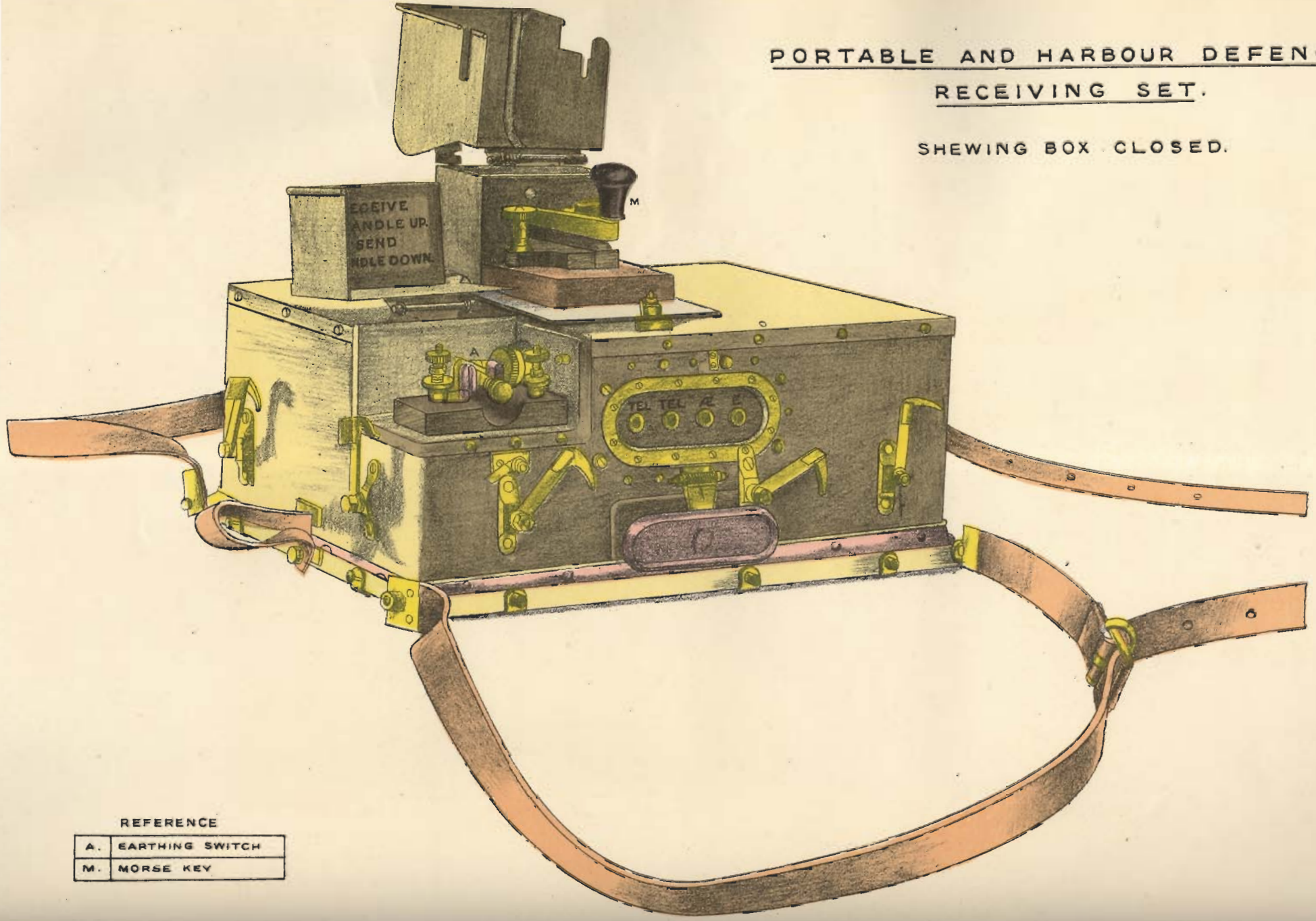
PORTABLE AND HARBOUR DEFENCE.
RECEIVING SET.

SHEWING BOX CLOSED.



REFERENCE

A.	EARTHING SWITCH
M.	MORSE KEY

PORTABLE AND HARBOUR DEFENCE RECEIVING SET SHEWING BOX OPEN.

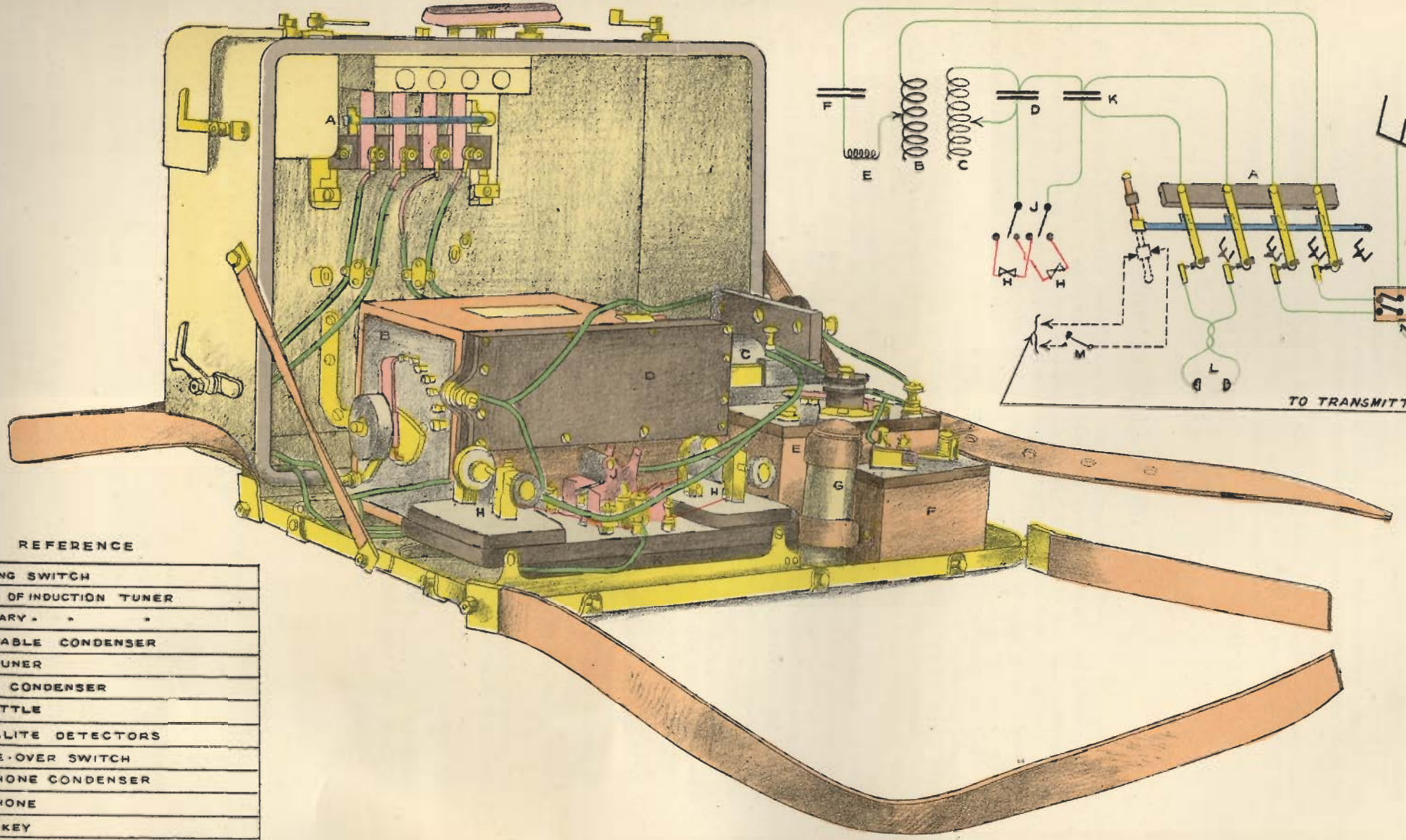


DIAGRAM OF CONNECTIONS

REFERENCE

A	EARTHING SWITCH
B	PRIMARY OF INDUCTION TUNER
C	SECONDARY " " "
D	ADJUSTABLE CONDENSER
E	FINE TUNER
F	SERIES CONDENSER
G	OIL BOTTLE
H	CRYSTALITE DETECTORS
J	CHANGE-OVER SWITCH
K	TELEPHONE CONDENSER
L	TELEPHONE
M	MORSE KEY
N	SEND RECEIVE SWITCH (NOT FITTED IN RECEIVING SET)

Mains.—As the carts, when in position, will be so far apart, it is evident that the mains carrying the power from the generator to the transformer will have to run for a considerable distance underneath the umbrella-shaped aerial. This will very possibly give rise to some inductive effects, and it will probably be necessary to screen the mains. This will be done either by having a metal braiding as covering, or by running a three-core wire and earthing both ends of the idle core. Further experiments will be necessary before finally deciding on the mains to be adopted.

Several of these sets, minus power generator and alternator, have been used in torpedo craft in connection with dynamos and induction coils. Though not so efficient as when using an alternator and transformer, the sets worked very well under these conditions.

AIRSHIP INSTALLATION.

Since the last Annual Report the installation has been completely altered. The quenched spark system has been adopted, it showing many advantages over the spark installation. The difficulty of overcoming arcing when using a 250-cycle supply proved to be insurmountable, a blower of greater capacity than could be allowed affording the only solution to the problem.

No trials with the set in place in the ship have, at the time of writing, taken place, but experiments have been carried out in the "Vernon," in conjunction with the "Furious," which give promise of the full range being obtained when the set is working under normal conditions.

The alternator has proved a great source of trouble to the makers, many unforeseen difficulties having arisen owing to the light weight of the design; these difficulties have now been overcome, and the machine has passed its tests, but no experience has yet been obtained as to its working. The alternator is of 3 kw. output, 200 volts at 250 cycles per second, and is self-excited, the total weight of the completed machine is 116 lbs.

The wave-length used by the ship will be 590 L.S., the primary condenser being approximately 160 jars. The di-electric used in this condenser is 1/32-inch ebonite, this size allowing three gaps to be used in series; under these conditions the power taken is about 3 kw.

The difficulties due to sparking in the framework are still being experienced, but to a lesser degree. Some further trials, similar to those described in last year's Report, were carried out at Barrow. In this case the hull of the ship was used as a passage to earth for the aerial currents. Sparking was found to take place between the framework and a broken bracing wire thrown back some 12 feet. The set employed for these tests was a "C tune" installation. After these trials it was decided to carry out further tests under conditions which would more nearly approximate to those obtaining when the ship was actually signalling, while still maintaining an ample margin of safety.

These tests were carried out when the hull of the ship was suspended from the roof of the shed by hemp tackles, the hull being thus sufficiently insulated to be used as the aerial.

In the first set the keel was not in place, and sparks were obtained in the frames near the aerial connections when a broken wire was used. It was considered that the addition of the keel would tend to minimise the sparking, as it would act as a distributor and prevent concentration of current at the aerial connections.

When the keel was in place tests were again carried out, the installations used being a "C tune" set and also a quenched spark set. The power put into the ship was in each case about 16 times that which would occur in actual working.

Faint sparks were obtained in the frames near the aerial connections when a broken wire was used. The sparks, when using the quenched spark installation, were very small, and it is doubtful if they were sufficiently vigorous to ignite a mixture of hydrogen and air even when combined in the proportions most favourable for combustion. Experiments to determine this point are being carried out in the "Vernon." It is considered that the danger of sparking can be eliminated by the addition of light metal screens to the frames affected.

RECEIVING CIRCUITS AND DETECTORS.

Receiving Set Type "B."

The 45 Receiving Sets Type "B," mentioned on page 35 of W.T. Appendix to Annual Report, 1909, were duly issued for trial, and reports on the points referred to in A.L. N.S. 10174/15208 of 27th October 1909 have been received and are summarised below.

1. *Reliability.*

(*a*) The detector is considered reliable for watch-keeping, provided the testing buzzer is employed as described on page 36 of W.T. Appendix to Annual Report, 1909.

(*b*) With ships in company whose transmitting circuits are adjusted for a 1 per cent. coupling, the organisation of Service wave-lengths can be used without interference except when ships are sending on full power.

(*c*) With ships in company the detector is rendered insensitive when another ship is sending on the same wave-length as the receiving circuit is tuned to. The effect is not permanent, and the crystals recover.

(*d*) Strong atmospherics affect the detector in a similar manner to that described in (*c*).

(*e*) Opinion is divided as regards the extent to which atmospherics can be cut out with the Crystalite Detector, but the majority of reports state that the Crystalite Detector is in this respect the equal of, and sometimes better than, the Magnetic Detector.

(*f*) It is found that the Telegraphist Ratings can be relied on for getting the circuit into accurate adjustment.

2. *Comparison between the Crystalite Detector and the Magnetic Detector.*

(*a*) The Crystalite Detector as compared with the Magnetic Detector is very much more sensitive, almost equally reliable, and rather more selective.

(*b*) The reports unanimously recommend the general introduction of the Crystalite Detector.

(*c*) The majority of reports recommend the retention of the Magnetic Detector for harbour exercises, extemporised sets, &c.

(*d*) It is recommended that the Crystalite Detector be the instrument normally used, and the Magnetic Detector be used as indicated in (*c*).

In view of these satisfactory reports on the working of the Crystalite Detector at sea, it has been decided to supply this detector to all ships, stations, and destroyers, with the exception of ships fitted with Mark I. sets.

Ships supplied with the Crystalite Detectors will carry only one Magnetic Detector.

The Crystalite Detectors will be supplied with an improved receiving set, known as the Type "C" Receiving Set, which is described below.

Receiving Set Type "C."

The articles comprised in this set are described below :—

The Induction Tuner is wound with a primary whose maximum inductance is about 1,200 mics. This winding is tapped in four places. The secondary is wound with a maximum inductance of 6,500 mics. which is tapped in 11 places. The coupling between primary and secondary can be adjusted by sliding the primary into, or out of, the secondary. In order to obtain a fine adjustment of this coupling, a pinion is fixed to the sliding drum, which engages with a rack on the underside of the slide.

The Condenser No. 7 consists essentially of a wave meter condenser with its fittings modified to suit the special requirements. It is mounted in a glass container on a metal base, and has a maximum capacity of about ·95 jar. The scale on the instrument is marked in jars, but the values shown are only approximate, as the instrument is not accurately calibrated. The condenser is heavy, but an air-vane condenser of this description is more efficient than the No. 4 condenser (which is used with the type "B" sets). It is also capable of very much finer adjustment than the No. 4 condenser. The necessity for a fine adjustment was referred to in many of the reports received on the "B" type sets. A switch is fitted on the cover to connect an additional condenser, of the approximate value of ·8 jar, in parallel with No. 7 condenser, as shown on Plate VIII. This extra condenser, which will be known as *No.* 8 *Condenser*, will only be required when receiving very long waves, of 16,000 feet or above.

The Telephone Condenser is built up of three sections of value 2, 3, and 6 jars. There is a plug connection for each section, so that a large range is obtainable.

The Crystalite Detectors are mounted dry, and are not immersed in oil as was the case with the "B" type set. The holders for the crystals are identical with those used in the portable and harbour defence sets. Two of these are mounted on suitable uprights, on a lead base lying on a bed of felt.

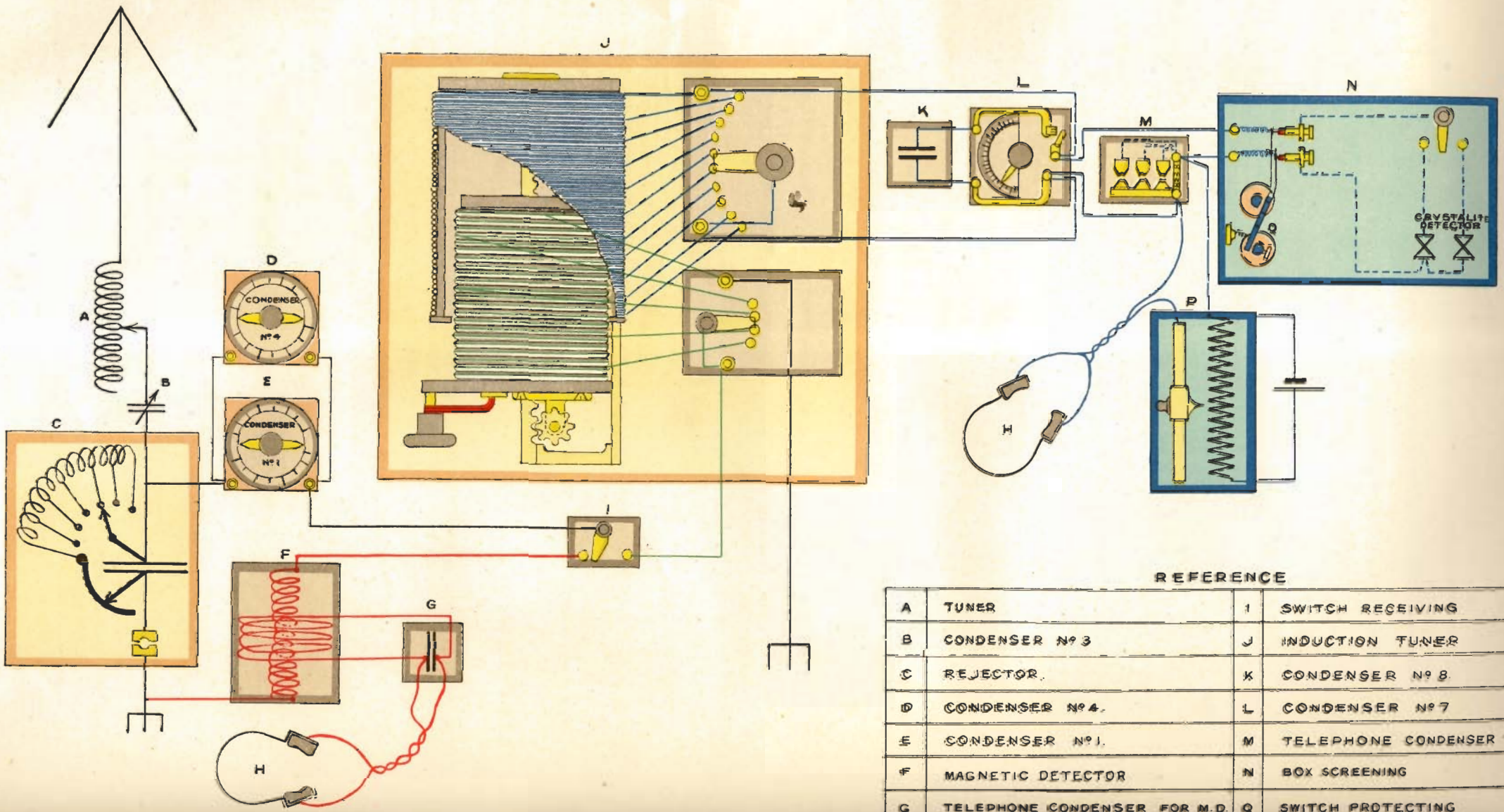
There is a single pole two-way switch for changing over from one detector to the other. The whole is mounted in a metal box called the—

Box Screening Type "C."

This box also contains in another partition the "*protecting switch*" which breaks the circuit on both sides of the detectors.

The Protecting Switch has been re-designed, and the magnetic circuit is very much better than that of the type "B" switch. The mild steel yoke is shaped to slide in grooves on the bottom of the box screening. The armature carries two insulated phosphor-bronze platinum-tipped strips, which make and break the detector circuit. The platinum pointed screws, with which they make contact, are carried on insulated brackets inside the detector partition of the box, and are adjustable. The protecting switch is built up so that the height of the platinum points on the armature extensions from the bottom of the box is exactly the same as that of the pointed screws, but adjustment is obtained in the horizontal plane by sliding the complete protecting switch in its grooves on the bottom of the box, and then locking when the contacts are exactly in alignment. The two phosphor-bronze strips carried on the armature are connected to the terminals by very flexible thin copper-foil strips.

RECEIVING SET - TYPE C.



REFERENCE

A	TUNER	I	SWITCH RECEIVING
B	CONDENSER No 3	J	INDUCTION TUNER
C	REJECTOR.	K	CONDENSER No 8
D	CONDENSER No 4.	L	CONDENSER No 7
E	CONDENSER No 1.	M	TELEPHONE CONDENSER TYPE C
F	MAGNETIC DETECTOR	N	BOX SCREENING
G	TELEPHONE CONDENSER FOR M.D.	Q	SWITCH PROTECTING
H	TELEPHONE HEAD GEAR	P	POTENTIOMETER.

High Resistance Telephones are used.

A Detector Tester, as described in Annual Report, 1909, W.T. Appendix, page 36, should be put up, pending the introduction of a properly tuned buzzer, experiments in connection with which are at present in progress.

The Switch Receiving consists of a single pole two-way switch for putting either the M.D. or the type "C" set into the circuit. The connections are shown on Plate VIII.

Explanation of the Circuit.—A comparison with the type "B" circuit described in last year's Annual Report will show that the "*Strengthener*" has been done away with and a potentiometer included. The inductance of the strengthener has been included in the secondary of the induction tuner. This enables a tighter coupling to be employed than was possible with the type "B" set.

It has not been definitely decided to include a potentiometer in the set, but its position in the circuit is shown in case it is eventually adopted.*

It has been found by experience that a potentiometer brings up very weak signals. This is particularly noticeable when receiving very long waves, but it is not so marked with the shorter waves.

Many contact detectors, however, work very much better with the potentiometer than without it, notably the *Smallite and Carborundum detector*, and the *Telurium and Zincite detector*.

The action of the crystalite detector is probably that of a rectifier and not that of a thermo-junction.

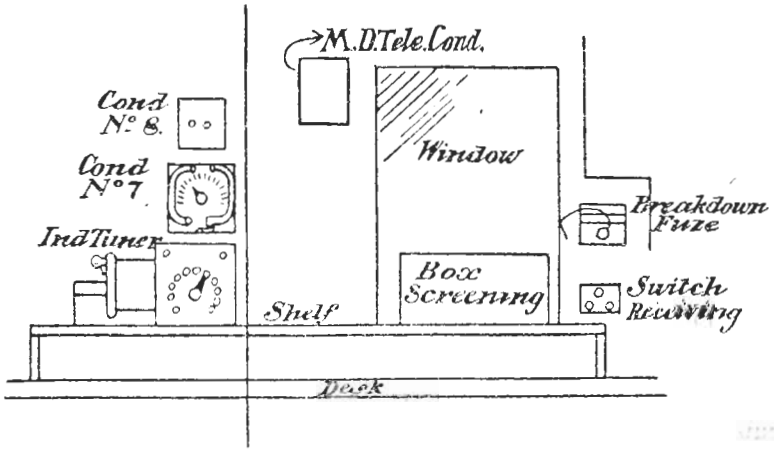
Experiments reported from time to time in the technical papers have usually shown that the current which flows, when an alternating or oscillating E.M.F. is applied to the junction, is in the opposite direction to that obtained by artificially heating the junction. (The gallena detector appears to be an exception.)

Wiring.

It is extremely important that all the wiring be run non-inductively, to prevent interference from other leads, &c.

The instruments should be arranged in the cabinet as shown in Fig. 1. The arrangement is the same for right- or left-handed cabinets.

FIG. 1 (not to scale). Part expansion of Cabinet.



It may be found in some cases that the telephone condenser for the magnetic detector may have to be shifted to a position higher up the side of the cabinet.

Also, in cases where the acceptor capacity is on the left of the window, this instrument will have to be moved to a position below the tuner, and the aerial condenser placed above the tuner.

FIG. 2.

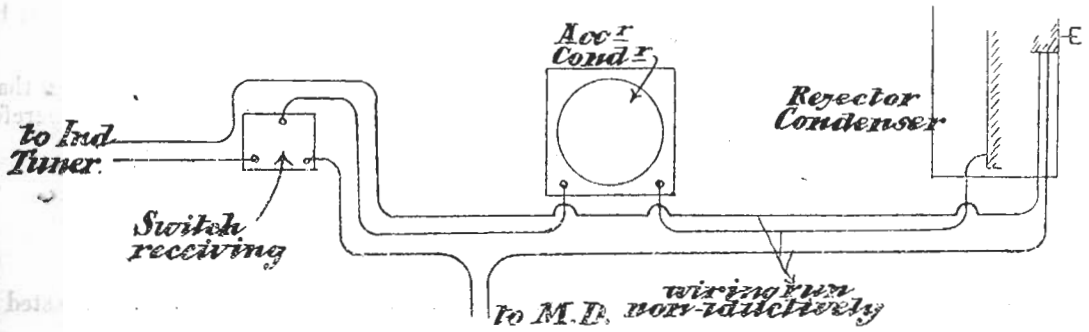


Fig. 2 shows the wiring.

As stated above, it is of the greatest importance that the wiring should be of a permanent nature and non-inductive.

* The positions shown for the potentiometer in Plate VIII. and in Figure 3 are not identical. That shown in Plate VIII. is the correct position.

A shelf should be fitted into the cabinet at a height of about 3 inches above the table, and the instruments should be placed on strips of felt on this shelf.

The object of fitting the shelf for the instruments is to keep the table clear for books, signal pads, &c.

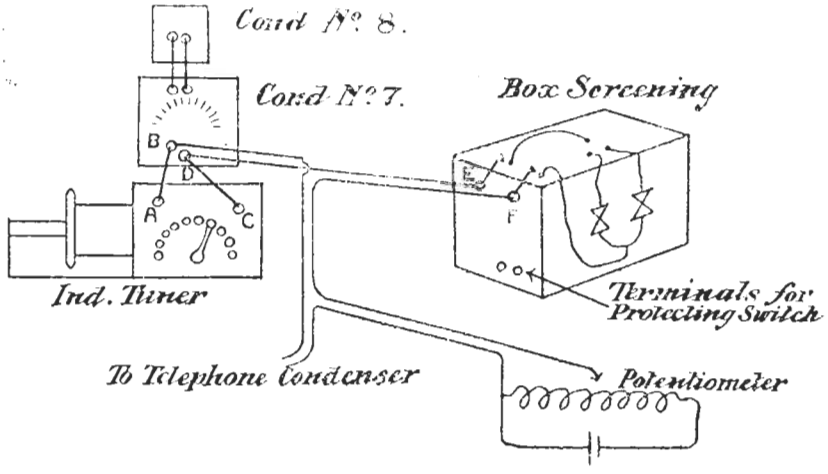
The inside of the cabinet, behind these instruments, should be metal lined; thin sheet copper or brass, which must be earthed, being used for this purpose.

Condensers Nos. 7 and 8 should be screwed up to the bulkhead immediately above the induction tuner. The box screening is on the shelf immediately in front of the operator, and should be placed as close up to the induction tuner as possible, leaving only sufficient space between them for working the tuner switch. In this position it may cut off some of the view from the window, but this is not a serious matter, as the box is small.

The exact position of the switch receiving will not very much matter, provided the scheme of wiring, as shown in Fig. 2, is strictly adhered to. A very suitable position for it would be in front of the operator, between the window and rejector condenser, and below the breakdown fuze.

Fig. 3 shows the wiring of the oscillation and detector circuits.

FIG. 3.



In the oscillation circuit, consisting of the secondary of the induction tuner and the No 7. condenser, it will be found that the best results are obtained by using only a very small condenser (about ·2 jar or less for " S " tune). It is extremely important therefore that the wires connecting these instruments be as short as possible, and without appreciable capacity to one another.

Referring to Fig. 3, in which the terminals are lettered for convenience in description, it is essential that the leads joining A to B, C to D, and D to E, should be as short and direct as possible ; also that the wires C to D, and D to E, be of a permanent nature, and fixed so that it is not possible for them to be moved at all. Care should be taken that the terminal E is connected, inside the box screening, to the two-way switch (through the platinum-pointed screw), and that F is connected to the cups of the two detectors.

The exact position of the telephone condenser is immaterial, but for preference, it should be high up on the side of the cabinet, and, if a screw hook is screwed into the roof, the telephone leads can very well hang down from there, and will not be in the way.

The exact position of the potentiometer, if fitted, is also immaterial. It can be placed where convenient, but the wiring, both to it and to the telephone condenser, should be permanent and put up with clips. If the telephone condenser is placed beyond the limits of the metal sheeting, it will be necessary to mount it on a small sheet of metal, and to run a piece of Pattern 611 wire under the same clips as the wiring. This piece of Pattern 611 should be soldered to the metal sheeting at both ends. Pattern 611 wire should be used throughout for this wiring.

Note.—It is pointed out that the telephones have a resistance of about 2,000 ohms, so that it will be obvious that the insulation resistance is a very important item. Great care must, therefore, be taken, when running the wiring, that the insulation is not in any way damaged.

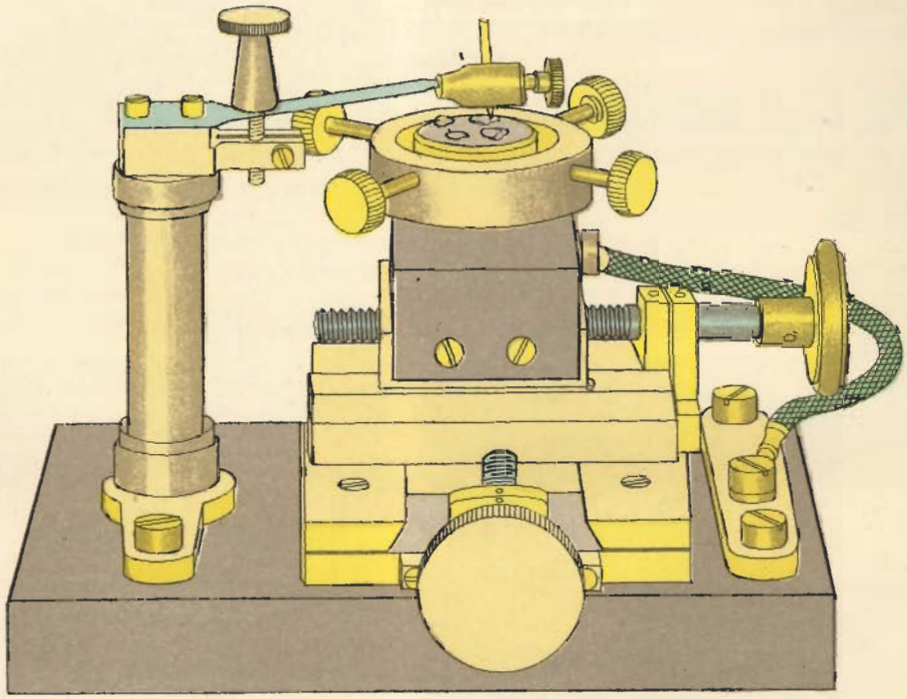
TWO-RECEIVER METHOD OF JOINING UP RECEIVING CIRCUITS.

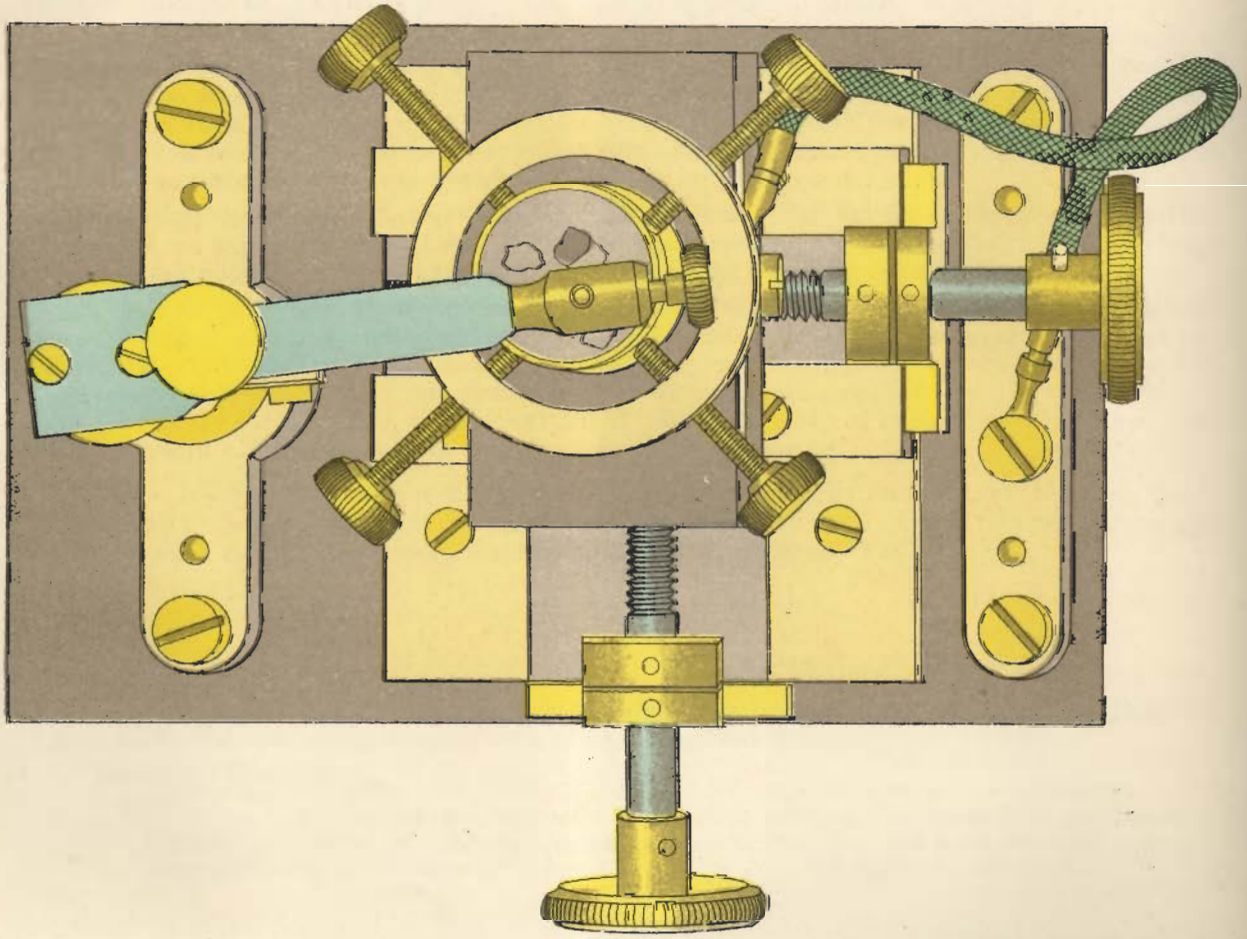
A two-receiver method of joining up Wireless Receiving Circuits has been suggested by Lieut. R. F. Pitcairn, and is reported to have been tried with advantage in " Leviathan."

Principle: The principle of the device is as follows :—

The primary winding of the magnetic detector is used as the conductive mutual of a crystalite detector circuit, and the two telephones on the one head-piece are actuated separately, one by the crystalite detector and the other by the magnetic detector.

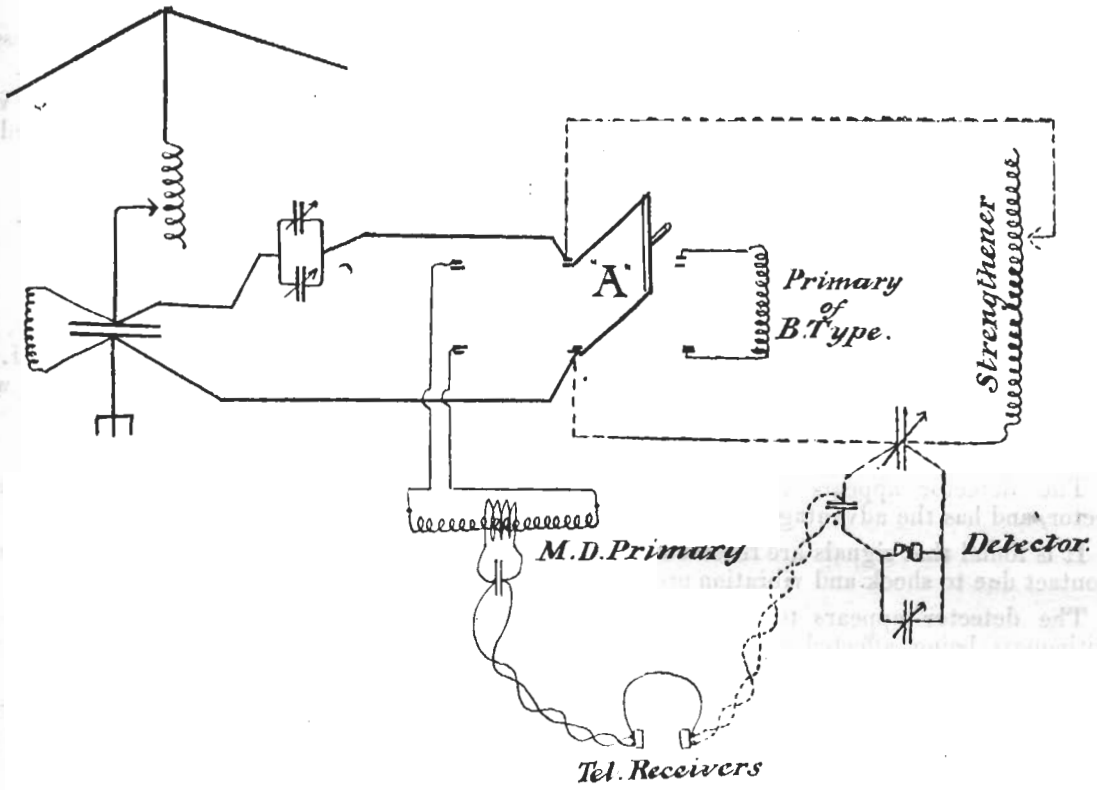
THE MEUNIER DETECTOR.





Method of using the Circuit.—With the circuit in its normal condition (*see* Fig. 1), both the crystalite detector and the magnetic detector are affected by oscillations in the primary winding of the magnetic detector. Signals are thus heard in both receivers, the resulting strength being slightly greater than when using the magnetic detector alone. If a faint signal is heard, the

FIG. 1.



magnetic detector primary is cut out by means of the switch "A," and the crystalite detector is then actuated by being directly coupled to its own primary winding. No transformer tuner is used. Signals are now produced in one telephone only.

The following advantages are claimed for the system:—

1. The reliability in all cases is as good as with the magnetic detector alone.
2. The sensitiveness of reception, when using the crystalite alone, is as good as with the Service crystalite detector.
3. The sensitiveness, when in the normal position for watch-keeping, is sufficient to ensure that a signal, which is strong enough to be read with the crystalite detector alone, will be strong enough to attract attention in the normal position, and thus allow the operator to switch over to the more sensitive detector.

This circuit was tried in "Vernon," and was found to work satisfactorily, but in view of the complications entailed, and the proved reliability of the crystalite detector for watch-keeping purposes, it is not recommended for adoption.

MEUNIER DETECTOR.

A Meunier Detector has been lent by the Ministry of Public Works, Post and Telegraph, of France.

The detector is a contact detector, consisting of a brass point on iron pyrites. The arrangement and setting can be seen in Plate IX.

No battery is required with it, and no advantage is obtained by using one.

This detector is used extensively by the War, and Post and Telegraph, Departments, of France, and has been tried in "Vernon" in comparison with the zincite-bornite detector; it has been found to be decidedly less sensitive, but apparently possesses the advantage of being able to stand being sparked into without loss of sensitiveness, and is cheap. The disadvantage of the detector is that it is somewhat difficult to adjust (a light contact being best), and is liable to be thrown out of adjustment if exposed to shock or vibration.

It is not recommended for introduction into the Service.

Silicon Detector used by "Barham."

A report has been received from H.M.S. "Barham," Mediterranean Fleet, on the results obtained with a silicon detector made up in the ship and used with considerable success.

The detector is a contact detector consisting of graphitoid silicon and a copper point.

A circuit resembling the Service "B" type circuit was made up in the ship. Low resistance telephones were used, no high resistance telephones being available; no battery was used.

The report states that the detector would stand being deliberately sparked into without loss of sensitiveness or need for readjustment.

The report did not state whether vibration affected the detector, which appears to be very similar to the Meunier detector, and probably subject to the same disadvantage when exposed to shock and vibration.

Experiments are being carried out in "Vernon" with graphitoid silicon.

Tellurium-Zincite Detector (or "Dennis Detector").

A detector employing a *Tellurium-Zincite contact* has been invented by Major M. J. C. Dennis, R.A., at Woolwich, and trials with this detector have been commenced in "Vernon" with most promising results.

Tellurium is used in lieu of the bornite employed in the Service "crystalite" detector.

The detector appears to be of the same sensitiveness as the crystalite (*zincite-bornite*) detector, and has the advantage of being easily adjusted.

It is found that signals are received on any spot on the stones, and the movement of the point of contact due to shock and vibration produces no loss of sensitiveness.

The detector appears to be very stable, and will stand being sparked into without its sensitiveness being affected. A potentiometer has to be used with the detector, the best voltage across the contact being very critical.

High resistance telephones are necessary to get the best results with this form of detector.

Tellurium is an element very similar to selenium, and is found in close association with a few rare metals—gold, silver, bismuth, &c., from which it is extracted by fusion. It possesses the colour and lustre of silver, is brittle, and is a comparatively bad conductor of heat and electricity.

It is expensive, costing about 16*s.* an ounce.

Further experiments are in progress; gold and silver tellurides, which are cheaper, will be tried.

If the further trials prove satisfactory, this detector will probably be introduced for use in the "C" type sets.

It has been decided that this form of detector shall be called the "Dennis Detector."

Brown's Telephone Relay.

Experiments with Brown's Telephone Relay, mentioned in last year's Annual Report (page 39 of W.T. Appendix), have been continued, and tuned reeds have been tried. In addition to the trials in "Vernon," the relay has been tried in H.M.S. "Dreadnought" and "Furious," and at some of the shore stations. The instrument is extremely sensitive, and will bring magnetic detector signals up to the same strength as if they were read on the crystalite detector. The great disadvantage of the instrument in its present form is its susceptibility to shock, which for the present prohibits its adoption for use at sea. Further experiments with improved relays, fitted with special windings, finer adjusting screws, and arrangements to overcome vibration, are now proceeding.

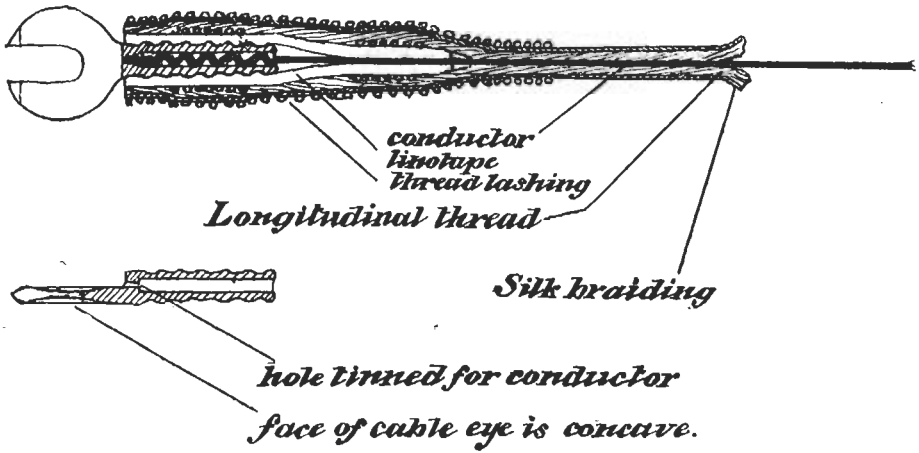
An excellent description of the instrument by the inventor will be found in "The Electrician" of May 6th, 1910.

Telephone Leads for Headgear for W.T.

Considerable trouble having been experienced with the present pattern telephone leads owing to the leads breaking, a new and stronger pattern has been designed. The new pattern leads are constructed as follows:—

The conductor consists of six parts of 36 L.S.G. enamelled copper wire laid up over a silk heart. This conductor is covered with fine linen thread and braided with silk. Two parts of the cable are then laid up together, forming a twin flexible. A strong cord is laid up with the telephone leads at each end, as in the present type, for securing to the headgear, &c., and takes all strain off the leads themselves. Phosphor-bronze cable eyes are fitted. To prevent strain coming on the conductor, a little slack is left inside the hollow part of the spill, and only the very end of the conductor is soldered to the cable eye.

FIGURE.



A piece of linotape is then wrapped over the conductor and cable eye. This linotape is placed longitudinally and secured with thread lashings at the ends. The linen covering thread is then drawn over and secured with a lashing, which is continued to meet the silk braiding. The construction can be seen in the figure.