## (C.)—General Working Instructions applicable to both Systems installed in H.M. Ships.

The following revised working instructions and general hints will be found to be valuable, and they apply equally to the Service or to Marconi sets.

Insulation of aerial.

Always see that the aerial wire is well clear of stays. In staying it precaution should be taken that the wind does not blow stays, signal halyards, or signal flags across it. Should any of these touch the wire while the operator is sending, it will be impossible to obtain the necessary spark at oscillator, which is essential for transmitting.

In wet weather the ebonite insulators should be wiped with an oily rag at least once a day; linseed oil is the best for this purpose.

Always be prepared for the worst conditions of weather. Unless the insulation is well attended to, fog, rain, or salt spray will make working irregular or impossible.

Top of aerial to be 20 feet at least above all earthed metal.

It is necessary that the coils should be kept dry. Moisture, if allowed to collect upon it, will prove fatal to good working and ultimately to the coil. The air at sea level is more or less impregnated with salt; this will be found to form a coating on the ebonite, with very bad effects on insulation. An occasional wiping of coil with rag, moistened with paraffin, and wiped quite dry with clean rag or duster, remedies this.

Never touch an aerial wire unless the switch of the coil is to "off" and the battery disconnected at the poles.

Whenever the office feels damp or there is a suspicion of moisture, a fire should be lighted in it, or other means taken to dry it.

### *Transmitting.*

Length of spark.

The method of sending has been well described in Annual Report, 1899.

In harbour $\frac{1}{8}''$ spark gap is sufficient, excepting when there are obstacles in the way, *e.g.*, a line of battleships between the communicating ships, when it should be slightly increased.

For distances at sea, no land intervening:—

10–25 miles use $\frac{3}{4}''$ spark.
25–40 „ „ $1''$ „
Over 40 „ „ $1\frac{3}{8}''$ „

Where land intervenes, or at greater distances than named above, the spark gap should be lengthened according to the requirements of the receiving station.

Failure of spark "cure."

Should at any time the spark fail, at once look to the insulation of the aerial and make sure that all insulators are cleaned, dried, and oiled. If the spark fails intermittently it is due to intermittent contact of the aerial with

stays, flags, &c., due to motion of ship or the wind. Surface leakage on the coil, loose connexions, dirty and worn contacts, may all cause failure of spark; if there is any doubt, disconnect the aerial and earth connections and test the coil, *i.e.*, make it spark between the balls; a good steady 8 inches is always obtainable from a properly adjusted and dry coil, and if this test is satisfactory, but the proper spark is not obtained when aerial and earth are connected, the fault is clearly in the aerial wire.

Should excessive sparking take place at the "make and break," the condenser should be tested and the "make and break" contacts filed smooth.

Before starting to receive at any time the following tests should be carried out:— Receiving.

Disconnect the coherer.

Make the relay work through the resistance of the body. (This may be done by pinching the two inner jigger terminals of the jigger between the moistened fore finger and thumb, when the relay should work.) Test of relay.

This test will not be fulfilled by the first set of Service instruments fitted with the old Sullivan relay which will only test through a resistance of 15,000 to 20,000 ohms.

Ascertain that the relay does not stick when the same terminals are short circuited.

The relay may now be assumed to be in adjustment.

Connect the coherer and carry out the same tests again; no extra signals should be made after the fingers have been removed; if extra signals are made they may be due to a faulty coherer or a spark somewhere in the instrument cohering the tube.

Satisfy yourself on this latter point by examining all the shunts, more especially those of the tapper, and the local shunt of the relay.

If these are all correct the coherer is defective, and must be discarded. Should the tapper vibrate directly the coherer is joined up, the latter is too sensitive.

The coherer's most sensitive position is with the side tube pointing vertically downwards; it may be rendered less sensitive by turning this tube into a more horizontal position.

Next, seeing the aerial and receiving earth wires are connected, try to excite the apparatus by means of the buzzer, making Vs with the buzzer push;

Vs should be recorded on the tape. The procedure, should this not be the case, is the same as that laid down in the following working instructions.

Having adjusted the instrument to work with the buzzer (*i.e.*, the relay is perfectly adjusted).

Now suppose that on starting to receive, the signals on the tape are broken. This may be due to either the inker spring, coherer, or tapper. Cure for broken signals.

*Cure.*—Listen to the tapper, if it is making good signals it shows that the inker spring is too taut.

If not making good signals but broken ones, it shows that the relay (which is in adjustment) is jumping.

This may be caused by the coherer or the tap.

*Cure.*—Turn the tube into a more sensitive position.

If still broken, decrease the strength of the tap. (This cannot be conveniently done in the original Jackson tapper.

This system of elimination is bound to either cure the fault or locate it.

**If signals are still broken the coherer is not sensitive enough, or the senders spark is too small, in which case use a better tube or ask sender to increase the length of the spark.**

**Now consider the case in which the relay is in adjustment, but the signals are running into one another.**

This, as before, may be due to the inker spring, coherer, or tapper.

Cure for signals running into one another.

*Cure.*—Listen to the tapper; if it is making good signals the inker spring is clearly at fault. If, however, the tapper's signals are also running into one another, the fact points to the sender's spark being too long, coherer too sensitive, or tap not hard enough.

*Cure.*—(*a.*) Turn the tube into a less sensitive position.

(*b.*) Increase the strength of the tap.

(*c.*) *Disconnect the receiving earth.*

(*d.*) Finally, ask sender to decrease his spark.

It is of great importance that the relay should be worked first, and also that the instrument should be tested with the buzzer before attempting to receive.

Irregular working of the receiver may take place if any of the shunts become disconnected, also great attention should be paid to earth connections and loose contacts generally, as there is plenty of scope for them.

Be careful that the receiving wires from the key to the box are not making earth anywhere.

If the receiver will not work at all with the buzzer, examine these leads, test them for continuity and insulation; if found to be correct, the fault is in the receiver itself.

It should be noted that the dry cells of the receiver require occasional testing, either with a small voltmeter or with an electric bell which will work with one cell, especial attention being given to the coherer cell.

When the gear is to be used ashore in conjunction with dry cells it is to be understood that the dry cells are to be used to charge the accumulators, the cells and accumulators working the coil in fork. *See* the diagram on page 97.

Charge and discharge currents for secondary batteries.

When Jelly-type cells are used, the M-type obach are to be joined up, 8 in parallel and 12 in series.

When the chloride type are used, 6 in parallel and 15 in series.

The charging current for the Jelly-type cells is about three ampères, the voltage when charged is 8·6, and they should not be discharged below 7 volts, nor at a greater rate than 10 ampères.

The charging current for the chloride type cells should not exceed five ampères; the voltage when fully charged is from 10·8 to 11 volts, they should not be discharged below 8 volts nor at a greater rate than 10 ampères.

Precautions against lightning strokes.

The aerial wire forms a lightning conductor, and when leaving the instruments at any time, and during heavy thunderstorms, it should be put to earth.

This may be quickly done by causing the balls to touch together, the lead from aerial standard to the receiving terminal of the signalling key should also be disconnected from the key and connected to the earth standard of the coil.

Care should be taken not to touch the aerial during thunderstorms, as most unpleasant shocks have been obtained in this manner.

**It has been found by experiment that placing the instruments below the waterline, behind armour, &c., does not impair the efficiency of the communication, provided the aerial wire is properly insulated.** Receivers placed below water-line.

Where two receivers are fitted, one should be kept more sensitive than the other, the unnumbered jigger will be found to work in both.

A break in the aerial wire will prevent signals being received, although if the insulation is still holding it is possible to transmit with it, so the break may not be noticed, the double wire affords special facilities for testing as it is not necessary to lower it; break the junction near the deck and test round the loop.

When messages to be sent by wireless are very long, a mark should be made against every tenth word, the receiver sending RT if correct, or IMI if not so.

It should be borne in mind that there are many wireless installations out of the British Navy, and, for this reason, no confidential signal is to be spelt by wireless, but should always be sent in code.

*Tuning.*

Experiments with Captain Jackson's pattern of primary and secondary tuner were carried out in the early months of the year, and it was found possible, when lying off Cowes in the "Jaseur" to read either the signals made by Marconi at his station at the Needles, or those made by "Hector" at Portsmouth, by inserting turns of wire in the secondary circuit of the jigger, between the coherer and the jigger terminals. Tuning.

Secondary tuners, similar to the primary tuner, but smaller, were made, and these proved of great use, but when within two or three miles of either station, the signals were so strong that it was impossible to tune them out.

Experiments with similar tuners in the primary circuit gave no results, the insertion of 1,000 or even 2,000 turns of wire in the aerial circuit made no appreciable difference, and signals could be read by the same adjustment of receiver and tuners at the other end. This may have been caused by the primary requiring less turns instead of more.