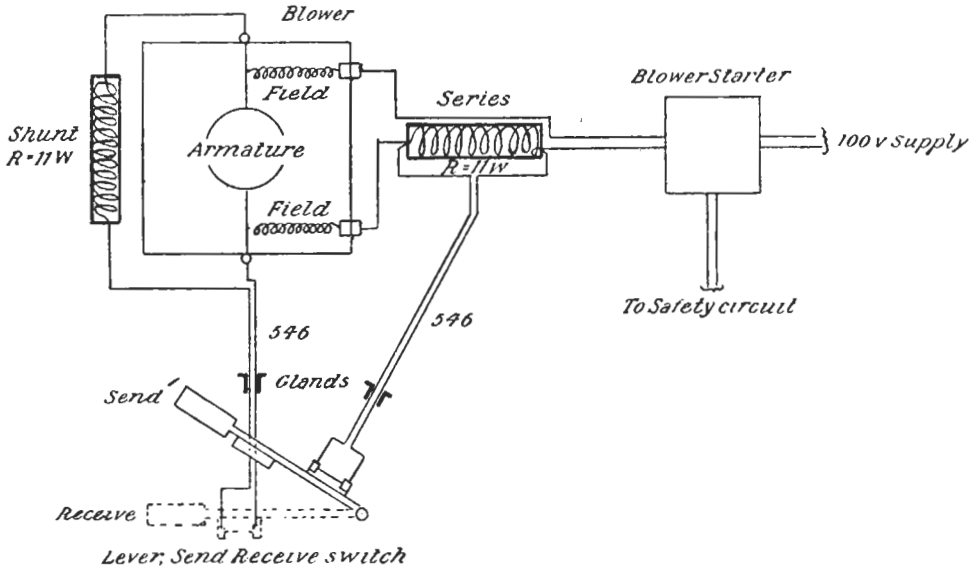
REMARKS ON SERVICE MARK II. INSTALLATION.

The following points in connection with the working of the Service Mark II. apparatus may be of interest.

The noise of the blower when running at full speed has in some cases been found to interfere with the reception of weak signals, especially if the silent cabinet has become warped and is not quite sound-tight. The following arrangement of circuit has been tried in "Vernon," and found to get over the difficulty :— Blower.



It will be seen from the diagram that when at receive one resistance is placed in series with the blower motor field, and another in shunt with the armature.

The blower will then run dead slow and will not be heard, the series resistance being inserted to prevent the field getting hot. On pulling the lever of the send-receive switch up to send, both resistances are cut out of the circuit and the blower at once speeds up.

Pattern No. 546 cable is recommended for the leads entering the silent cabinet, as then only two holes will have to be made in the casing. The resistances can be conveniently placed close to the blower inside the cage.

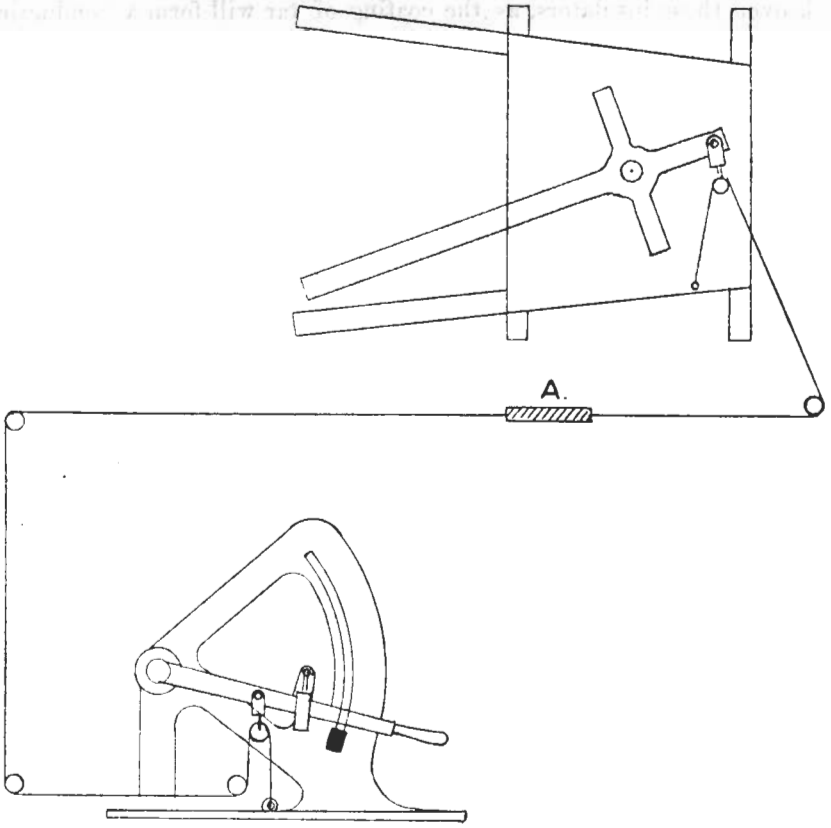
It will be found that the blower can be started up as usual when both resistances are in the circuit, and that on releasing the lever at the end of a message it will slow up very quickly.

The nut securing the handle on the outside of the Blower Starter is to be kept well screwed up; if this is not done the spring plungers on the inside do not make good contact; these inside springs may also require attention to see that all the different contacts are making properly. Blower starter.

The present large type of send-receive switch is not considered satisfactory, and a new design, electrically operated, is being prepared. Send-receive switch.

Send-receive switch.

Pending the introduction of the electrically operated switch, the difficulties with the Bowden wire can be avoided by using the inner member only and a system of pulleys as shown in the diagram.



A is a bottle screw or other device for adjusting the length of the wire.

Earth terminal on send-receive switch.

The earth terminal on send-receive switch should be connected to earth by a path of small inductance in order that it may be impossible to get a shock from the handle of the lever in the silent cabinet.

Magnetic key.

Great care must be taken in getting the magnetic key into good adjustment, and the instructions given in the Annual Report, 1907, page 28, should be accurately followed. To ensure both lower contacts being exactly equidistant from the main brush it is found convenient to construct a small gauge $\frac{1}{4}$ inch in thickness. All the resistances must be kept in good working order; it should be remembered that the small shunt resistance (D.C.) prevents sparking at the Morse key, and also protects the condenser, by absorbing the inductive kick of the bobbin when the circuit is broken; if this resistance is not working properly the condenser will puncture. The method of connecting up the key to the concentric cable leading to the non-inductive resistances is not very convenient and is being improved in the later designs. A case has occurred of these leads making connection to the body of the key at the back and so causing half the key to be short-circuited, due to the key being pushed home into its case too violently after being joined up.

As copper dust from the contacts falls down inside the bobbin, and may cause the armature on the bottom of the spindle to work stiffly, a little lubricating oil should be applied to these parts when required. It should be remembered that it will save time to refit the key when required before it gets badly burnt away.

Alternating current cut-outs.

The alternating current cut-outs tend to get rather hot. If further ventilation is required, small holes can be drilled in the sides and bottom of the case. Care should be taken that the nuts securing the clips are kept well screwed up.

Spark gap and primary connections.

The spring fingers making contact with the moving plug of the spark gap are apt to lose their temper due to heating; this requires attention; it is most important to keep the ohmic resistance in this part of the circuit as low as possible; serious heating will take place unless all primary clips and condenser connections are kept well screwed up.

The spark gap insulators are always to be cleaned after sending; if they are allowed to get dirty, irregular sparking will occur at the safety discs, &c. The bolts supplied for securing the spark gap to its stand are required to ensure the spring contact under the box making good connection and so efficiently earthing the transmission gear.

The copper strips connecting the large primary tubes to the condenser bars should be bound round with tape, as the edges are very sharp and may cause abrasions to the skin when changing the series parallel clips.

Mutual coil.

Due to the swelling of the wood, the working of the mutual coil along its bar tends to get rather stiff. If this occurs, to ensure being able to quickly and accurately alter

the coupling, it is necessary to ease the fitting by slightly increasing the size of the square hole in the mutual coil.

Before joining up the direct-current ammeter, it should be seen that all parts of the main D.C. circuit are completely disconnected from the ship's mains; a case has occurred of the instrument being burnt out by a rush of current caused by the lead from the ammeter being accidentally earthed when joining up the instrument. Direct-current ammeter.

When starting up the alternator it is necessary to wait, exactly on each stop of the starter, until the current falls to 75 ampères. Provided this is done, it is quite safe to start up with the field regulators adjusted so as to give full volts (450) and the correct frequency (350). Alternator starter.

The motor alternator brushes, marked "KK III," are of soft carbon and are always to be used for the A.C. side; the hard carbon brushes for the commutator are marked "S." The brushes on the slip rings require frequent attention. The springs may lose their temper and require setting up; this can be easily done. There may be no indication in the W.T. office that sparking is taking place; the examination of the machine when the key is being pressed should, therefore, be made a matter of daily routine. Motor alternator brushes.

The field regulators get very hot, and should therefore have a thick pad of asbestos between them and the side of the silent cabinet on which they are mounted. Field regulators.

The relay switch is not thoroughly satisfactory. It has been found convenient to fit a small tin plate on to the insulated moving part, and cut a slit in the top of the case to allow the plate to act as an indicator and show when the switch is made; should the switch jamb mechanically the safety arrangements are seriously interfered with. Cases have occurred of the switch failing to make on completing the safety circuit due to the series resistance not being cut out when the switch last opened, and consequently there not being sufficient current flowing through the bobbin to overcome the weight of the moving part. To obviate this defect the pivot and weight, controlling the resistance, require to be kept in proper working order; the former should be made to work freely and the weight of the latter should, if necessary, be increased, to ensure the contact being a good one when the main switch is open. Relay switch.

The sparking pieces on the switch are inclined to give trouble and can with advantage be removed. All nuts inside the instrument are liable to work loose, due to the vibration, and must be kept well screwed up.

The porcelain and ebonite parts of the deck insulator both inside and outside the office must be kept clean and as dry as possible. Deck insulator.

The black insulated coating of the new pattern aerial wire is of very high resistance. When joining up, all the insulation must be carefully scraped off and a good low-resistance connection made; afterwards the junction should be coated with black varnish to prevent verdigris forming. A good low-resistance connection is essential for receiving purposes. Aerial wire, new pattern.

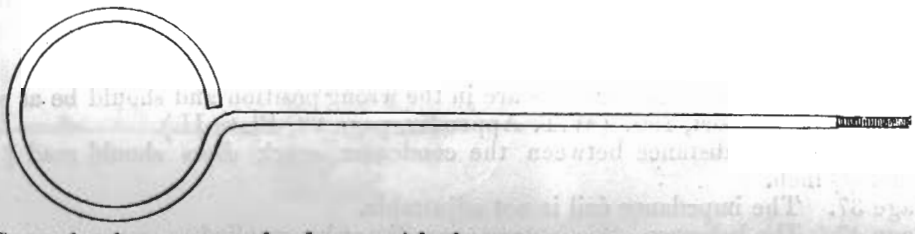
The safety spark discs should be occasionally moved round so as to present a fresh surface. It must be remembered that when a spark takes place across them they rapidly burn away, and will not then efficiently protect the condenser; it is most important that the edges be kept quite sharp. The correct distance apart for these discs is $\frac{3}{4}$ inch, not $\frac{7}{16}$ inch as given on page 36 of the Instructions. Safety spark discs.

No cases have yet occurred of these condensers breaking down, but should a plate puncture in the condenser, a spark can still be obtained as there are four sections in series in each element; a slight alteration will, however, take place in the capacity, and if working at full power will probably cause the longs to break up a little, due to the circuit being out of resonance; the note will also alter. Condenser

The burning ebonite produces a characteristic smell which can easily be detected; the gas given off is inflammable. On no account should sending be continued after puncturing the condenser, as, in addition to rapidly burning away the ebonite, the other sections of the same element will be unduly strained and the insulating properties of the oil quickly damaged. The spare element must be put in and the punctured one returned to the dockyard for repair.

The impedance coil is not adjustable and will be found correct for a frequency of 340–360 cycles. To get accurately into resonance the frequency must be adjusted in each ship until the best note is obtained, which will be at about 350 cycles. (*See* page 20.) Impedance coil.

The implement shown in the accompanying diagram is supplied for fitting on the special connectors to the aerial coil, as described in page 39 of the Instructions. Aerial coil and fittings.



Spare implements can be drawn with the spare connectors.

Insulating oil.

The special insulating oil supplied is hygroscopic and its insulating properties depend upon its being always kept away from moisture or damp air. The oil is supplied in 2-gallon petrol tins painted yellow ; they are returnable and must not have any other liquid put into them. Any instrument that is going to be filled with oil for the first time must be thoroughly dried on the inside; the oil must never be allowed to remain exposed to the air or it will absorb moisture which can only be driven out again by boiling ; the oil before being supplied is boiled and put into the tins hot.

If the transformer has been kept for any length of time without being filled with oil, before using it in the series position the windings should be warmed to ensure the insulation being perfectly dry and good. This can be done after filling the transformer with oil, either by sending with a big spark for some time in the parallel position or else short-circuiting the secondary and keeping the key pressed for half an hour so as to thoroughly warm the windings in the parallel position before using the transformer in series.

The pumping outfit must be kept thoroughly clean and dry.

Improvements in the later Designs of Instruments.

Blower.

To reduce the noise of the blower the case is being made of thicker material and arranged to screw down on to a leather washer. The clearance between the blades of the fan and the case is being altered. The spare parts will not be interchangeable with those of the old pattern.

Magnetic key.

The whole front and sides of the new magnetic key case can be removed, leaving the key in place, so that all the parts are readily accessible. The spare fittings of the new key will be interchangeable with those of the old. A box of spare fittings will be supplied and in addition spare parts, such as bobbins, condensers, &c.

Cut-out box.

The case of the cut-out box is being made of an improved lighter design.

Primary.

All the present brass fittings in the primary will be made of copper or copper plated. The springs of the clips will also be of copper.

Condenser.

In the condensers the large washer will be made of woodite instead of leather; the former substance has the advantage of not getting hard when in contact with oil for any length of time.

It will be found when starting with the maximum spark that the safety discs spark across considerably just at first. This will cease after a short time, the reason being that the insulation falls due to the heating and formation of copper dust and dirt on the surface of the spark gap insulators. The voltage required for a given spark is slightly greater when all the instruments are cold.

Arrangement of instruments inside screen.

As regards the relative position of the movable doors and fixed part of the screen it must be remembered that the arrangement of instruments inside depends upon the position of the deck insulator ; the transformer and the impedance coil must be placed under the deck insulator, and the spark gap &c. at the other end of the cage; the movable doors must be at the spark gap end of the cage and the fixed part of the screen at the transformer end.

It will be noticed that Plate II., Annual Report, 1907 (W.T. Appendix, page 22) is correct, and that the diagram given on page 9 of the Service II. handbook is wrong.

Service II.—Arrangement of Trunk.

Plate VI. shows the aerial and earthing arrangements made in the case of a Service II. ship with her W.T. office down below. An expansion joint, G, is fitted in the copper pipe to allow for alterations of temperature. The earth leads, F, consisting of eight pairs of wires, are taken up as shown from the lower to the upper deck insulator. One of each pair of the long insulators, C, used for staying the upper part of the pipe, has to be cut down as shown. A ladder is fitted inside the trunk leading from the door down to the lower insulator.

To assemble the parts :—Remove the upper insulator, lower the copper pipe down the trunk, screw it on to the top of the lower insulator, cut the pipe to the required length, put the upper insulator in position, secure the expansion joint, care being taken not to damage the spring fingers, then bolt down the upper insulator. There is a clearance of 1 inch in the expansion joint. Now place the upper pipe in position and, after staying it, attach the feeders. A door is fitted in the screen round the upper insulator. The terminals, N N, are for the sending and receiving earth in the W.T. office.

Errata in Mark II. handbook.

The following corrections are required in the Service II. handbook :—

Fig. 1, page 9. The sliding doors are in the wrong position and should be as shown in Annual Report, 1907 (W.T. Appendix, page 22, Plate II.).

Page 36. The distance between the condenser spark discs should read $\frac{3}{4}$ inch, not $\frac{7}{16}$ inch.

Page 37. The impedance coil is not adjustable.

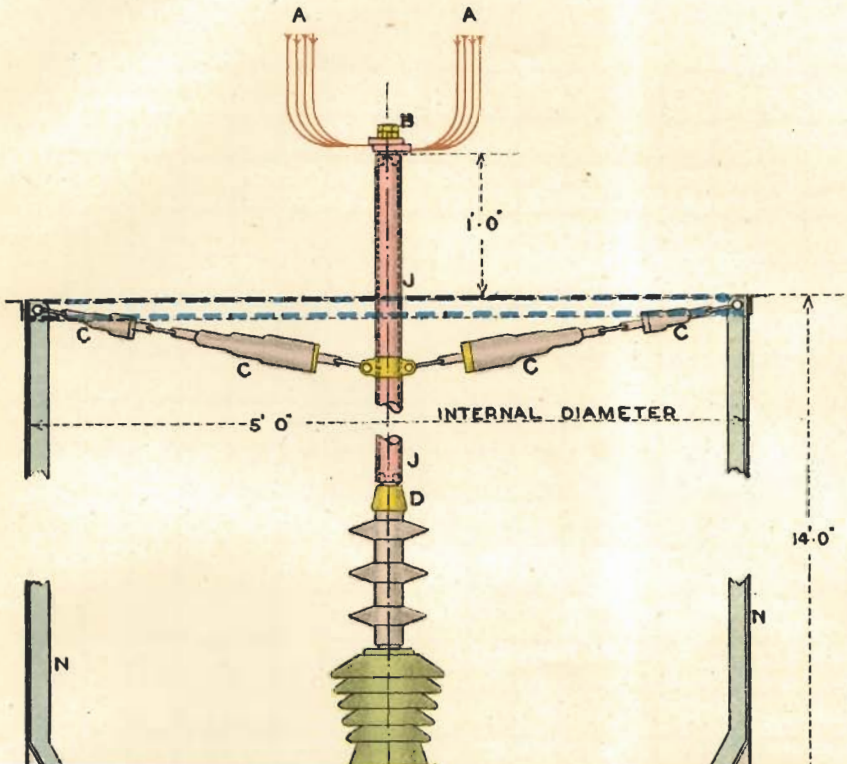
Page 47. The balancer—this instrument will not be supplied.

A.R.1906.

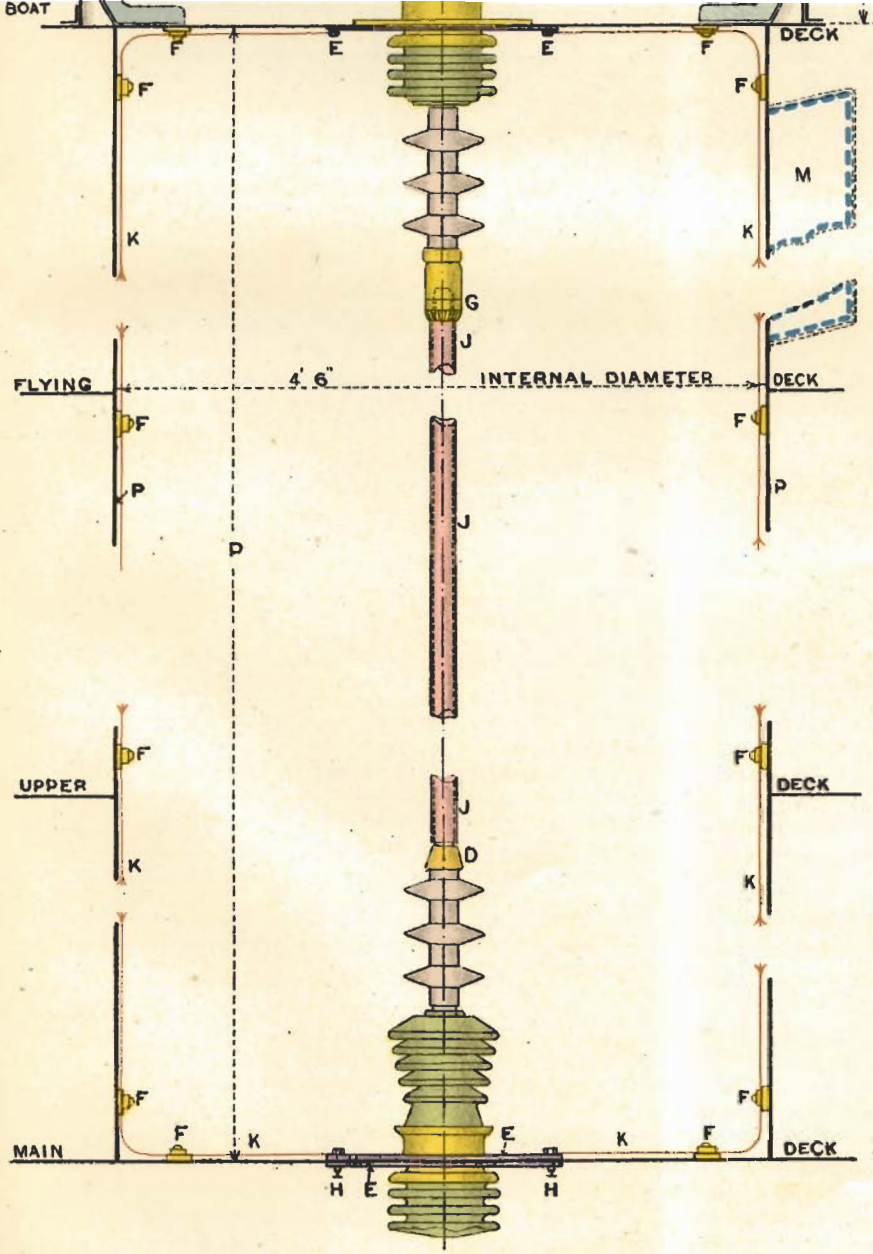
"BELLEROPHON" CLASS

ARIEL TRUNK AND SCREEN AROUND DECK INSULATOR

SCALE 3/4 INCH = 1 FOOT.



REFERENCE



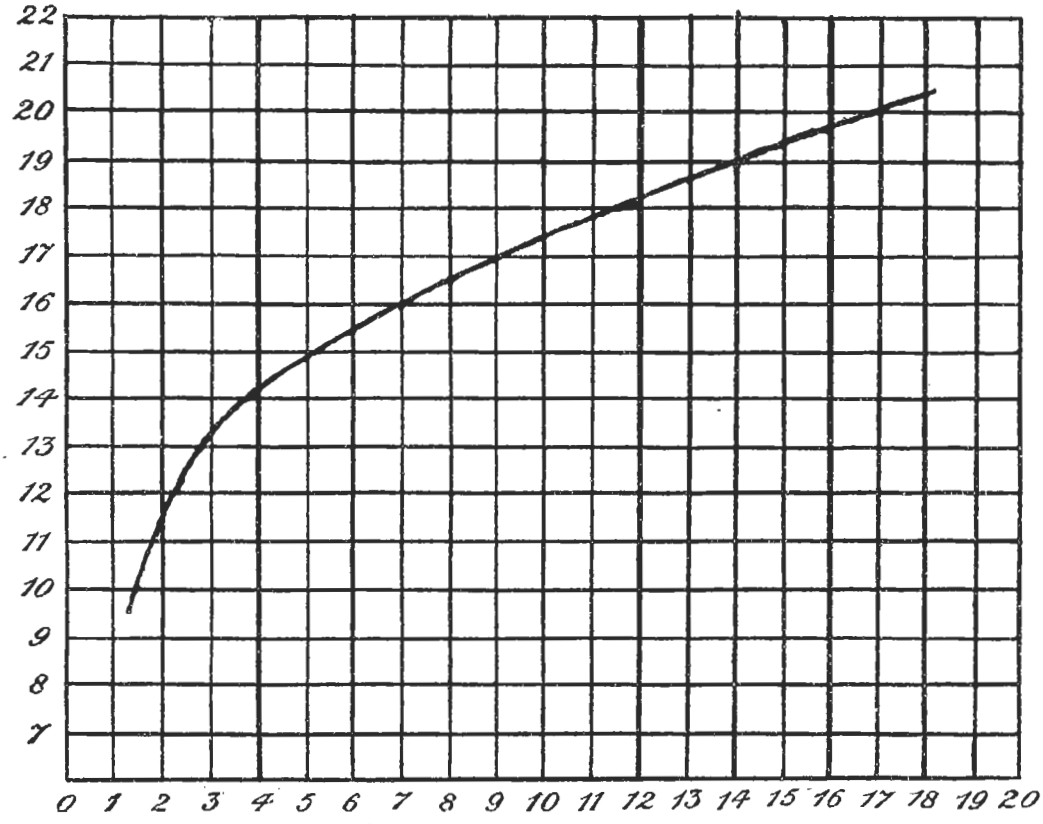
A	FOURFOLD FEEDERS.
B	CABLE EYES SECURED BY NUTS.
C	LONG INSULATORS.
D	FIXED JOINT.
E	EARTHING RINGS.
F	SECURING CLIPS.
G	EXPANSION JOINT.
H	TERMINALS
J	COPPER AERIAL PIPE
K	COPPER EARTH WIRES
M	WATERTIGHT DOOR
N	WOVEN WIRE SCREEN (CIRCULAR)
P	WATERTIGHT AERIAL TRUNK (CIRCULAR)

WIRELESS TELEGRAPH OFFICE.

To face page. 18.

Weller & Graham Ltd. Litho. London.

With reference to Chapter III., on tuning, attention is called to the remarks on page 20 of this report describing method of tuning with vacuum tubes.



The above curve shows the relation between the length of spark and voltage in the Service II. It will be found useful in order to compare the power in the primary circuit with the different arrangements of spark length and capacity.

As an example :—

With 160 jars 8 mm., $\frac{1}{2}$ S.E.^{2} = $\frac{1}{2}$ 160 × (16,500)^2 = 218 × 10^8.

With 40 jars 16 mm., $\frac{1}{2}$ S.E.^{2} = $\frac{1}{2}$ 40 × (19,760)^2 = 78 × 10^8.

It will be seen that with "S" tune the power used with 40 jars and maximum spark (16 mm.) is only half that which can be obtained with 160 jars and maximum spark (8 mm.).

ADJUSTMENTS OF SERVICE MARK II.

The following arrangements of adjustments and couplings are recommended, with a view to reducing the strength of signals, and consequently the general interference, for ordinary use, and at the same time having the full range readily available.

The system adopted is to arrange the number of turns on the mutual coil so that, when close up to the primary, the coupling is about 6 per cent., which is found to give the maximum range when using a large rejector.

For normal work a spark of 4 mm. is used, with the mutual coil hard back to give the loosest possible coupling, when the range should be very considerably reduced.

It is not recommended to reduce the spark much below 4 mm., as difficulty will be experienced in getting a good note.

To obtain full power all that is necessary is to open the spark out to 8 or 16 mm. and close the mutual coil against the primary.

The following table gives the adjustments and results obtained with the "Vernon's" Mark II. set, the receiving station being Scilly, and should serve as a rough guide for obtaining the best coupling, 6 per cent., with the mutual coil close up to the primary, and also the proportional strength of signals which may be expected when the spark and coupling are reduced :—

Results of Experiments with Scilly.

Tune.	Primary.	Mutual Turns.	Aerial Turns.	Spark.	Coupling.		Strength of Signals.
					Inches on Slider.	Percentage.	
"Q"	A 15½	4	41⅛	16	0	8	10
				4	2·5	6	3
				4	5	1·2	Nothing received.
* "S (p)"	A 7	4	20⅔	8	0	6·4	11
				4	2·5	3·3	8
				4	5	1·8	7
† "S (s)"	D 17	4	20⅔	16	0	5	10
				4	2·5	4·2	4
				4	5	2·5	2
"U"	C 9	6	41⅝	8	0	6	10
				4	2·5	5·4	7
				4	5	4	3
"W"	D 22	14	59	8	0	8	10
				4	2·5	7	9
				4	5	5	8
"W"	D 22	6	62	6	2·5	2·5	7
				6	5	1·5	6

* "S (p)" With condensers in parallel. † "S (s)" With condensers in series parallel.

The best note was obtained when using the maximum spark with a voltage of 440, current varying from 75 to 85 ampères.

For the smaller spark lengths the voltage was about 330; current taken, 60 ampères.

It will be noticed that a considerable reduction in the strength of signals on "S" tune is obtained by using a 4-mm. spark, mutual coil as far from primary as possible and the series arrangement of the condensers, and this is recommended as the normal adjustment for ships working on "S" tune. No attempt should be made to improve the note or spark by variation of the frequency, but this should be done by raising or lowering the volts, *see* next paragraph.

Best frequency.

Too much attention cannot be paid to getting a good note. When the best frequency has been found the machine should, after starting, be set to run at this frequency. To obtain a good note the voltage should be raised or lowered, as the case may be, the operator listening with the telephones in the cabinet while doing so. A slight alteration of the spark length one way or the other may also be made to get the note true and clear.

The best frequency at which to run depends on the induction of the alternator, and, although constant for each machine, is not the same for all machines. The impedance coil is not intended to be adjusted on board seagoing ships, and therefore it is necessary to obtain by trial the frequency at which each machine will work so as to give the minimum variation of frequency; this will then always be the best frequency to use when signalling with that particular machine.

TUNING BY MEANS OF A VACUUM TUBE.

In order to reduce the time taken to tune up an installation, trials have been carried out with various forms of tubes, containing rarefied gases, which possess the property of becoming luminous when exposed to a high frequency discharge. This method has been attended with considerable success, it being found possible to adjust the secondary circuit to within one turn on the aerial coil, once the primary has been tuned, without the use of a wave-meter. The whole operation of tuning up a Service Mark II. installation on "Q," "S," "U," and "W" should not take more than one hour.

Having tuned the primary in the usual manner, a vacuum tube is hung from the beams within a few inches of the top of the aerial coil, and should preferably be arranged so that this distance can be readily adjusted. Method of tuning.

The aerial is joined up and a rough adjustment put on the mutual and aerial coils for the wave-length required, the mutual being placed close to the primary. A "short" or two is then made, and this should cause the tube to glow; if it fails to do so, the tube must be placed closer to the aerial coil, in some cases having to be hung on the high tension lead to the S.R. switch.

In general the tube will be found to glow brightly at once, provided the rough adjustments of the secondary are even approximately near those of the primary.

The coupling should now be reduced, and the distance of the tube from the aerial coil increased until the former only just glows, after which the tuning clip must be moved up or down the aerial coil until the maximum glow is obtained, the coupling and distance of the tube being varied until the position of the tuning clip can be determined to within one turn, or less.

To obtain the exact position of the clips for the various tunes, it may be desirable to make use of the wave-meter after tuning up as decribed above, but no diffiulty should be experienced in obtaining the two resultant waves, since the positions found on the aerial coil will never be far out.

The advantages claimed for this system are :— Advantages.

(*a*) A very close approximation to the correct tuning can be made by an inexperienced man, provided the primary is tuned up.

(*b*) The tuning of the secondary with direct current and an induction coil is done away with.

(*c*) The black lacquer on the aerial coil need not be cleaned off for every position of the tuning clip tried, if a single short only is made with the key each time, since the lacquer will not be materially damaged, as it would be if continuous longs or successions of shorts were made for influencing a wave-meter.

A further use of the vacuum tube is to check the tuning of the secondary quickly and frequently, since a certain variation has been noticed from day to day, particularly on "W" tune. Checking the tuning.

Various tubes have been tried, among them being those containing Neon or CO_2 gas, and several makes of Geissler tube. The latter have been found to be the most suitable, though those obtained from different firms varied considerably in sensitiveness. They have the advantage of being very cheap and quite small.

A suitable type of tube is being introduced into the Service.

Vacuum Tube used to indicate if Aerial is not radiating.

Another use of the vacuum tube is to indicate to the operator if the primary and aerial circuits are not in tune, or if, for any other reason, the aerial is not radiating properly. The tube is fixed on the outside of the silent cabinet in such a position that it is visible to the operator through the window. One electrode is earthed to the cage and a lead of Pattern 733 wire is led from the other, stopped up clear of all instruments, parallel to the high-tension copper pipe from the aerial coil to the S.R. switch, the end being secured to one of the insulating cords supporting the aerial coil. Care should be taken that this wire is outside the safe sparking distance from all parts of the high-tension circuit, but, consistent with this, the nearer the wire is to the high-tension copper pipe the more readily will the tube respond to the oscillations in the aerial circuit.

Should the tube not respond when using the loosest coupling and a 4-mm. spark, it can be made to do so by continuing the lead of 733 round the insulating cord above the aerial coil, the upper turns of which will then assist in influencing the tube. With this arrangement the operator will know at once if any mistake has been made in the connections of the primary or aerial circuits, or if the aerial is disconnected, provided that the lead of 733 is arranged so that the tube just glows distinctly, when in tune, with a 4-mm. spark and the loosest coupling. When a longer spark and tight coupling are used the tube will of course glow very brightly, but it will be found impossible to cause it to respond at all unless the circuits are very nearly in tune.

The above remarks only apply to the longer wave-lengths, "S," "U," and "W," since for "Q" it is necessary to bring the lead of 733 very much closer to the high-tension circuit, and this is considered to be an undesirable complication, as "Q" wave-length is so rarely used.