BUZZER REPEATER IN LIEU OF INKER RECORDER.

It having been decided that no more Inker Recorders would be purchased (N.S. 6186/10466 of 20.7.11), it was found necessary to provide some instrument which would take the place of those mentioned on page 15 of last year's Annual Report.

It has been ascertained that a Patt. 1301 telephone receiver gives a loud clear note when joined across the terminals of the Mark II. or Mark I*. impedance coil when using the main installation, or across the bobbins of the buzzer transmitter when this form of transmission is in use. Taking advantage of this fact a buzzer repeater has been evolved whereby signals are automatically repeated on the bridge and in the signal house of the transmitting ship.

By means of a change-over double pole switch in the W.T. office, it can be arranged that the buzzer repeaters, placed in the signal house and on the bridge, are caused to respond to the working of the sending key for either method of transmission. By means of a switch placed close to each repeater it can be silenced when not required, and a lid, which works on hinges, can be used for regulating the amount of sound given out.

It has been found that anyone touching the terminals of the buzzer repeater might, in ships fitted with Mark II. installations, receive a severe shock if the repeater was connected directly across the impedance coil; the addition of a small transformer, comprising two similar coils, and therefore having unity ratio of transformation, has therefore been instituted for those ships. These transformers are so designed as to be capable of being secured to the cover of the impedance coil terminals.

A third buzzer repeater will be supplied for use in connection with the short distance sets in some ships not already supplied with inkers.

Radiation Gauge.—This instrument has been devised to give an indication of the amount of current in the aerial, *i.e.*, to show the radiating power of the aerial. It also serves to show that the aerial is receiving the correct amount of power, thereby acting as a check on the adjustments, and an indication that the transmitting instruments are correct. It consists of a low reading hot wire voltmeter having a resistance between terminals of about 2·5 ohms. and a full scale deflection of about ·7 ampère, so designed as to obtain as dead heat an action as possible. One terminal of this instrument is earthed to the metal casing. The voltmeter is to be hung inside the cage in such a position that the scale, which is marked in arbitrary divisions only, is fully visible to the operator in the silent cabinet. With the voltmeter is supplied an adjustable shunt, which is arranged to be connected between the earth terminal on the earth-ring fitting, and earth, in the place of the metal strip at present supplied for that purpose. The connection between the shunt and the voltmeter is to consist of a length of Pattern 798A lead-cased cable, the lead casing acting as one conductor. The shunt will require to be so adjusted that a full scale deflection of the gauge is obtained when transmitting at maximum power on "Q" tune. Only a slight flicker of the gauge will show when sending "D" or "P," even when the full amount of shunt is used; no deflection at all will be obtained when sending on buzzer transmitter, though this can be remedied in that case by substituting an inductance of about 10 mics for the present shunt. The gauge is fitted with a fuse and spare fuse, together with a reel of fuse wire.

It is proposed to make the addition of a radiation meter to the destroyer installation, in order to afford an immediate indication of any defect in the circuit, and to assist tuning. To make the radiation meters types 1 and 2 suitable for this purpose it will be necessary to substitute a single turn of wire, having an inductance of about 1 mic, for the adjustable portion of the shunt.

SERVICE MARK II.

IMPROVEMENTS.

Switch, Two-way, for protecting Circuit, Type 1.

When working with the "Buzzer" transmitter, it has been found that the action of the protecting switch is too slow to protect the detectors efficiently, owing to the delay caused by the inductance of the magnetic key bobbin which is in series with it. The above-named switch has therefore been introduced so as to cut out the magnetic key when sending with the "Buzzer" transmitter, and to substitute for it two 50 c.p. lamps in parallel as a resistance.

(G. 7858/11, G. and T. Orders, May 1st, 1911.)

Inker Recorder.

The inker recorder referred to on page 15, W.T. Appendix, Annual Report, 1910, is found to be of but little use at sea, and has therefore become obsolete. (*See* page 10.)

Experiments to improve Note.

In continuation of the experiments described in Appendix to Annual Report, 1910, page 35, further trials were carried out on the Mediterranean station towards the end of 1910, with a view to improving the note.

Additional impedance coils, from ·4 to ·23 millihenries, were tried in conjunction with the special spark plugs previously described. It was found that, other things being equal, an increase in the apparent power factor of the alternating power supplied to the transformer gives an increased range, and also that neither the frequency nor the coupling appreciably affect this power factor. Owing to the arcing which takes place, the power factor diminishes as the voltage is raised with a given spark length. This, however, does not decrease the range, but rather increases it owing to the higher note, although an excessively high voltage may cause arcing which will spoil the note and so again reduce the range.

The combination of the extra impedance coil and the special spark plugs produces a higher and clearer note, increases the strength of signals, and reduces the strain on the alternator.

The aerial brushing has been eliminated by fitting multiple feeders containing up to 40 parts of wire.

With this arrangement daylight range between "Exmouth" and St. Angelo was increased from about 500 to 650 miles, when using a spark length increased by about 75 per cent. This increased spark length no doubt reduced the arcing, and it has been recommended that a more powerful blower be tried so as to still further reduce this arcing.

(2) "D" and "P" Tunes—best Methods of Transmitting.

In accordance with the report of the Wireless Telegraphy Conference (*vide* Annual Report, W.T. Appendix, 1910, page 8), a series of experiments have been recently carried out between the "Vernon" and "Velox" to determine the following points:—

(1) The best arrangement of the Primary Oscillating Circuit; and
(2) The best arrangement of the aerial circuit.

Primary Oscillating Circuit.

Three arrangements were tried for sending "D" tune from Mark II. sets, viz.:—

(*a*) The main Mark II. condensers were cut out by removing the series-parallel clips, and 20 Leyden jars (10 in parallel and 2 in series) were connected up across its terminals. Rough resonance was obtained by the use of the extra impedance coil. Otherwise the circuit was the same as that used for the longer waves. It was found that not more than about 6 mm. spark could be used without puncturing the Leyden jars, and the range was only moderate. This arrangement was therefore discarded.

(*b*) With a view to increasing the capacity of the circuit, a destroyer's oscillator and condenser (capacity, 17 jars) were next tried. The spark gap was specially fitted with an air-blast, and the arrangement was joined up to the secondary of the Mark II. transformer. Owing to the excessive sparking at the top of the spark gap, not more than about 5 mms. spark could be used. Although possibly the range was slightly better than with the arrangement described below (*c*), it was not considered satisfactory, in view of the large amount of space taken up by the condenser, complication in the air-blast arrangements, and the expense of providing every Mark II. set with a specially-designed condenser and oscillator somewhat similar to those supplied to destroyers.

(*c*) A special condenser was then constructed, having a capacity of five jars, consisting of five sections in series; each section was built up with 12 sheets of $\frac{1}{32}$ inch ebonite, connected in parallel as in the Mark I*. condenser. The condenser was supported in a frame which hung from the upper flange of the main condenser tank, and was secured in that position by three of the butterfly nuts which secure the cover to the tank. The terminals of this condenser were connected to the terminals of the main condenser by $\frac{1}{2}$ inch copper tubes, the actual connection being made to suitable terminals sweated to the top of the condenser safety discs. The remainder of the circuit was the same as that described in (*a*) above. A spark of 18 millimetres was used, and the range was very nearly as good as with the (*b*) arrangement. The condenser only projected about 6 inches from the side of the main tank, and might be left in position when sending on the longer waves. This appears to be the most suitable arrangement, and a condenser is now being designed on these lines. It will be suitable for sending on either "D" or "P" tunes. With the extra impedance coil (as described in G. and T. Orders, June 1909), approximate resonance was obtained at a frequency of about 360 cycles.

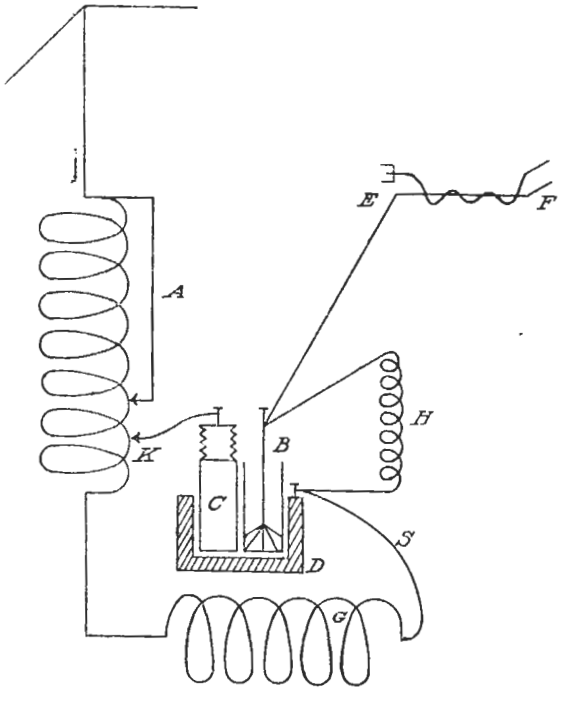
Aerial Circuit, "D" Tune.

The harmonic principle has been adopted since it appears to give rather better range than any other method, and has also certain other practical advantages.

The principal disadvantage of the harmonic method hitherto has been the fact that it not only transmits the harmonic wave, but also sends out the fundamental wave with sufficient strength to interfere with ships within a mile or so, which are receiving on approximately the same wave as this fundamental. This defect was overcome by first tuning the aerial to a wave-length of about 1,400 feet, by placing a condenser in the earth lead, and then forcing a 700 feet harmonic wave into this aerial by placing a second condenser in parallel with the mutual coil.

To tune—(1) Disconnect terminal K and tune aerial to 1,400 feet.
Do not disconnect large inductance.

(2) Insert a spark gap at S.
Connect terminal K and tune circuit K, G, S, C, to 700 feet.
Do not disconnect aerial when doing this.



The arrangement is shown in the above sketch, in which A is the aerial coil, B is three Leyden jars connected in parallel, C is two or three Moschicki condensers as required, also joined in parallel. These condensers are all contained in a small Leyden jar box, D ; G is the mutual coil, and E and F the earth-ring fitting and the operating switch respectively ; H is an inductance of approximately 15,000 mics. The Leyden jar box is slung with insulating cord from the bottom of the aerial coil. The range with this arrangement was found to be at least equal to that obtained when the aerial was tuned to a fundamental of 2,800 feet. The interference caused by this set to a ship 3 cables away, and receiving any of the longer waves, could be easily cut out. The adjustments of this set for receiving are the same as when using a special small aerial. A destroyer receiving from this set requires the same adjustments as when receiving from another destroyer. At 90 miles, a destroyer fitted with C type gear, received signals sent by this method at strength 10 by day.

It may be found in small ships that the natural wave-length of the aerial is not more than 1,400 feet, and in this case the Leyden jar condenser can be dispensed with. In all cases, however, the aerial must be tuned to about 1,400 feet.

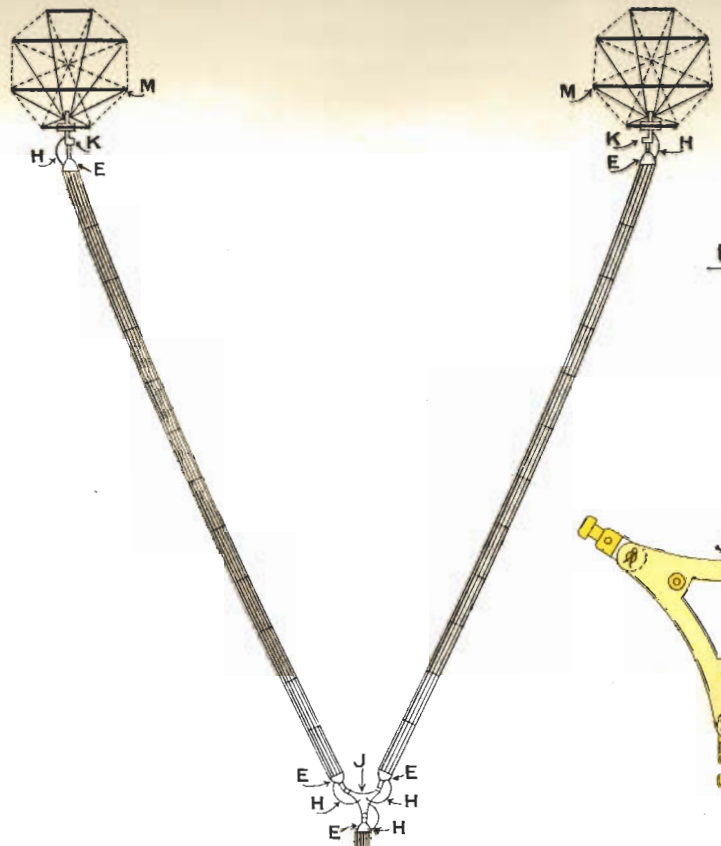
Aerial Circuit for "P" Tune.

Since the fundamental of an aerial tuned to a harmonic of 1,000 feet is bound to interfere to a certain extent with ships looking out on 2,000 and 4,000 feet waves, this method of tuning is considered undesirable for sending "P." Instead of the above, a condenser should be placed in series with the aerial to reduce the latter to 1,000 feet. The Moschicki condensers used for "D" tune would probably be suitable for this purpose.

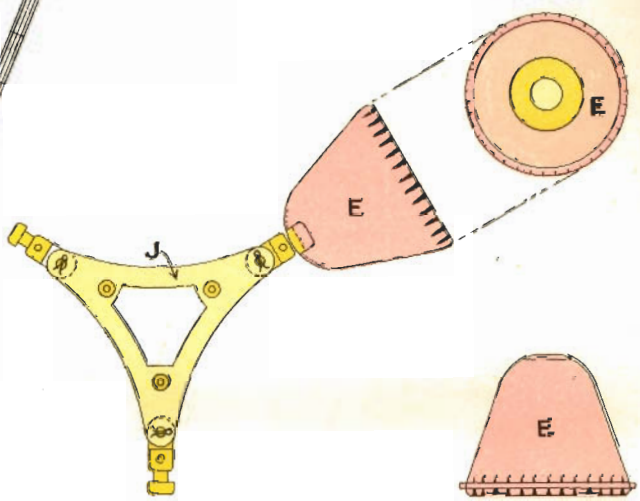
Mark I. "D" and "P" Tunes.*

The same arrangements for the aerial are recommended for Mark I*.

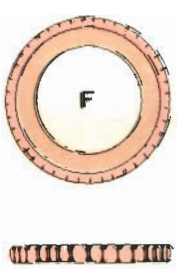
MULTIPLE FEEDER & ANTIBRUSHING GEAR.



BRANCH FITTING AND SPREADER CONE



SPREADER DISC



SPREADER RING

COUPLING NUT

SCREW LONG

SCREW SHORT

REFERENCE.

A	CROWN OF WIRELESS OFFICE
B	DECK INSULATOR
C	COUPLING NUT FOR FEEDER
D	SCREW LONG FOR FEEDER
E	SPREADER CONE AND SPREADER RING
F	SPREADER DISC AND SPREADER RING
G	SCREW SHORT FOR FEEDER
H	RECEIVING WIRE
J	BRANCH FITTING FOR FEEDER
K	SLOT AND BOLT FITTING
M	POLES FOR EQUALISING STRAIN ON AERIAL WIRES

IMPROVED FORM OF AERIAL FEEDER.

(*See also* A.R., p. 31, 1910.)

The design of fitting for this form of feeder is practically complete.

The feeder will consist of a tube 5 inches in diameter, made up of (probably) 40 parts of 21 L.S.G. enamelled wire. This tube will run between the deck insulators in ships which have the W.T. office below. The same form of feeder will be continued for the first 20 feet or so above the upper deck insulator; the feeder will at this point divide into two parts of 20 wires each, the division being effected by a branch fitting. The 20 wire tubes will run to the aerials, the connection to the latter being made through a slot and bolt arrangement, special care being taken to divide the strain equally among the various parts of the aerial.

The wires are kept in cylindrical formation by means of "spreader discs" and "spreader rings." The former consist of copper discs approximately 5 inches in diameter, having a turned down flange of half an inch, in this flange 40 grooves are worked at equal intervals round the circumference. The "spreader ring" consists of a ring having an internal diameter of 5 inches and cut from $\frac{1}{8}$ inch copper tube, the edges being well bevelled. The feeder wires are fitted in the grooves of the "spreader discs" and are held in place by the spreader rings.

The connection of the tube to the deck insulator or to the branch fitting or aerial connection is effected by means of fittings termed "spreader cones." These fittings are arranged with 40 grooves similarly to the "spreader disc," the wires being held in place as before by "spreader rings." The feeder wires, after passing under the spreader rings, are bared and sweated to the surface of the spreader cone, one wire being left sufficiently long to act as a receiving connection. The smaller end of the spreader cone is fitted with a gunmetal casting which is sweated and rivetted to the copper cone. This casting acts as a bearing surface for the deck insulator connection (known as "screw short" or "screw long") or for the bolt of branch connection. The "screw short" or "screw long" passes through a $\frac{1}{2}$ inch hole in the copper cone. In the case of the "between deck" fittings it is necessary to have an arrangement to take up the slack caused by the stretching of the feeding wires. For this purpose "coupling nuts," into which fit "screws long," are provided. The "coupling nuts" screw on to the "between deck ends" of the deck insulators, and into these nuts are screwed the "screws long," the other ends of the "screws long" fitting into the spreader cones.

Each "screw long" allows of 3 inches adjustment, and as a "screw long" is fitted at each end of each "between deck" portion of the feeder, the total adjustment of that portion is 6 inches.

The upper bolt of the upper deck insulator is fitted with a "screw short," no adjustment of length being here necessary.

A cover is supplied to fit into the base of the copper cones to prevent water, &c. from accumulating therein; drain holes are also drilled through the gunmetal seating of the copper cones.

In a ship having three deck insulators, the following fittings would be in place when using the new feeders with a Mark II. aerial consisting of two main parts and two after legs.

Article.	Number.	Remarks.
Coupling nut - - -	5	Two to each deck insulator, except the connection in the W.T. office.
Screws long - - -	4	Upper side of upper deck insulator.
Screws short - - -	1	
Branch fittings - -	1	
Aerial connections - -	2	
Spreader cones - -	16	
Spreader ring - - -	16+*	
Spreader disc - - -	*	

The receiving connections are not sufficiently good with the above arrangements, and in order to reduce the resistance, one or more wires have to be left sufficiently long at each cone feeder to connect directly to a cable eye placed under the nuts of the deck insulator or under the heads of bolts placed in the branch fitting.

The wire used for the feeders will be single strand wire of 21 L.S.G., the wire being insulated with enamel; a first supply, sufficient to fit "Vernon," "Furious," and two ships at sea, has been purchased. When these fittings are supplied, information will be obtained as to their behaviour in a sea-way, wind-holding effect of the tubular feeders, liability of receiving wire to be burnt out when sending, &c., and from the information thus obtained any necessary modifications will be introduced and the fittings then supplied to all Mark II. ships.

* Allowance of spreader discs has not yet been settled; it will probably be about one to every 4 feet of feeder. Spreader rings will be supplied, one to each spreader disc and one to each spreader cone. The above allowance does not include spares, the necessary proportion of which will be determined from the reports after trial at sea.

EXTRACT FROM REPORT OF "EXMOUTH" ON TRIAL OF MULTIPLE FEEDERS.

Ship.	Aerial.	Feeder.
"Exmouth" - - - -	Ordinary Service Pattern - - -	Two ten-fold cylindrical. Lowest part of feeder 20-fold of 8 inches diameter.
"Bacchante" - - - -	Similar to "Exmouth" - - -	Do.
"Suffolk" - - - -	Four parts between the masts no after legs.	Four ten-fold cylindrical.
St. Angelo W.T. Station -	Three parts between masts - -	Three ten-fold cylindrical, one to each end and one to centre of aerial. Lowest part of feeders 30-fold of 10 inches diameter.

N.B.—"Aboukir" and "Lancaster" are fitting similar feeders. All ten-fold feeders are made of Service pattern aerial wire with 4 inches diameter rings or ¼ inch brass bolt staves as spreaders. Elbow pieces are constructed of similar material, where sharp bends are taken in the feeders. All reports state that brushing has been abolished. Both sending and receiving efficiency is noticeably increased.

The "Exmouth" and St. Angelo aerials have been exposed to exceptionally severe gales since fitting the new feeders, and no trouble has been experienced.

"VERNON'S" REMARKS ON "EXMOUTH'S" REPORT (12.5.1911).

The report is interesting and very satisfactory. The form of multiple feeder for which designs are now being got out in "Vernon" will be of a somewhat lighter construction than those described in the Mediterranean report, it having been found desirable to modify the original design in detail to render it suitable for manufacture in quantities and more convenient for fitting.

DESTROYERS INSTALLATIONS.

The following destroyers have been fitted during the year :—

"Acorn."	"Fury."	"Minstrel."	"Rifleman."
"Alarm."	"Goldfinch."	"Nautilus."	"Ruby."
"Brisk."	"Hope."	"Nemesis."	"Sheldrake."
"Cameleon."	"Larne."	"Nereide."	"Staunch."
"Comet."	"Lyra."	"Nymphe."	"Stour."
"Ferret."	"Martin."	"Redpole."	"Test."

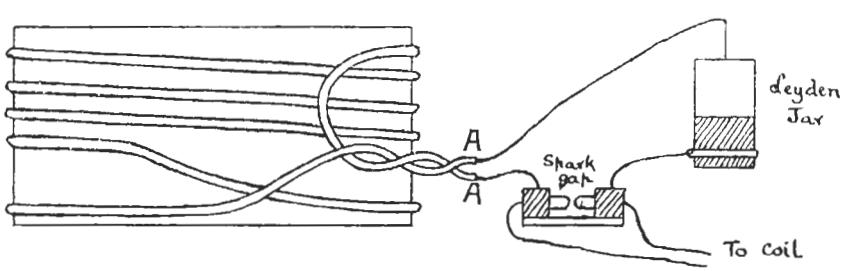
All these installations are working satisfactorily. This brings the total number of destroyers fitted to 85.

The fitting out and wiring specifications for destroyers sets have been completely rewritten and revised. A diagram of the system of wiring was given in last year's Annual Report. This new arrangement of office appears to be working well.

Exercise Transmitter.—This was described in last year's Annual Report, page 18, W.T. Appendix.

All the sets have been bought and issued. It has been found that the range obtainable is all that was expected; but it has also been found that great interference is experienced by other ships in the vicinity, the set being a "plain aerial" set. It was observed that at a range of 2 miles it interfered with ships receiving "W" wave. The following modified method of connecting up the set has given very good results. It has the advantage that a definite wave is emitted, and the range between destroyers using magnetic detectors is about 3 miles. It does not interfere with reception by other ships in the harbour.

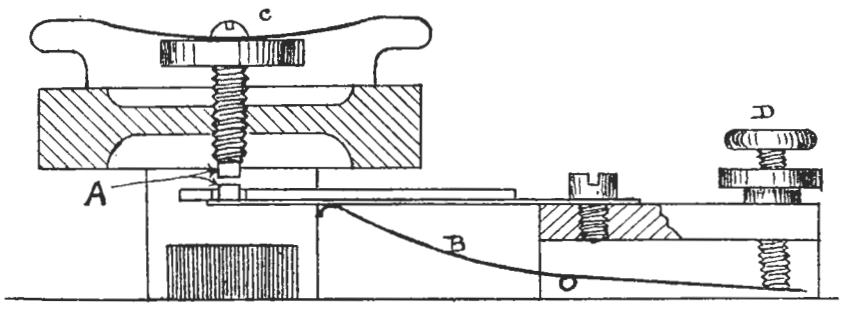
FIG. 1.



A primary coil, consisting of seven turns of Pattern 611 wire, wound round the outside of the winding on the aerial tuner, connected in series with one Leyden jar and the small spark gap on the lid of the "Box for Exercise Set" forms the primary circuit. The combined lengths of the

connections between the primary winding of seven turns, the gap, and the Leyden jar should be, approximately, 1 yard. It is found that this arrangement is very nearly exactly "D" tune. It will vary slightly, of course, owing to differences in the Leyden jars and in the positions of the leads; but it is sufficiently accurate for all practical purposes, and more exact tuning can then be obtained as opportunity offers in the usual manner. The arrangement is shown in Fig. 1.

FIG. 2.



Note on the Adjustment of Coils.—Fig. 2 shows the arrangement of interrupter in the small coils. A, A are the platinum contacts, and B is a spring for keeping the armature off the pole tip. The best adjustment is obtained when the contact screw C is eased fairly far back, and the screw D (which puts more pressure on the spring B) screwed right down. As, however, the cells gradually run down, it will be found necessary to ease up D and screw down on C.

When sending on power it is necessary to leave the "exercise primary" winding on *open* circuit and disconnected from the jar and gap at the points A, A, Fig. 1. It should not be short-circuited, and there is no necessity for it to be unwound.

Hand Operating Key.—It has been found possible to force the lid of the box down on to the top of the phosphor-bronze blade carrying the contact for the protecting circuit; that is usually a live contact, and if there is an earth in the ship on the opposite pole, a burn out will result.

In order to avoid this it is advisable to secure a slip of micanite to the inside of the cover over this contact.

EXTRACTS FROM REPORT BY COMMANDER PAYNE, H.M.S. "CRUSADER."

Exercise Transmitter.—The new circuit for exercise transmitter has only been in use for under two months. Results so far very satisfactory. Range between destroyers, 3 miles. No interference with other ships at a distance of two cables.

Dennis Detector.—An extempore detector made up from details given in last year's Annual Report has been tried against the crystalite detector. It is more stable, and does not lose in sensitiveness from sending or from strong signals from ships close by. It does not require continual adjustment, and when once adjusted it remains sensitive for at least a month. It is not quite as sensitive as a crystalite detector when in its best adjustment.

SHORT-DISTANCE SETS.

It was approved as a special instance to supply the "Neptune" with a short-distance set (G. 20422/10).

This set has been fitted and is in use.

It has also been approved as a special instance to supply the "Hercules" with a short-distance set (G. 9600/11/17040).

The fitting of this set has been deferred till next financial year (G. 14768/11/22397).

It has now been approved to fit short-distance sets in all battleships and cruisers of the first and second divisions of the Home Fleet. There will, for the present, be no increase of complement of telegraphist ratings to work these sets (G. 0567/11/22470).

In view of this decision the fitting out specifications for short distance sets have been completely re-written and revised; and the alterations to establishment includes a hand operating key, Pattern 2483, and a box-screening (with detectors and protecting switch), of the Type "C" pattern, instead of the operating switch Mark I*. and the Type "B" box-screening, and its fittings.

Policy.—It has been decided that, of the ships to be fitted with short distance sets, all the battleships shall have the existing 5-mile set, but that the cruisers shall wait till a set with a longer range is available. It is proposed that then all the battleships shall have the new set.

Experiments.—The experiments mentioned in last year's Annual Report to be conducted with a set to send out a 30,000-foot wave were temporarily discontinued, but are now again in progress.

It is thought, however, that possibly the short wave with quenched spark, utilising higher power, will be more suitable for this set.

PORTABLE HARBOUR AND DEFENCE SETS.

These sets are now completed as to design, and are only waiting for delivery of gear. At the same time many of the instruments have been modified as to details where experience has shown this to be necessary.

Power Generators.—Referring to page 59 of W.T. Appendix to Annual Report 1910, the engine as designed for paraffin has been modified in detail and made suitable for petrol. The engine has two cylinders, which are horizontally opposed, and it runs with very little vibration. It is air cooled, the flywheel spokes being so shaped that a strong draught is directed by them on to the cylinders. Ignition is by high tension magneto. The carburettor is an Amac carburettor. The first lot of 20 engines have been delivered from the contractors, and are, on the whole, satisfactory, with the exception that they throw a certain amount of oil. It is thought that a few small alterations in design will overcome this defect in future engines.

A very good engine was obtained from the Marconi Company for trial against the Service engine. It is much lighter and cleaner, but it has not got the same reserve of power.

It has been found impracticable to fit a governor, which will work satisfactorily and will not hunt, to so small an engine. It is recommended, therefore, that the governor as fitted to the Service engine should be disconnected, and the engine speed controlled by means of the throttle and air levers. New engines will have no governor, and the speed will be controlled by the spark.

Alternators.—Very considerable delay has been experienced with these machines owing to the firm Messrs. Veritys, who were given the order, failing to comply with the requirements of the specification. However, Messrs. Crompton have produced a very satisfactory machine, and the order placed with Veritys has therefore been cancelled. It is hoped that these machines will be ready for delivery by about March or April 1912. This machine can be clearly seen on the cart in Plate IV.

Mains.—A four-core cable will be supplied for conveying the power from the alternator to the transmitting instruments. Two of the cores will be used for power, one for a buzzer for signalling between the operator at the instruments and the operator at the engine, and one for the earth wire for screening. This must be earthed at both ends to the metal frames of the instruments, *see* page 21 of W.T. Appendix to Annual Report, 1910.

Carts.—Two carts have been made locally under the supervision of "Vernon," and have been well tested. Various parts have given way, and this has caused some delay in repairs and replacements, &c. The carts have now, however, been so reconstructed that they appear quite satisfactory, and it is proposed to get firms to quote for carts exactly to these two as patterns. The two carts loaded up with all gear on them are shown in Plates III. and IV.

Mast.—The mast described in the Annual Report 1909, has proved quite satisfactory, but it is, on occasion, somewhat difficult to erect. If the ground on which it is to be set up is not quite level, or if it is not clear of bushes and similar obstructions, the adjustment of the stays is not at all easy; and if it is blowing at all hard under these conditions the process of getting the mast up becomes a rather critical operation, as the tubes are liable to buckle.

It is, therefore, proposed to experiment with wood-lengths to be used in the place of the steel tubes, and two sets of such lengths are now on order. Canadian spruce and bamboo will be tried. If these do not prove more satisfactory it is proposed to divide the mast up into two short masts of only 30 feet in height, as in the Marconi set described below. This reduction in height and consequent rearrangement of aerial will have the effect of emphasising the directional effect and of (in all probability) reducing the range. These points, however, would have to be confirmed by experiment, and the pros and cons weighed before deciding which type of mast would be the more suitable all round.