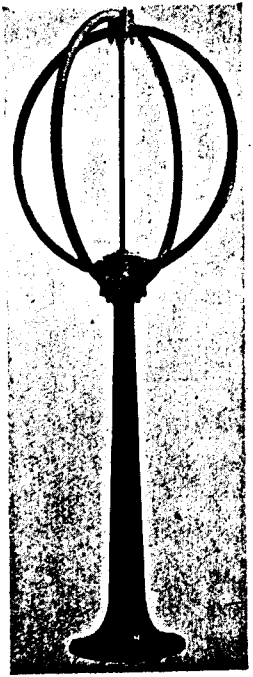


Frame Aerial.
Type F.g.6.

SHIP TYPE FRAME AERIAL

TYPE F.g.6

The illustration shows the type of frame aerial which is used in conjunction with the type D.F.M.4 direction finder and is described in detail in the next article.

A NAVAL DIRECTION FINDER
TYPE D.F.M.4

Wireless apparatus for naval use, is in general, subjected to rougher treatment than is the case with apparatus designed for ordinary use. When such instruments are erected on board warships, where the firing of guns, etc., introduces a considerable amount of vibration, the need for substantial design and shock absorbing devices is especially important. The Type D.F.M.4 Naval direction finder was designed with the above facts in view and combines selectivity and sensitivity with great mechanical strength.

The results obtained with this instrument have fully justified the care that was taken in its design, and have proved that such an instrument is capable of giving exceptionally good results, even when used under adverse conditions.

THE Type D.F.M.4 direction finder has been designed to receive both spark and continuous wave signals of from 350–4,000 metres. This is covered in three ranges, approximately as follows :—

Range 1. 350–750 metres.
Range 2. 750–1,800 metres.
Range 3. 1,800–4,000 metres.

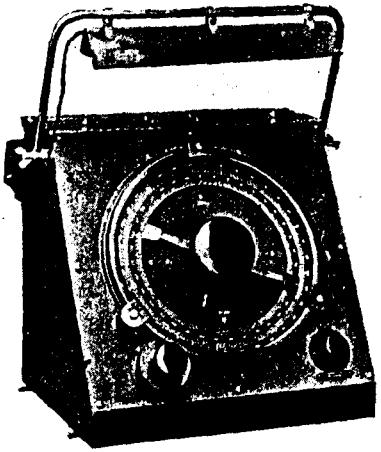
As in the case of the R.G.19 receiver, the D.F.M.4 direction finder has been designed for use on board warships where space is of primary importance. It will be seen from the photograph of the instrument shown below that the receiver has been made in as compact a form as possible, compatible with mechanical strength and efficiency.

The complete receiver is enclosed in two brass boxes, one containing the radiogoniometer and strength control, and the other the complete amplifier and tuner. These boxes are supported by specially designed shock absorbers.

The instrument utilises the Marconi-Bellini-Tosi system of direction finding and employs two metal shielded loop aerials mounted at right angles to each other and supported on a metal pedestal. A small unshielded vertical aerial of suitable dimensions is also used for " sense " determination.

The advantage of the Marconi-Bellini-Tosi system over any rotating frame system is that the aerials can be separated from the receiver, and can be mounted in any convenient position, both as regards pick-up and segregation from metallic masses, etc. When rotating frame aerials are used, as these act as the radiogoniometer of the direction finder, they must be mounted directly over the receiver.

Under favourable circumstances, *i.e.*, where no masses of metal are in close proximity to the frame, no aerial correction chart is needed in conjunction with fixed aerial systems, whereas any rotating frame system necessitates the use of such a chart.



D.F.M.4 Radiogoniometer.

The Marconi-Bellini-Tosi system enables a high degree of accuracy to be obtained on all bearings taken within the extreme navigational range.

A simplified diagram of connections of the radiogoniometer and receiver is shown in Figs. 1 and 2 and a detailed description of the various components is given below.

Aerial System.

The shielded frame aerial system intended for use in conjunction with the D.F.M.4 is illustrated in the photograph on page 6. It consists, as will be evident, of two circular loops, one mounted inside the other and at right angles to it. The two are supported at a convenient height on a pedestal.

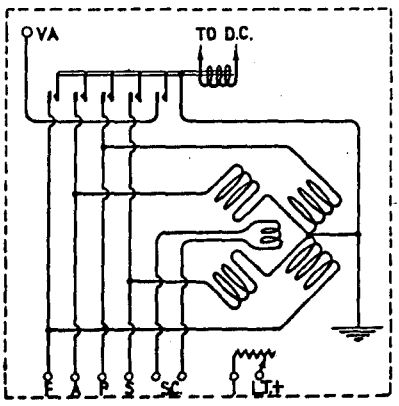
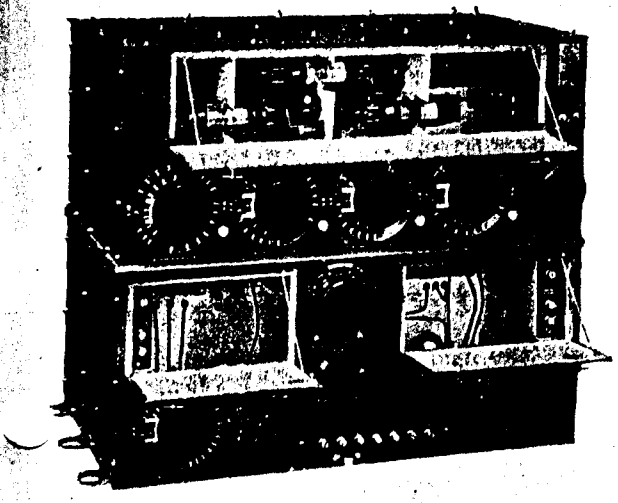


FIG. 1.

The two loops are of slightly different size, the smaller loop being placed accurately along the centre line of the vessel. The diameter of the larger loop is 4 ft. 5 in. The whole system is arranged so that it can be taken to pieces easily, the two loops being detachable from the pedestal.

Each loop is supported inside a copper tube. These tubes are bonded together at their mid-point and are connected to earth through the pedestal by means of a metal rod. Their extremities are carefully insulated from the pedestal by means of an insulated packing; this insulation being extremely important for the correct functioning of the complete system. Each loop consists of four turns of rubber-covered wire carefully insulated from the screening tubes.

The pedestal is of brass and is obtainable in various heights to suit different requirements. The leads from the two loops are connected to dry core lead-covered paper cables via suitable junction boxes and are passed through the pedestal in a convenient way and thence to a junction box located close to the radiogoniometer. Leads are taken from this junction box to the radiogoniometer terminals.



D.F.M.4 Receiver.

These frame aerials together with the vertical aerial system to be described later, enable either a figure-of-eight or cardioid polar diagram to be obtained.

Radiogoniometer.

The radiogoniometer consists of two similar field coils, fixed in position, and crossing each other at right angles. The four ends of these coils are connected to the corresponding ends of the loop aerials, as described above. The coils are mounted on a hollow cylindrical former and are well insulated from each other. A rotatable search coil is mounted symmetrically inside the former in such a manner that it can be set at any angle relative to the two field coils, and its direction read off accurately on a scale provided at the front of the receiver.

The whole radiogoniometer is mounted in a brass box with a sloping front to enable readings to be taken with greater ease and accuracy. A volume control is mounted in the radiogoniometer box, and a light is provided for illumination of the scales. These scales consist of one fixed and one rotatable 360° scale to enable either relative or true bearings to be obtained. This device has been found to be of great use in automatically eliminating a certain amount of calculation, and if operated by a gyro repeater compass greatly simplifies the operation of the direction finder.

The Receiver.

The receiver employs three stages of transformer coupled high frequency amplifiers, an anode bend detector, and a resistance capacity coupled note magnifier. A local oscillator is provided for the reception of the continuous wave signals.

It will be seen from Fig. 2 that the search coil of the radiogoniometer is connected to a closed tuned circuit provided with two coupling coils, one to the vertical aerial coupling valve, and one to the tuned grid circuit of the first high frequency valve.

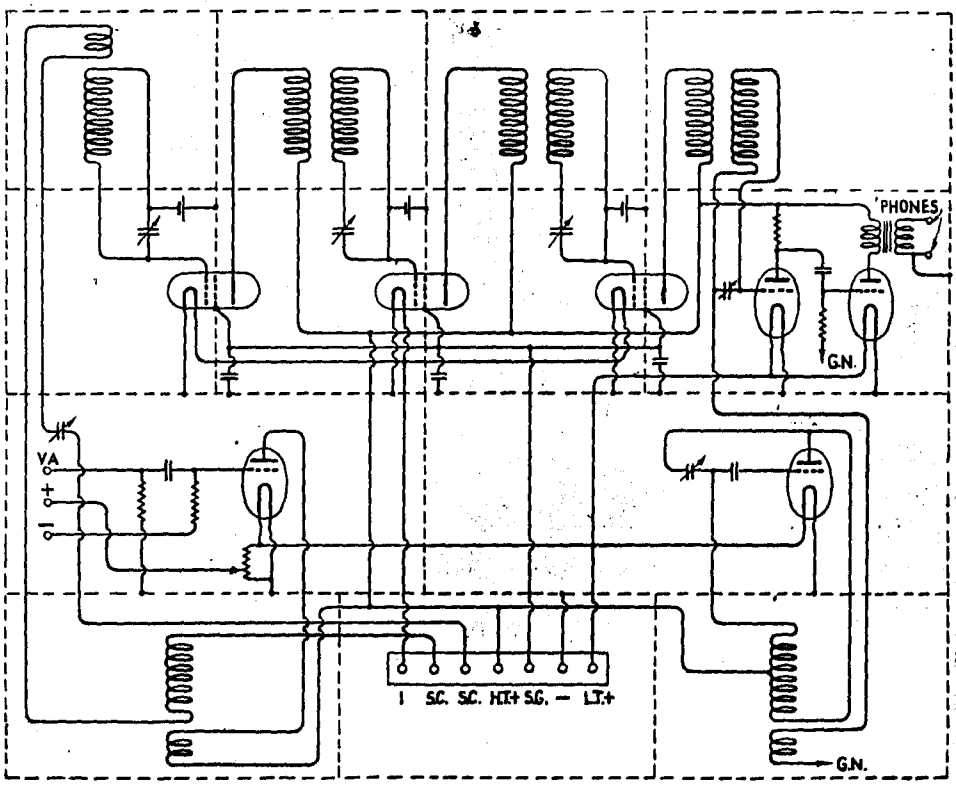


FIG. 2.

The aerial used for sense determination is coupled to the search coil circuit by means of a coupling valve. The signals are applied to the grid of this valve by means of a suitable resistance capacity arrangement. The use of such a coupling valve enables a smaller aerial to be employed, and at the same time, sufficiently good sense indications to be obtained over a large range of wavelengths without adjustment. This fact is of especial importance on warships where the use of a large aerial may be very inconvenient.

The intensity of vertical aerial signal is variable by means of adjustable grid negative on the coupling valve. This enables the correct amplitude of vertical

aerial signal to be combined with the signal from the loop aerials to produce a fine cardioid diagram of reception and thus to obtain good sense indication.

The three high frequency screened grid valves are transformer coupled with tuned grid windings. The coils are astatically mounted, and the set of coils for each stage is enclosed in a separate shielded compartment of the main receiver box. The tuning condensers for the grid windings are operated individually but are provided with a gang control to enable a small band of about 10 per cent. either side of a desired wave to be searched quickly. This device facilitates tuning, as each condenser may be accurately tuned to some pre-determined wave and the final adjustment to the desired wave made by the gang control. The condensers are fitted with special scales to enable the actual wavelength in metres to be read on any of the three ranges.

The coils for the high frequency transformers are changed by means of ganged barrel switches operated from the front of the receiver by a bevel gear and shaft.

After passing through the high frequency amplifiers, the resultant signal is rectified by an anode bend detector. In the grid circuit of this valve is a coil coupling into the output of the local oscillator. The local oscillator is of the usual type and needs no special description. The connections of it can be clearly seen on reference to the diagram. Switches are provided enabling the valve normally used for this local oscillator to be employed as an extra stage of note magnification if desired.

The rectified signal is amplified still further by a resistance-capacity coupled amplifier connected in the usual way.

The receiver is designed to work with low resistance telephones, and a step-down transformer is provided with the high resistance winding in the anode circuit of the last valve.

Stability.

The question of stability has been very carefully considered in the D.F.M.4. In the case of receivers employing a large amount of high frequency magnification, it is found in general that a compromise has to be effected between high electrical efficiency of each high-frequency stage, and overall stability of the receiver.

In the case of the D.F.M.4 the combination of three stages of high-frequency magnification with small astatic coils has been found to give extreme stability and remarkably constant voltage magnification over a large range of wavelengths,