aerial (8 wires to each cylinder), with wooden disc spreaders of 6 inch diameter and multiple feeder.

III. Double four-fold Aerial with cane spreaders 1 foot long, and multiple feeder.

IV. An Aerial wrongly named the "Star pattern Aerial." This is similar to No. III., but a multiple feeder is not used.

Up to the present, the trials have been giving promising results.

Signal Halliards on Aerial Yards.—Cases have occurred where Destroyers carrying W/T apparatus have been fitted with Signal Halliards to their Aerial Yards. This practice leads to considerable loss of efficiency in the reception and transmission of W/T messages, and is to be discontinued.

In cases where T.B.D.'s are fitted with Signal Halliards in the above manner, arrangements are to be made to remove them. (Admiralty Weekly Order, 18.4.13.)

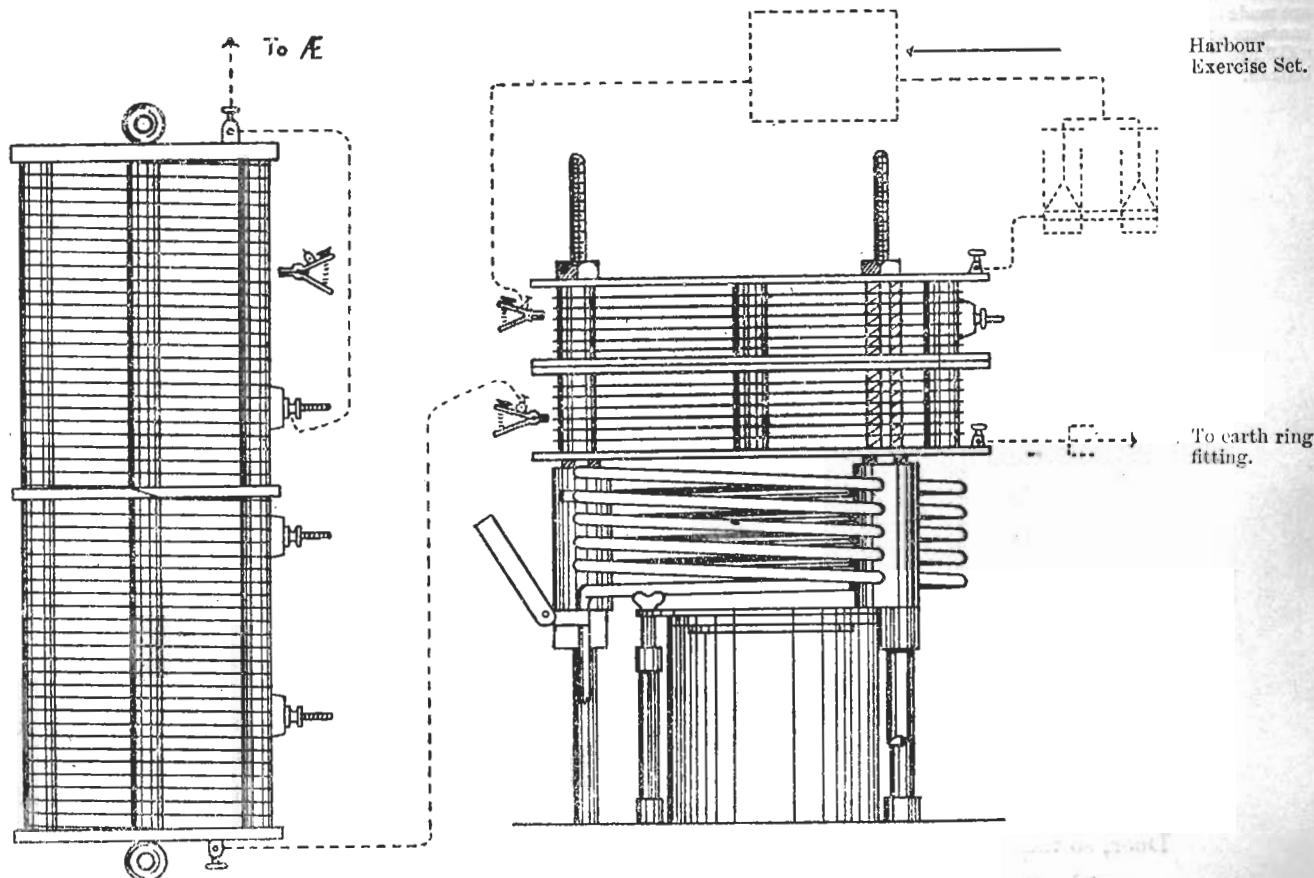
W/T Installation in Torpedo Boats.—It was alleged that there was considerable loss of speed in Torpedo Boats of the Patrol Flotillas, due to the weight of the Type IV. W/T Installation and ballast necessary to counteract the high position of the Office. Experiments in Torpedo Boat 36 tended to confirm the alleged loss of speed, which was said to be $4\frac{1}{2}$ knots. It was decided, therefore, to alter the equipment as follows, and then to carry out trials:—

1. To place office on Seamen's Mess Deck.
2. To reduce the thickness of the plates composing it to $\frac{1}{3}\frac{1}{2}$ in.
3. To use the ordinary masts of these boats and to generally reduce the size of the Yards, &c.

Aerial Receiving Tuner.—With the new W/T Organization of Wave-Lengths, Destroyers will be required to receive all Service Wave-Lengths. To enable this to be done, an Aerial Tuner is being designed in "Vernon."

Aerial Coil.—A new design of Aerial Coil has been made in "Vernon," to supersede the one wound with Pattern 611 wire now in use, which is generally unsatisfactory. The new coil is wound with 14 gauge enamel wire on a Skeleton Ebonite former. It is fitted with tuning and permanent clips, and will be recommended for adoption.

FIG. 4.



Mutual and Harbour Exercise Primary Coils.—The existing practice of winding, Pattern 611, wire on top of the Destroyers' Mutual Coil as a primary for the Harbour Exercise Set, has several objections, and the Mutual Coil itself is of unsatisfactory design.

"Vernon" is recommending that the old pattern Mutual Coils shall be replaced, when defective, by two identical coils similar in type to the Aerial Coil described above, and designed to fit above the primary of the Oscillator in the manner shown in Fig 4.

Each coil will be provided with tuning and permanent clips so that refinements of tuning and coupling variation may be obtained.

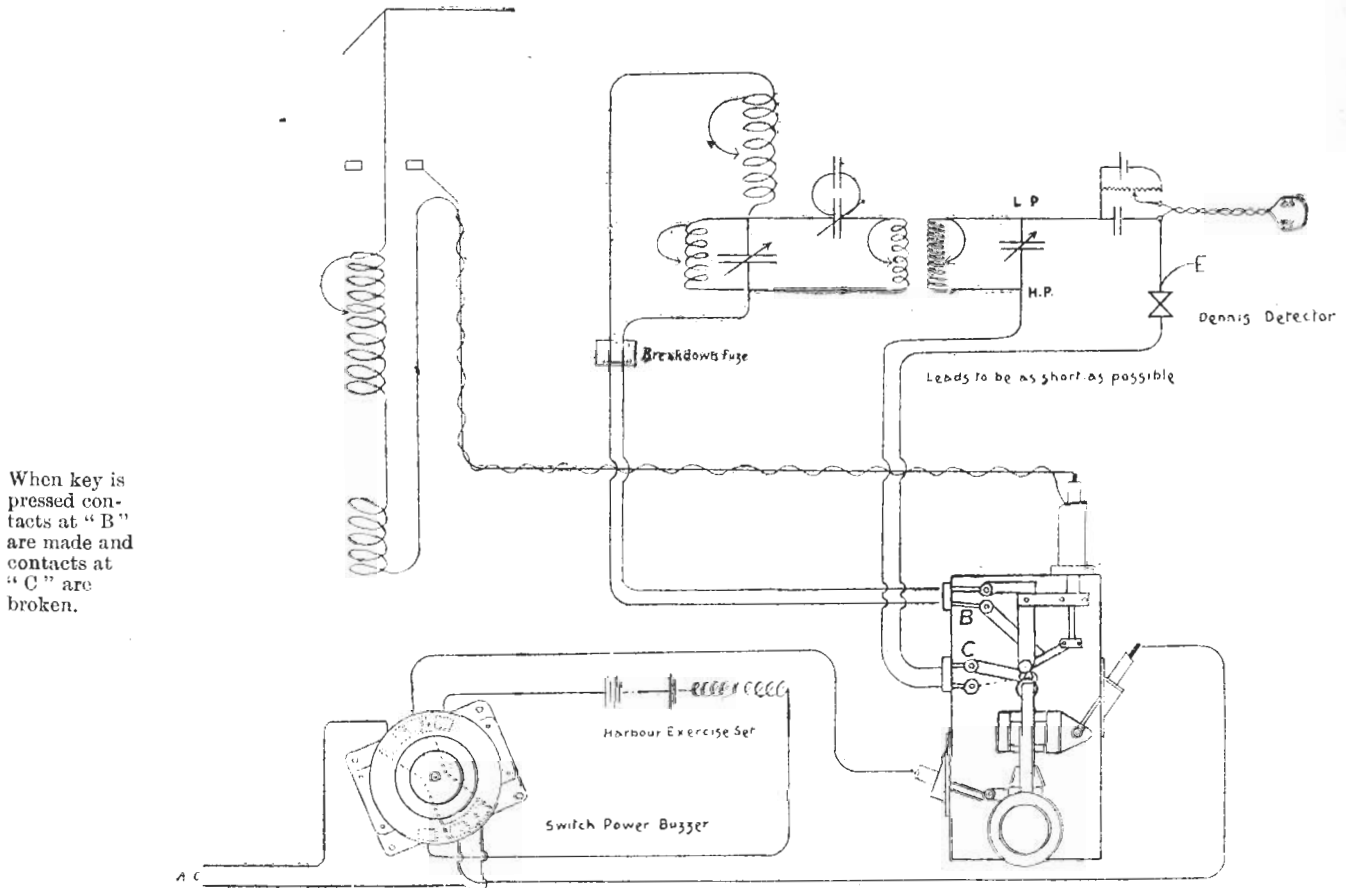
With the introduction of the 756 feet Wave in the W/T Organization, a Condenser of larger value will be recommended for supply with the new Harbour Exercise Primary.

Protecting Switch.—In Harbour, when steam is down, no provision is made for working the Protecting Switch when using the Harbour Exercise Set. With Pattern 2475 Protecting Switch, the switch can be worked off three dry cells, but with the introduction of the new Protecting Switch, Patt. 1138, this will not be possible.

Experiments are now being carried out with the new Hand Operating Key (Patt. 310), wired as shown in Fig. 5. If the trials continue to be satisfactory it will no longer be necessary to supply Protecting Switches, as arrangements are made to break the lead to the high potential side of the Detector, the opposite side of the Detector being permanently earthed.

In Fig. 5 the contacts at "C" are broken whenever the Hand Operating Key is depressed.

FIG. 5.



Destroyer Installation (type IV.) Proposed improvements.

Switch Power Buzzer, Type II.—In order that Signalling, both on Power and the Harbour Exercise set in Type IV. Installations, may be carried out by means of the Hand Operating Key, alone, it has been decided to supply one "Switch Power Buzzer, Type II.," to each of these installations so that the operator may change over from "Power" to "Harbour Exercise Set" or *vice versa*, as required. (Vide Torpedo Order No. 57, of 1st August 1913.)

FITTING OF RUBY GLASSES, PATTERN 307, TO OSCILLATORS AND SPARK GAPS, TYPE IV. (OLD PATTERN).

The glass cylinder will be found to be longer than the existing brass one, which it replaces. Instructions for fitting it will be found in Torpedo Order No. 54 of 1st August 1913.

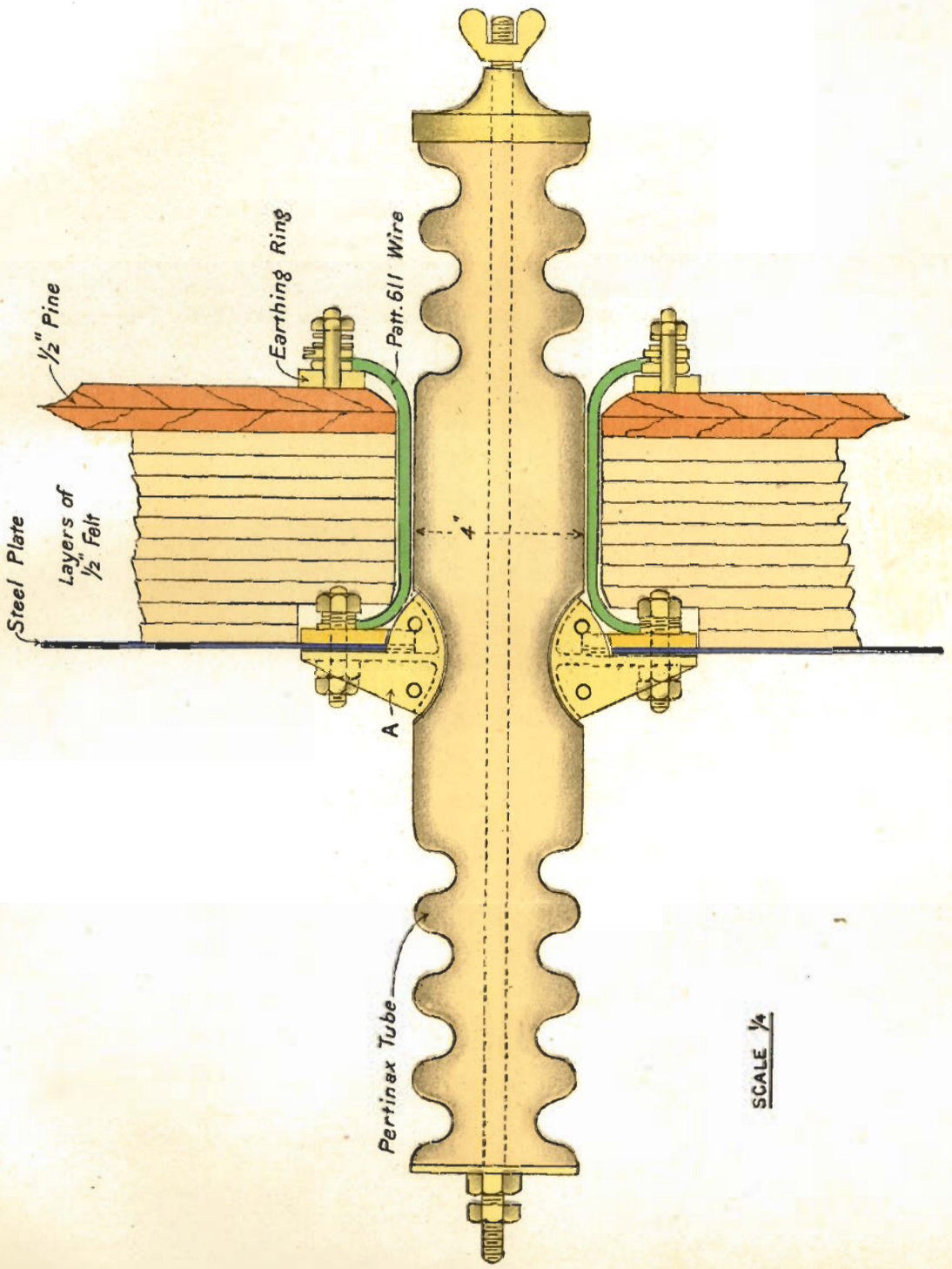
Window in door of Destroyers' Offices and Safety Switch for Lights.—It is under consideration to fit a Window in the Door of Destroyers' Offices, and to supply a safety Switch to be fitted to the Door, so that the lights will be switched off by the door opening.

Mica Block Transmitting Condenser.—Trials are being carried out with a 16 Jar Dubilier Mica Block Condenser, which is much smaller and lighter than the existing Ebonite one. Greater efficiency is expected with the former, but the question of endurance and constancy has yet to be settled.

Deck Insulators.—It is reported from Sea that very heavy brushing occurs at the Deck Tube in Destroyers when transmitting on "Q" Wave. "Vernon" has designed a Deck Insulator for

DECK INSULATOR UNDER TRIAL.

PROPOSED DESIGN FOR DESTROYER SETS.



SCALE 1/4

Type IV. Installations, which will shortly be tried, and which it is hoped, will overcome the trouble.

Plate I. shows the Deck Insulator in question. It will be noticed that the Pertinax Rod is recessed at the Gland "A"; the reason for this is that it is advantageous to arrange for the surrounding earth to be along the lines of Potential strain.

EXPERIMENTS CARRIED OUT WITH A VIEW TO OBTAINING A RANGE OF 150 MILES ON "U" WAVE FROM DESTROYERS.

It was proposed to convert the "Crusader," "Maori" and "Zulu" for service as Flotilla Leaders. Experiments were therefore carried out to enable them to send on all Waves up to "U" without extensive alteration to existing Offices. The idea of converting these T.B.D.'s has now been abandoned, but the result of the experiments is as shown below.

Trial of Motor Buzzer Set.—An ordinary Service Motor Buzzer with 220-volt wheel was employed, the voltage of supply being 300 volts. The Primary Circuit consisted of a Mica Condenser with stout wire Primary, special Mutual and Aerial Coils. An Aerial was rigged in "Vernon" to represent the type of Aerial that could be used in a Destroyer of the "Crusader" Class, given two 60 feet masts. The best results obtained with this Set were with Portland (*i.e.*, at a distance of 54 miles), the signals being Strength 5.

Modified Destroyer Set.—A Destroyer Set, Type IV., was modified as follows:—An additional Destroyer Transmitting Condenser was joined up in parallel with the existing Condenser, giving a total transmitting capacity of 30 jars. A special wire Primary was used in lieu of the Destroyer Primary, and special mutual and aerial coils built. This gear was installed in the "Velox," and she was then despatched to Falmouth to carry out a two days' trial.

The maximum reliable range obtained was 80 miles, with a 6 per cent. coupling and a 5-millimetre spark.

The present Destroyer Deck Insulator was found quite unsuitable; owing to the fact that when sending on "U" wave, the tension at the insulator is equivalent to a 7-inch spark to earth. The mean height of the aerial used in "Velox" during these experiments was approximately 50 feet above water-line, and it is thought that with two 60 feet masts the reliable range for this Set would probably be 120 miles.

AUXILIARY SETS (LATE SHORT DISTANCE).

All Battleships of the 1st, 2nd, and 3rd Battle Squadrons are now fitted with the Battleship Auxiliary Sets, Type III.

Other Battleships are being, or have been, fitted, except "Bulwark" Class and earlier, who will not be so fitted (A.L.G., 463/13, of April, 1913).

Pending the completion of the Cruiser Auxiliary Set, certain Battle Cruisers are being, or have been fitted, temporarily with the Battleship Set.

When these Ships are fitted with the Cruiser Auxiliary Sets, the Battleship Sets, thus released, will be fitted in the following Ships (A.L. 19th April 1913, G. 1386/13/6475):—

"Active."	"Blanche."
"Bellona."	"Diamond."
"Boadicea."	"Topaze."

Cruiser Auxiliary Sets, Type IX., are being purchased for the following Ships (A.L. 27th June 913, N.S. 6463/9892):—

"Tiger."	"Defence."	"Devonshire."
"Queen Mary."	"Shannon."	"Roxburgh."
"Princess Royal."	"Minotaur."	"Hampshire."
"Lion."	"Warrior."	"Antrim."
"New Zealand."	"Natal."	"Carnarvon."
"Australia."	"Achilles."	"Vernon."
"Indefatigable."	"Cochrane."	"Actæon."
"Invincible."	"Black Prince."	"Defiance."
"Inflexible."	"Duke of Edinburgh."	
"Indomitable."	"Argyll."	

And two for Portsmouth Reserve.

The proposal to fit this Set in Cruisers of the "Drake Class was cancelled (A.L. April 1913, G. 463/13).

BATTLESHIP AUXILIARY SETS, TYPE III.

Considerable experience has been gained with the use of this Auxiliary Set during the past year, and many of the difficulties previously encountered have been to some extent overcome.

The main sources of trouble are :—

- (1) Interference in main office.
- (2) Interference in auxiliary office.
- (3) Insufficient range.
- (4) Screening on certain bearings.

The fact that some ships have reported complete immunity from mutual interference points to the fact that the interference experienced in other ships is of local origin and must be dealt with in the ships concerned.

(See remarks in paragraph 11, page 15, on Cruiser Auxiliary Set.)

The question of insufficient range and screening are both caused, it is thought, by the aerial being both short and hidden behind funnels, &c., and many ships have got over this difficulty satisfactorily by increasing the length of their aerials very considerably, the L.S. of the aerial being kept down by moschichi or other condensers inserted in it.

This appears to have overcome the range and screening difficulty but has, as was to be expected, accentuated the interference problem.

For this reason increasing the length of the aerial is a practice to be discouraged except so far as is absolutely essential.

The insertion of a moschichi is also most undesirable as, on account of the low efficiency of these pattern condensers, the strength of incoming signals will be considerably reduced where they are employed.

CRUISER AUXILIARY SET, TYPE IX.

The experiments with Quenched Spark for this Set having proved a failure, they were abandoned at the end of 1912. An entirely new design was then prepared and experiments were commenced early in 1913. These early experiments gave sufficient promise for the design to be further developed, and more elaborate experiments carried out.

Two Cruisers, "Achilles" and "Vindictive," were fitted with experimental Sets, purchased for the purpose, and a series of programmes and experiments were carried out during the month of June 1913.

As a result of these experiments, it was considered that the points enumerated below were sufficiently confirmed to justify finally ordering the sets to designs similar to those of the experimental ones, certain alterations and modifications found advisable being made as necessary.

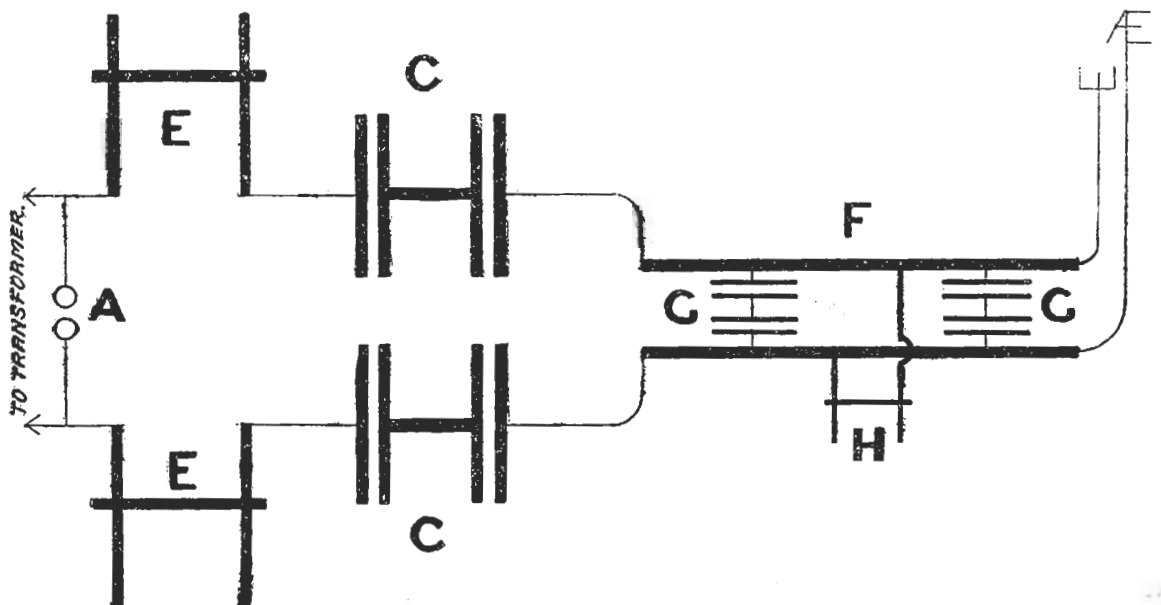
1. A range could be obtained up to 25 miles, using wave-lengths of 4 or 6.2 L.S.
2. The Set did not cause direct interference in the Main Office.
3. To a great extent, the new arrangement of Aerial removed the screening difficulty.
4. The new arrangement of earth wires pointed to a considerable increase in the efficiency of this part of the circuit.
5. The Transmitting Circuit is easy to manipulate.

The preparation of Drawings and Specifications, &c. was proceeded with as rapidly as possible; considerable delays, however, were experienced in settling the final form of the Transmitting Condenser, a long series of experiments having to be executed, and also in the design of an automatic "Send-Receive" Switch, a necessary adjunct to the Set, and the experiments with this mechanism are not yet concluded.

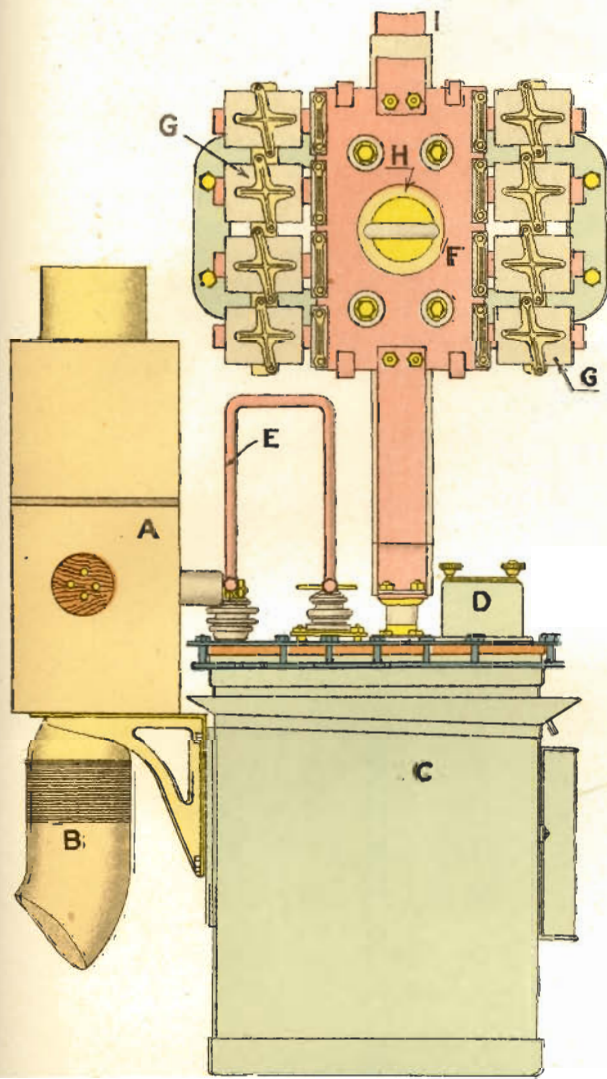
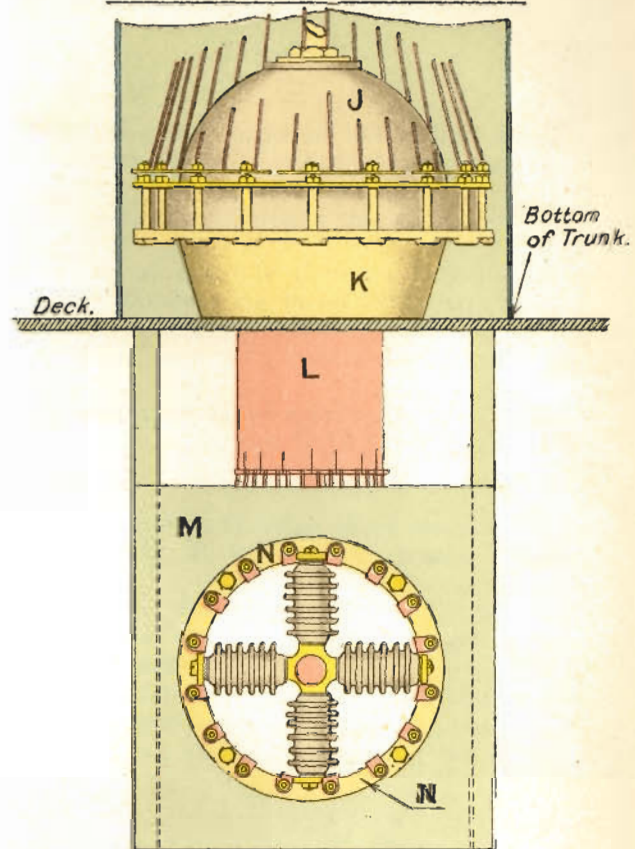
It is hoped, nevertheless, that the first Sets will be ready for issue early in 1914, and that ships will be fitted with the complete Set as they come into Dockyard hands during the year.

General Description.—A general view of the Set from the protecting coils to the Aerial and the bottom of the trunk is shown in Plate II. and a diagrammatic sketch of the circuit below.

FIG. 6.



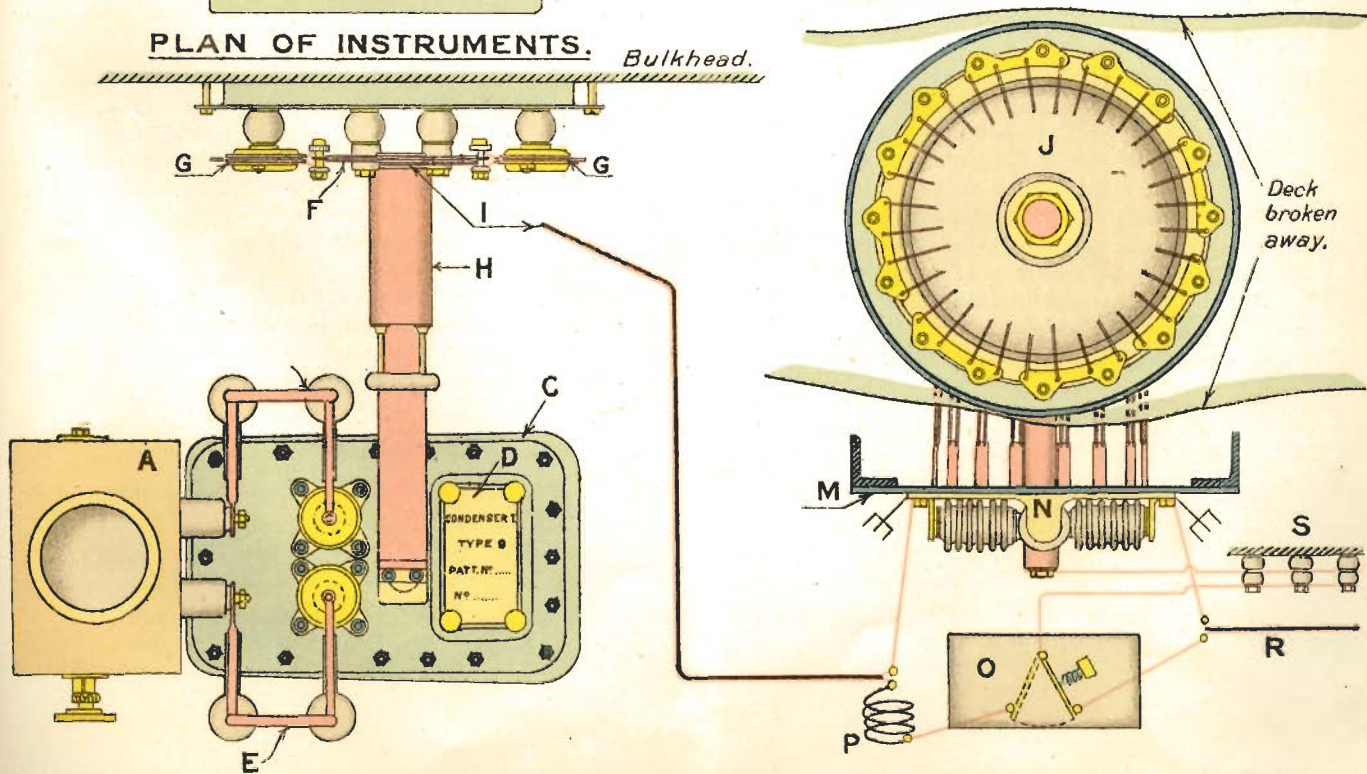
Cruiser Auxiliary Set—Diagram of Set.

CRUISER AUXILIARY SET.**(INSTALLATION TYPE 9)****TRANSMITTING APPARATUS.****SCALE 1½ INCHES = 1 FOOT.****ELEVATION OF INSTRUMENTS.****ELEVATION OF TRUNK.****REFERENCE.**

A	<i>Spark Gap.</i>	L	<i>Copper Tube for Earth Connections.</i>
B	<i>Hose to Blower.</i>	M	<i>Steel Plate to support Earth Ring.</i>
C	<i>Condenser Tank.</i>	N	<i>Earth Ring.</i>
D	<i>Oil Expansion Box.</i>	O	<i>Send-Receive Switch (Magnetic type).</i>
E	<i>Primary Inductance, (Adjustable).</i>	P	<i>Coil, to balance self induction of receiving leads.</i>
F	<i>Coupling Board.</i>	R	<i>Copper strips to Receiving Instruments.</i>
G	<i>Coupling Board Condensers.</i>	S	<i>Copper strips to Aerial Coil.</i>
H	<i>Coupling Board Inductance, (Adjustable).</i>		
I	<i>Copper Strips between Coupling Board & E & Earth.</i>		
J	<i>Porcelain of Dk. Insulator.</i>		
K	<i>Deck Fitting.</i>		

PLAN OF TRUNK.

PLAN OF INSTRUMENTS. Bulkhead.



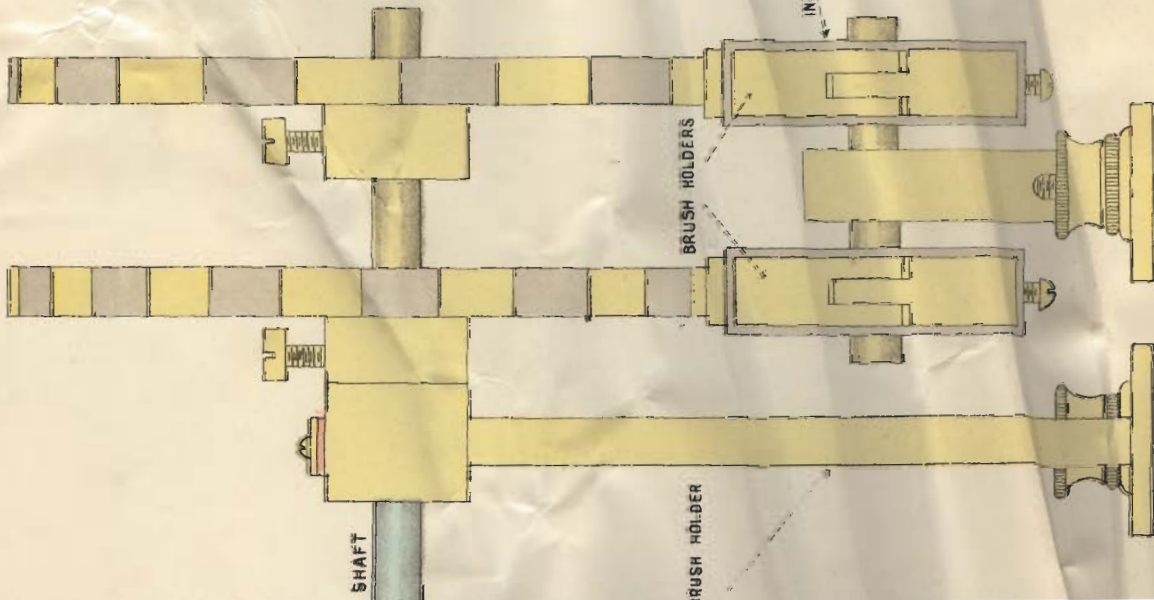
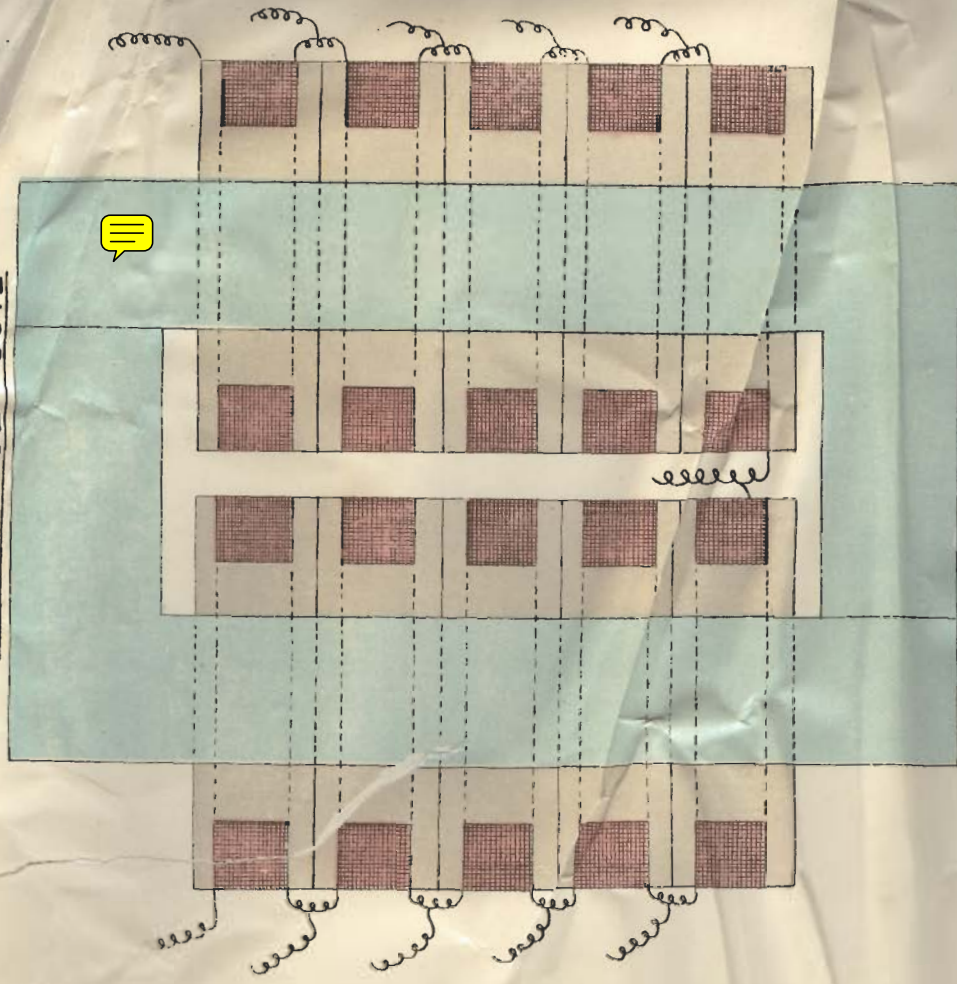
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MOTOR BUZZER

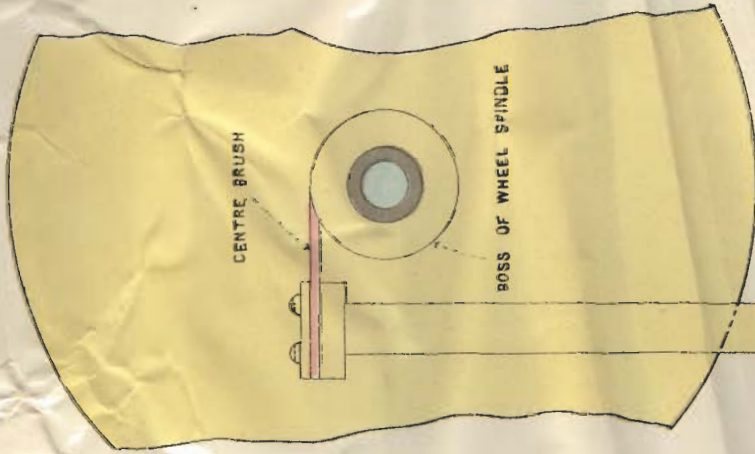
FOR FURTHER DETAILS SEE PLATE XV.

SCALE: FULL SIZE

IMPEDANCE COIL

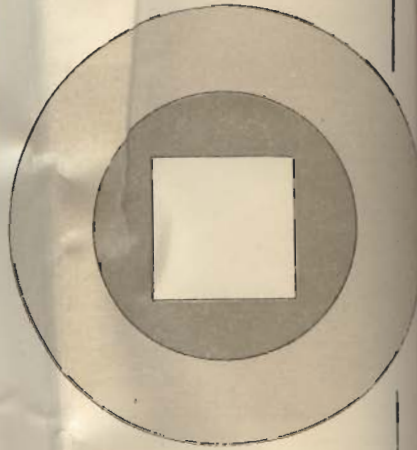


SIDE VIEW SHOWING 15 & 12 STRIP WHEELS, AS MOUNTED COMPLETE WITH BRUSHES, SPINDLE & BRUSH HOLDERS

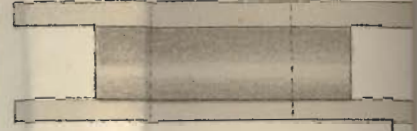


FRONT VIEW OF CENTRE BRUSH & HOLDER

SECTION OF EBONITE BOBBIN



SIDE VIEW OF EBONITE BOBBIN



E E are the two halves of the primary coil, adjustable to give a range of tuning from about 3.6 to 7 L.S. It is in two halves in order to equalise the distribution of potential along the side of the circuit.

C C are the transmitting condensers, each of 9 jars capacity, contained in one tank, the four terminals being brought out close to each other on the top.

From the lower tension terminals of the condenser the circuit is led to the lower terminals of the coupling board F. Leads go from the upper terminals of the coupling board to the aerial and earth ring respectively.

The coupling board consists of two copper plates (about 11 inches by 6 inches) separated by a sheet of $\frac{1}{16}$ inch ebonite.

These plates are electrically connected by a variable inductance H, of maximum value .025 mics, in parallel with a capacity of 40 jars, composed of 16 condensers G G of 10 jars each arranged two in series, eight in parallel.

The action of the Set is as follows:—

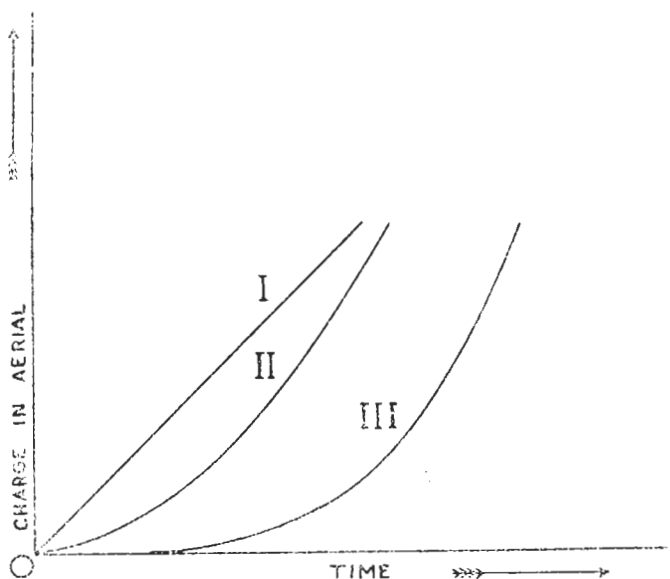
The circuit is charged through the inductance H, the condensers G being short circuited by the inductance at the charging frequency (250 cycles); the D. P. between the plates, when charged, being only a few microvolts.

When the spark passes, however, the circuit oscillates at a frequency of 2.4×10^6 cycles, and the back E. M. F. of the inductance H comes into play, the condensers are no longer short circuited and the D. P. between the plates rises to about 2,000 volts.

This D.P. charges the aerial and causes it to oscillate. Before, however, the potential across the plates can rise at all, the condenser G must be charged, a proceeding which delays the charging of the aerial and makes it a more gradual process, absorbing any shock, thus causing the aerial oscillations to commence very gradually.

This action may be gathered from Fig. 5.

FIG. 7.



- I. Shows the growth of the Current in a plain Aerial.
- II. Shows the growth of the Current in an ordinary coupled circuit.
- III. The growth of the Current in this special circuit.

It will be seen that the oscillation in the aerial is of a nature less likely to disturb neighbouring aerials by shock than in the usual circuits, and the interference from the auxiliary set experienced in the main office is thus reduced to negligible dimensions. That part of the interference due to sparking in the rigging, &c., will of course remain and must be dealt with locally as the conditions will vary in different ships; a very probable cause of interference, and one that will be difficult to eradicate, is the sparking that may occur at points where there is a bad or partial electrical contact between the different parts of stanchions, stays, guys, running, rigging, &c. Discontinuities in the lead casing of electric cables and places where thimbles and eyes are served with hemp or partially insulated from the wire rope or shackles, &c. by paint, will possibly cause trouble; this can be removed by making good electrical contact across them. A very minute spark may cause serious trouble, especially if the natural frequency of the circuit in which it occurs should happen to be of about 4 or 6.2 L.S.

DETAILS OF THE INSTRUMENTS, TYPE IX.

Patt. No.	Article.	Details.
3171 } 3177 }	Motor Alternator	Output 1½ k.w., 100 volt, 250 cycles.
341	Transformer	Output 1½ k.w., step-up 111 to 1.
528	Condenser	Glass plates and tinfoil under oil in two halves of 9 jars each, each half composed of 2 sections.

Patt. No.	Article.	Details.
—	Spark Gap and Silencer - -	Stationary type, adjustable, with 2 nozzle air blast.
1577 } 1578 } 1579 }	Blower - - - - -	Same as Type I. blower.
—	Primary Fittings, Set of - - -	To be assembled by ship's staff.
—	Trunk - - - - -	16-inch internal diameter, non-watertight.
962	Deck Insulator - - - - -	Porcelain domes secured to a special deck or bulkhead fitting made water-tight by felt washers.
897 } 898 }	Deck Fittings - - - - - } Bulkhead Fittings - - - - - }	A gunmetal casting holding the deck insulator, and to which are attached the ends of the Earth wires.
—	Earth Wires - - - - -	
—	Aerial - - - - -	

Cruiser Auxiliary Office.—Wherever possible there will be a self-contained office, it will require a space of 7 feet 2 inches by 7 feet 8 inches.

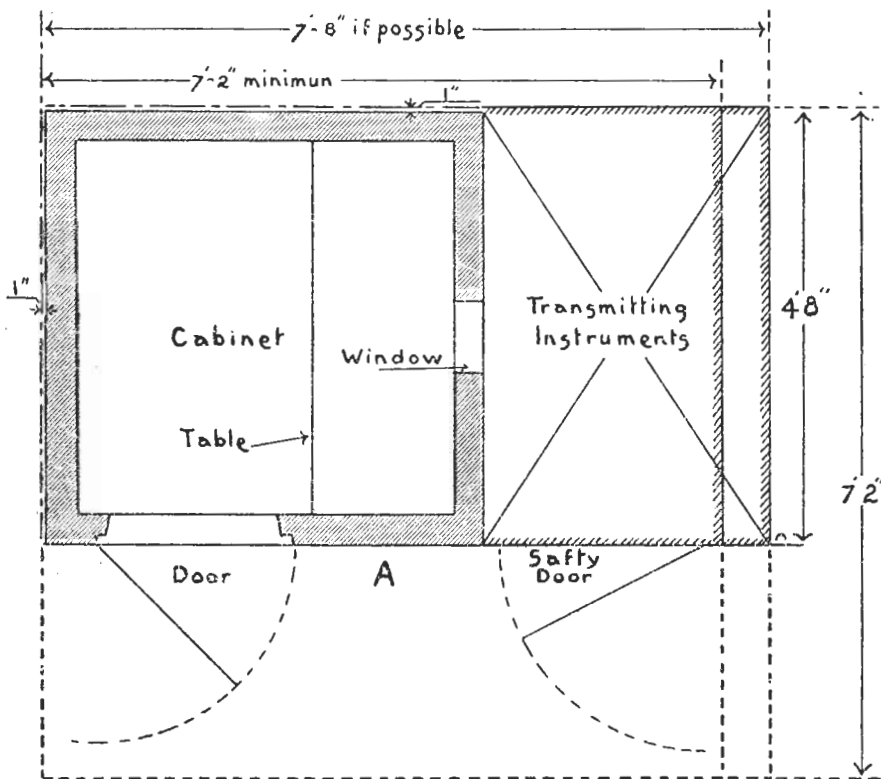
The cabinet will be situated in one corner of this space, as shown in Fig. 8, and the space for the transmitting instruments will, in general, be adjacent to the Cabinet.

CRUISER AUXILIARY SETS.

Arrangement of Office.

Scale $\frac{1}{2}$ inch = 1 foot (approx.).

FIG. 8.



Area required 7' 8" x 7' 2" clear of stiffeners.
or 7' 2" x 7' 2" "

The Motor Alternator starter, Blower Starter, and the Field Regulators will, be mounted on the outside of the Cabinet, or on a small Instrument Board with the various other instruments.

When selecting the position of the office it should be borne in mind that this space must be quite clear of stiffeners and other obstructions.