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Section E

NAVIGATIONAL AIDS

NAVIGATIONAL AIDS

THE IMMENSE VALUE of radio as a navigational aid is being proved more and more every day. Ships and aircraft are thereby provided with a reliable means of guidance even under the worst possible weather conditions. Blind landing, direction finding, radar detection and many other uses have been found, all of which lead to a greater degree of personal safety combined with an increased operational efficiency.

5683

VHF Direction Finder Type AD 200 installed in the control tower at Jersey Airport.

20-Watt MF Beacon Transmitter
Type RB 109

DESIGNED for short range automatic working, the RB 109 has a variety of uses including aeronautical location beacons used with instrument landing systems, and maritime marker and calibration beacons. The entirely automatic nature of the equipment means that the installation requires no attention other than for normal periodic servicing and for the adjustment of the time period to meet local conditions.

Two editions are available to cater for operation from either AC mains, or DC mains or batteries. Emergency power arrangements ensure continuous service on AC-operated equipments.

Fully duplicated installations can be provided to meet particular requirements for important beacon services.

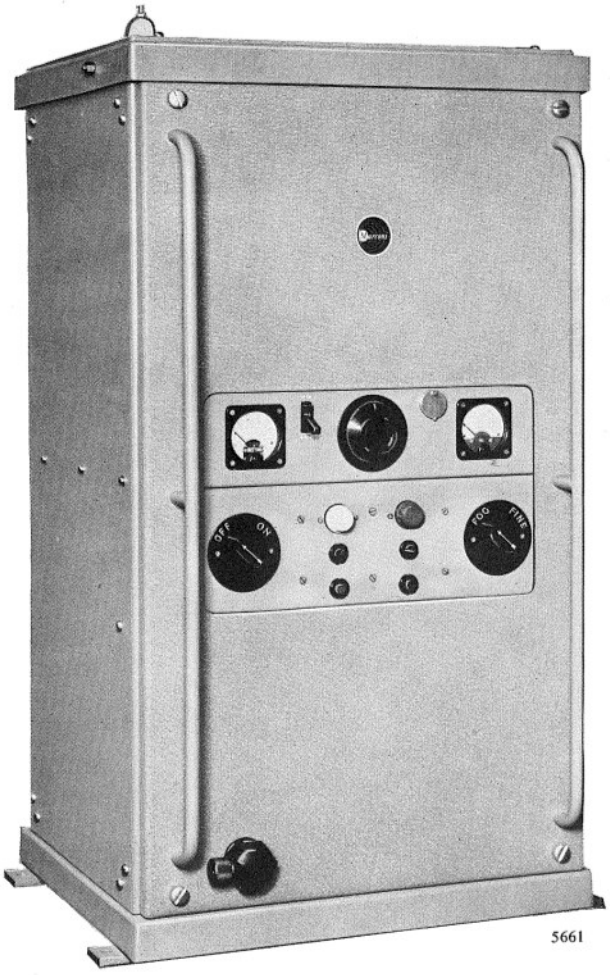
The basic installation comprises the transmitter assembly, which includes the control panel, transmitter circuits and power supply circuits, and the automatic code sender. A master time switch is also supplied, when required, for maritime services.

All controls are on the front panel and switching to 'calibration', causes the power output to be reduced, changes the characteristics of the code and also the frequency.

CIRCUITS

The RF circuits comprise a crystal oscillator, an aperiodic amplifier, a harmonic generator and an output amplifier. The crystal is hermetically sealed and has a low temperature coefficient, ensuring the necessary degree of frequency stability for compliance with international requirements.

Modulation is applied to the anode of the final stage; the modulator being a class 'C' AF self-oscillator.



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The power supply unit is housed in the lower section of the transmitter cabinet. A small additional unit supplies the code sender and relays in the AC edition.

MASTER TIME SWITCH

Alternative types of time switches are available to

provide the two different service conditions, as follows:

(*a*) *For shore use*—operating on the free pendulum principle and consisting of an electrical controlling pendulum with seconds impulsing mechanism and contactor device.

(*b*) *For lightship use*—consisting of a clockwork movement and timing mechanism with contacts and cams.

AUTOMATIC CODE SENDER

Various types of code sender are available, as follows:

For Aeronautical Services a motor driven code sender can be used. A keying speed of approx. 7 WPM is provided and in conjunction with the code sender relay unit coding cycles of approx. 15, 30, 45 or 60 seconds are catered for.

For Maritime Services and as an alternative for the above the Types SM 3A and RM 101 are normally used. They are fully described on page 337.

MONITORING AND WARNING DEVICES

The RF output of the transmitter is monitored. An indicator lamp provides visual indication that the beacon is working correctly, whilst a loud ringing bell gives aural warning of transmission, modulation, or keying failures and incorrect frequency radiation.

The indicators and bells are separate units, so that they may be mounted at a control point away from the apparatus. They can be operated (within certain distance limitations) at more than one control point.

DATA SUMMARY

Output rating: 20 W* to aerial circuit on MCW with 90% modulation. 6 W and below for calibration purposes.

Frequency range: 200–415 kc/s with pre-tuned adjustment.

Frequency tolerance: Within ±0·02%. Conforming with Atlantic City Standards.

Modulation depth: 80%.

Emission designation: CW (A1) and MCW (A2).

Aerial system:
Output circuits suitable for connection of:
Mast or Tower Radiators,
Twin Wire 'T' aerial,
connected either directly or via a screened or matched unbalanced feeder line.

Note frequency: Any selected frequency between 350 and 1300 c/s.

Keying speed: Up to 30 WPM.

Noise level: −40 db with reference to 90% modulation.

Harmonic radiation: At least −40 db with ref. to the fundamentals.

* *This may be pre-adjusted in steps down to* 1 *W.*

Power supplies:
Alternative arrangements for use with:
(*a*) 200–250 V, 50 c/s, single phase, AC mains. Voltage regulation ±5%. Frequency variation ±2½%.
(*b*) DC mains of 50–53 V or 100 V ±3%.
(*c*) DC mains of 50–76 V with additional automatic voltage regulators.

Power consumption: 350 W approximately.

Dimensions:	Height	Width	Depth
Transmitter	2 ft 11 in. (88·9 cm)	1 ft 8 in. (50·8 cm)	1 ft 4 in. (40·6 cm)
Master Clock*	4 ft 2 in. (122 cm)	11 in. (28 cm)	6 in. (15 cm)
Contactor*	7¼ in. (18 cm)	12 in. (30 cm)	5½ in. (14 cm)
Time Switch†	7½ in. (19 cm)	12½ in. (32 cm)	9 in. (23 cm)
Code Sender Type SM 3A	7¼ in. (18 cm)	12½ in. (32 cm)	11½ in. (29 cm)
Code Sender Type RM 101	6 in. (15 cm)	13 in. (32 cm)	11 in. (27 cm)

* *For shore use.* † *For marine use.*

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Head Office: Marconi House, Chelmsford

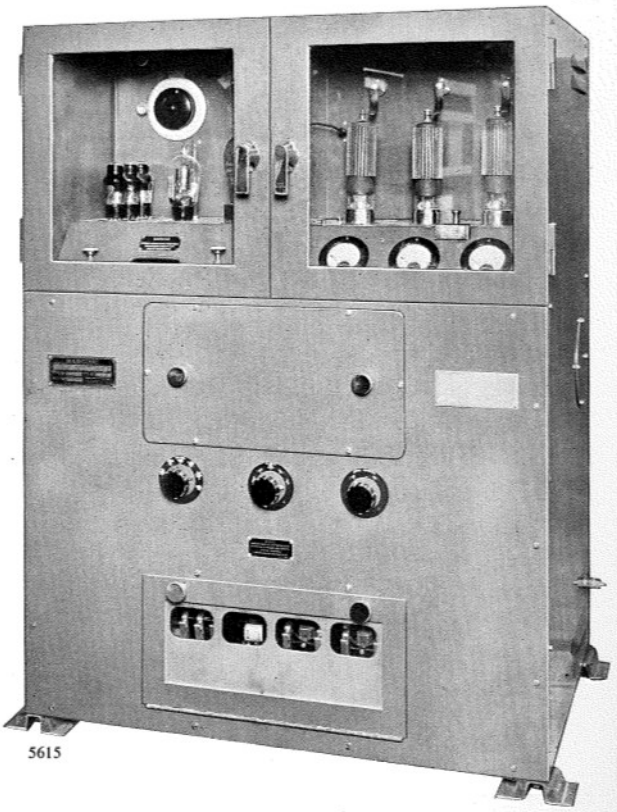
Telephone: Chelmsford 3221. Telegraphic Address: Expanse, Chelmsford

100-Watt MF Beacon Transmitter
Type WB6

THE TYPE WB 6 beacon transmitter is designed as a long range approach beacon and is suitable for shore or shipboard use. It is fully automatic in action and will operate unattended over long periods. Any adjustments that may be necessary can be made by unskilled personnel.

The transmitter is housed in a robust metal case which is suitable for bench mounting. The upper portion of the cabinet contains two units, one of which houses the drive stages and associated amplifiers. The other unit incorporates the modulator, the final stage amplifier and the indicating instruments.

The units are protected by two hinged glass-panelled doors that are fitted with safety switches to disconnect the supplies when the doors are opened. Opening the doors provides access to all of the valves used in the transmitter.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CIRCUITS

Basically the transmitter consists of a tuned aerial circuit indirectly coupled to the final stage tuned circuit. The latter is energised by two amplifier valves connected in parallel. A valve note-oscillator modulates the grids of the final stage valves. For normal working a crystal-controlled master oscillator provides the HF drive to the final stage. This is followed by an isolator stage and one stage of drive amplification.

Signalling is effected by earthing the screen grid of the isolator valve.

POWER SUPPLY APPARATUS

The power supplies can be provided by means of a power rectifier supply unit or by a motor-generator-alternator group, according to the requirements of the installation.

The power rectifier supply unit for use with AC mains is arranged for mounting underneath the transmitter and it incorporates all associated control switchgear. Full-wave thermionic rectifiers provide the main and auxiliary HT supplies, whilst a metal rectifier furnishes current for the relays and the code-sender.

The motor-generator-alternator group is for use with DC mains and it is wound to suit the characteristics of the supply available. It can be housed wherever is convenient, away from the apparatus if necessary.

Batteries may also provide the power source with either of the above systems.

MASTER TIME SWITCH

Alternative types of time switches are available to provide the two different service conditions, as follows:

(*a*) *For Shore Use*—operating on the free pendulum principle and consisting of an electrical controlling pendulum with seconds impulsing mechanism and contactor device.

(*b*) *For Lightship Use*—consisting of a clockwork movement and timing mechanism with contacts and cams.

AUTOMATIC CODE SENDER

Either a Type SM 3A or a Type RM 101 code sender is employed. These are described on page 337.

MONITORING AND WARNING DEVICES

The RF output of the transmitter is monitored. A neon indicator provides visual indication that the beacon is working correctly, while a loud ringing bell gives an aural warning of transmission failures.

DUPLICATE INSTALLATIONS

Fully duplicated installations can be provided to requirements for important beacon services.

The facilities available normally provide complete interchangeability of the automatic time control gear and supply apparatus, as well as changeover between the installations by means of hand-operated switchgear.

DATA SUMMARY

Output rating: 80–100 W to aerial circuit.

Frequency range: 285–320 kc/s, with pre-tuned adjustment.

Frequency tolerance: Within ± 0·02% (conforms to Atlantic City Standards).

Modulation depth: 80%.

Modulation tone: Any selected frequency between 400 and 1300 c/s.

Emission designation: CW (A1) and MCW (A2).

Aerial:

Output circuits suitable for connection of:
Mast or Vertical Tower Radiators,
Twin Wire 'T' Aerial,
connected either directly or via a screened or matched unbalanced feeder line.

Power supplies: Alternative arrangements available as follows:

(*a*) From 200–250 V, 50–60 c/s single phase AC mains. Voltage regulation ± 5%. Frequency variation ± 2½%.

(*b*) From DC mains or stationary batteries, using either:

(i) Motor-alternator in conjunction with (*a*), or,

(ii) Motor–HT/LT generator group.

Power consumption: 1·25–1·5 kVA approximately, according to the supply arrangement employed.

Dimensions:	Height	Width	Depth
Transmitter	3 ft 9 in. (114 cm)	3 ft (91 cm)	2 ft (61 cm)
Master Clock*	4 ft 2 in. (122 cm)	11 in. (28 cm)	6 in. (15 cm)
Contactor*	7¼ in. (18 cm)	12 in. (30 cm)	5½ in. (14 cm)
Time Switch†	7½ in. (19 cm)	12½ in. (32 cm)	9 in. (23 cm)
Code Sender Type SM 3A	7¼ in. (18 cm)	12½ in. (32 cm)	11½ in. (29 cm)
Code Sender Type RM 101	6 in. (15 cm)	13 in. (33 cm)	11 in. (28 cm)

* *For shore use.* †*For marine use.*

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MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED

Head Office: Marconi House, Chelmsford

Telephone: Chelmsford 3221. Telegraphic Address: Expanse, Chelmsford

250-Watt MF Beacon Transmitter
Type AD 501

THE TYPE AD 501 low-power aeronautical beacon has various applications such as a locator for Instrument Landing Systems, and a holding and homing beacon for installation near or within the confines of airports.

The transmitter units are built into a single-bay cabinet. The construction is such that all parts of the transmitter are easily accessible for maintenance purposes, hinged doors on the cabinet facilitating this. Overload trips and mechanical interlocks ensure safety of equipment and personnel.

REMOTE CONTROL

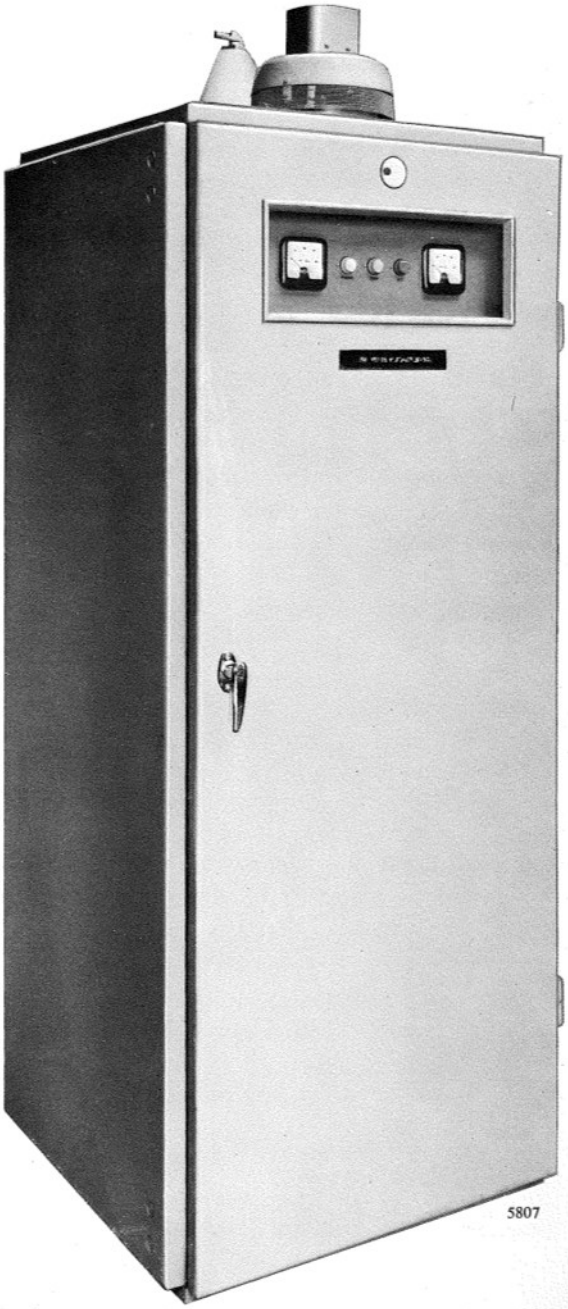
The optional facility of remote control provides either remote on/off switching, or on/off switching together with service selection. The former control is effected over a two-wire line, the latter requires a three-wire line.

CIRCUITS

The RF circuits are conventional. A crystal oscillator, operating at half the final frequency, is followed by a harmonic generator which drives the final power-amplifier stage. The modulator consists of an audio-frequency oscillator which anode-modulates the final RF power amplifier. The RF circuits are keyed by applying cut-off bias to the harmonic generator stage in the transmitter, and the AF oscillator is keyed by a cathode resistor. The general cooling of the transmitter is assisted by a fan.

AUTOMATIC CODE-SENDER

The code sender is motor driven. A keying speed of approx. 7 WPM is provided and in conjunction with the code sender relay unit coding cycles of approx. 15, 30, 45 or 60 seconds are catered for.



AERIAL EQUIPMENT

Choice of aerial equipment depends largely on the purpose for which the transmitter is to be used. Locator beacons for installation on or very near airfields must necessarily have aerials of low height. This will reduce the radiation efficiency, but since the range is only required to be small, in view of the present congestion in the aeronautical MF beacon band, this is no disadvantage. Where greater ranges are required the radiation can be increased by the use of higher masts with top loading. With the above in view, therefore, the aerial circuits of this transmitter are designed to accommodate a wide range of 'T' type aerials up to 150 ft high.

The normal range of aerial capacity is from 500 to 750 $\mu\mu$F for radiated frequencies between 200 and 415 kc/s.

An external aerial loading unit is available with which the transmitter may work into an aerial capacity as low as 250 $\mu\mu$F on any frequency down to 200 kc/s.

DATA SUMMARY

Power output (to aerial circuit): CW 250 W.
MCW 300 W.

Frequency range: 200–415 kc/s.

Frequency tolerance: Within $\pm 0{\cdot}02\%$ by crystal control (conforms to Atlantic City standards).

Modulation: 80% by anode modulation.

Modulation tone: 1020 c/s $\pm 10\%$.

Emission designation: A1, A2 (keyed carrier), A2 (keyed tone).

Remote control: The transmitter can be switched on and off and the service selected by remote control.

Aerial: Can be used with a wide range of aerials, depending on the service.

Power supply: 200–250 V 50–60 c/s single-phase AC mains. Reduction of output to quarter full power can be effected by switching.

Power consumption: 1·1 kW max. at 0·85 PF (MCW key down conditions).

Dimensions:

	Height	Width	Depth	Weight
Transmitter:	6 ft 7¼ in. (203 cm)	2 ft 5¾ in. (76 cm)	2 ft 9¾ in. (86 cm)	670 lb (304 kg)
Aerial loading unit:	2 ft 10 in. (87 cm)	3 ft 0¾ in. (94 cm)	2 ft 3½ in. (70 cm)	150 lb (68 kg)

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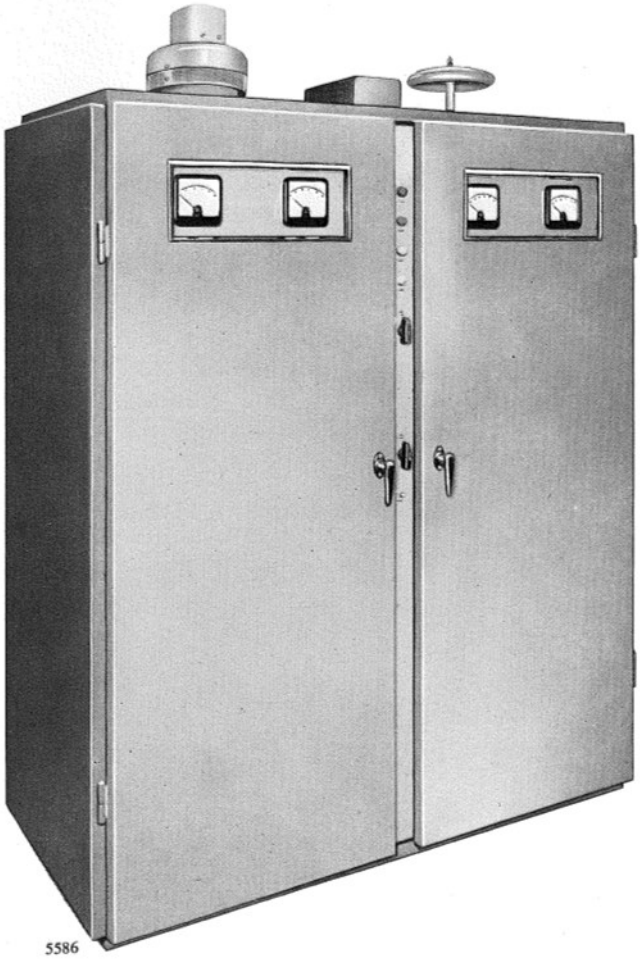
3-Kilowatt MF Beacon
Type WB8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THE MEDIUM-POWER aeronautical beacon Type WB 8 has been designed specifically for operation in areas of low-density traffic, as exist over large continents, and where a high output power is necessary to overcome high noise levels that may be prevalent.

The complete transmitter is housed in a double-bay cabinet, the RF panels being built into one bay and the power pack and modulator into the other. Hinged doors facilitate maintenance and inspection and all parts are easily accessible. HT overload trips and mechanical interlocks ensure safety of equipment and personnel.

CIRCUITS

The RF circuits are conventional; a crystal oscillator, operating at half the final frequency, is followed by a harmonic generator and a penultimate amplifier which drives the final power-amplifier valve. An audio-frequency oscillator anode-modulates the final RF power amplifier on MCW. The RF circuits are keyed by applying cut-off bias to two stages in the transmitter, and the AF oscillator is keyed by combined bias and feedback control.

The transmitter output circuit is designed primarily for direct connection to the down lead of a 'T'-type aerial but, if required, arrangements can be made for matching into a coaxial feeder.

The high-power stages of the transmitter are cooled by means of a blower motor built into the cabinet, assisted by a fan for general cooling.

AUTOMATIC CODE-SENDER

The code sender is motor driven. A keying speed of approx. 7 WPM is provided and in conjunction with the code sender relay unit coding cycles of approx. 15, 30, 45, or 60 seconds are catered for.

AERIAL EQUIPMENT

The choice of a suitable aerial equipment for beacons working in the band 200–415 kc/s is

complicated by conflicting factors. From the point of view of flying hazards it is desirable to keep the mast height down. On the other hand the efficiency of low aerials permits only a very small percentage of the total available power to be radiated. Another consideration is the cost of the aerial equipment.

The best compromise has been found to be a 'T'-type aerial using two 150 ft masts, with a 300 ft four-wire top and 20 ft spreader. The efficiency of such an aerial system when used with the earth specified below, is of the order of 25% at 300 kc/s, increasing with frequency. Such an aerial has been adopted as standard for this equipment.

A radial earth system is used with the aerial and consists of 36 radial wires 300 ft long, suitably bonded together. The length of these wires can be reduced when the soil conductivity is good.

DATA SUMMARY

Power output (to aerial circuit): CW 2·5 kW.
MCW 3·4 kW.

Frequency range: 200–415 kc/s.

Frequency tolerance: Within ±0·02% by crystal control (conforms to Atlantic City standards).

Modulation: 80% by anode modulation.

Modulation tone: 1020 c/s ±10%.

Emission designation: A1: A2 (keyed carrier); A2 (keyed tone).

Remote control: The transmitter can be switched on and off by remote control.

Aerial: 'T' type, using two 150 ft masts, with a 300 ft four-wire top, 20 ft wide.

Power supply: 340–430 V 50–60 c/s, three-phase four-wire AC. One third power working can be obtained by star/delta switching of main HT transformer.

Power consumption: 14 kVA at 0·85 PF at 85% mod. 8 kVA at 0·85 PF on CW.

Dimensions (overall):

Width	Depth	Height
5 ft	3 ft	6 ft 8 in.
(152·4 cm)	(91·5 cm)	(203 cm)

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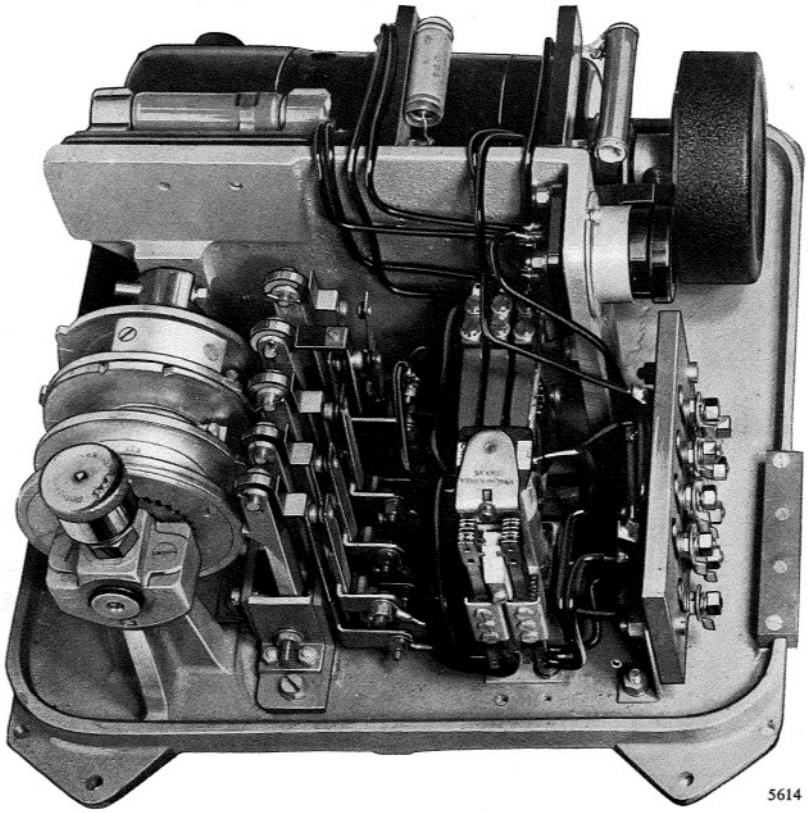
Automatic Code Senders

Type SM3A and Type RM101

FOR USE WITH RADIO BEACONS



5614

The Type SM3A Code Sender with cover removed.

AUTOMATIC CODE SENDERS are intended for telegraph transmitter keying, the signal consisting of a repetitive call sign for station identification followed by a long dash for direction finding purposes.

Two main types are available. The assemblies are mounted on a simple base plate to which is fitted a removable cover.

TYPE SM 3A

A fast running DC motor drives a governor and, *via* gearing, the main shaft which carries the fast cams. A hollow shaft fits over the main shaft and carries a code cam on its driven end.

On the section of the hollow shaft, remote from the motor, a slow moving cam assembly is mounted. This assembly comprises the unused cam and gear housing with the long dash cam. Fixed to the end of this assembly is a pinion with gear teeth cut round its inner edge. A driving pinion of somewhat smaller diameter is fitted on an eccentric cut on the end of the hollow shaft. A pin fixed in the end bearing bracket slightly below the centre of the shaft works in a slot cut in the driving pinion. As the shaft rotates, the pinion is rocked to and fro on the eccentric and drives the slow assembly intermittently. The average reduction ratio is 12:1.

This type of drive for the slow speed cams offers two main advantages.

(*a*) It gives a large ratio of reduction in a small volume.

(*b*) The drive is not at constant velocity.

As the eccentric rotates, the speed of drive of the assembly increases from zero to a maximum and then falls to zero again, maximum velocity being reached when the eccentric is in the top position and minimum (actually zero) when it is in the bottom position.

This means that there will be certain points on the circumference of the cam which are far more suitable for the position of the operating ramp than the remainder, for, when these points are passing the cam followers, the eccentric will be in the top position and thus the cams will be rotating at maximum speed and the contacts will be operated more positively and quickly than if a constant speed drive were used.

Mounted at the side of the shaft assembly is a cam follower and a pair of make contacts operated by it.

The two cams, (code and long dash) are adjacent to one another and both operate the contacts by means of the same cam follower. The code cam carries the station call sign cut on its periphery and keys the transmitter accordingly. The long dash cam lifts the cam follower off the code cam for two revolutions of the high speed shaft, closing the contacts, and preventing the code cam operating them.

TYPE RM 101

The contacts are of elkonite, and carried on substantial but simple straight springs clamped in insulating assemblies with contact plates of ample size interposed so that away leads can be connected by means of screws. The contacts are moved by follower arms actuated by variable code wheels.

The code wheels utilise a new principle which permits:

(*a*) Easy production of a new code.

(*b*) Wide variations of character of code.

(*c*) Clean make and break of keying circuit.

The code discs are made of fairly thin bakelite fabric sheet, and around their periphery are cut 150 angular teeth. The pawl or follower which rests on these teeth has a flat tip which just bridges two adjacent peaks, so that if the code wheel had all its teeth intact, when it rotated, it would not cause any movement of the follower to occur. Any required code can therefore be made on the edge of the disc by removing teeth as chosen. Depending upon the length of the code, required rate of transmission, and speed of rotation, one or more teeth can be made to represent a unit or 'dot'.

To achieve the sharp 'make' and 'break' feature, these discs are mounted in pairs with a gap between them. An associated pair of contacts disposed at right angles to the axis of the code wheels and lying between the outer edges of them, are arranged so that one code disc controls the upper contact and the other code disc the lower contact. A follower on either side of the contacts engages with each of the code discs, and actuates the respective contact to which it is allied.

The code discs are mounted in pairs on a metal hub and can be changed without difficulty. Up to three assemblies can be mounted on the drum attached to the main shaft.

On the end of the main shaft adjacent to the main vertical plate, the control drum assembly is carried and is able to rotate freely about the main shaft. This consists of a driving gear, and two control cams. One of the cams is used as a hold-on and cut-off control cam, and the other is used as required to give selections of other code wheels, long dashes or silent periods.

Dimensions:

	Height	Width	Depth
Type SM 3A	7¼ in. (18 cm)	12½ in. (32 cm)	11½ in. (29 cm)
Type RM 101	6 in. (15 cm)	13 in. (33 cm)	11 in. (28 cm)

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Head Office: Marconi House, Chelmsford

Telephone: Chelmsford 3221. Telegraphic Address: Expanse, Chelmsford

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Flying control. ABOVE: *a present-day installation showing the remote bearing indicator of the Type AD* 200 *Direction Finder neatly fitted into the control desk.*

BELOW: *a contrast – Manchester Airport* 1933.

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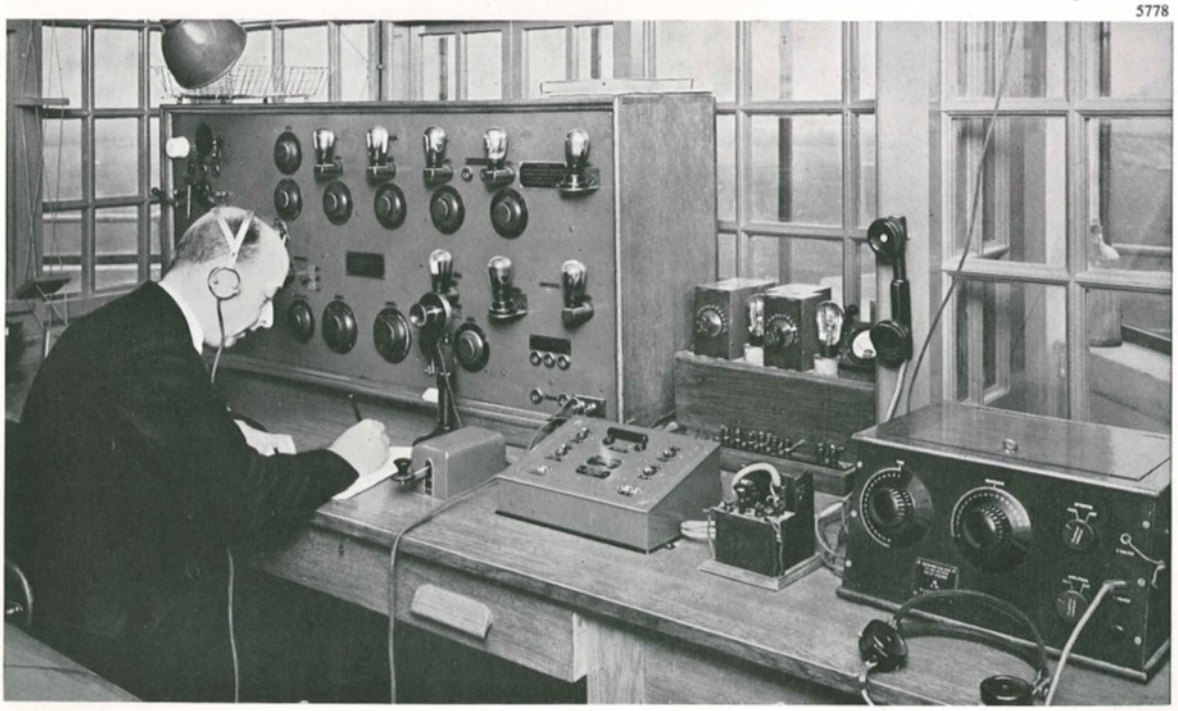

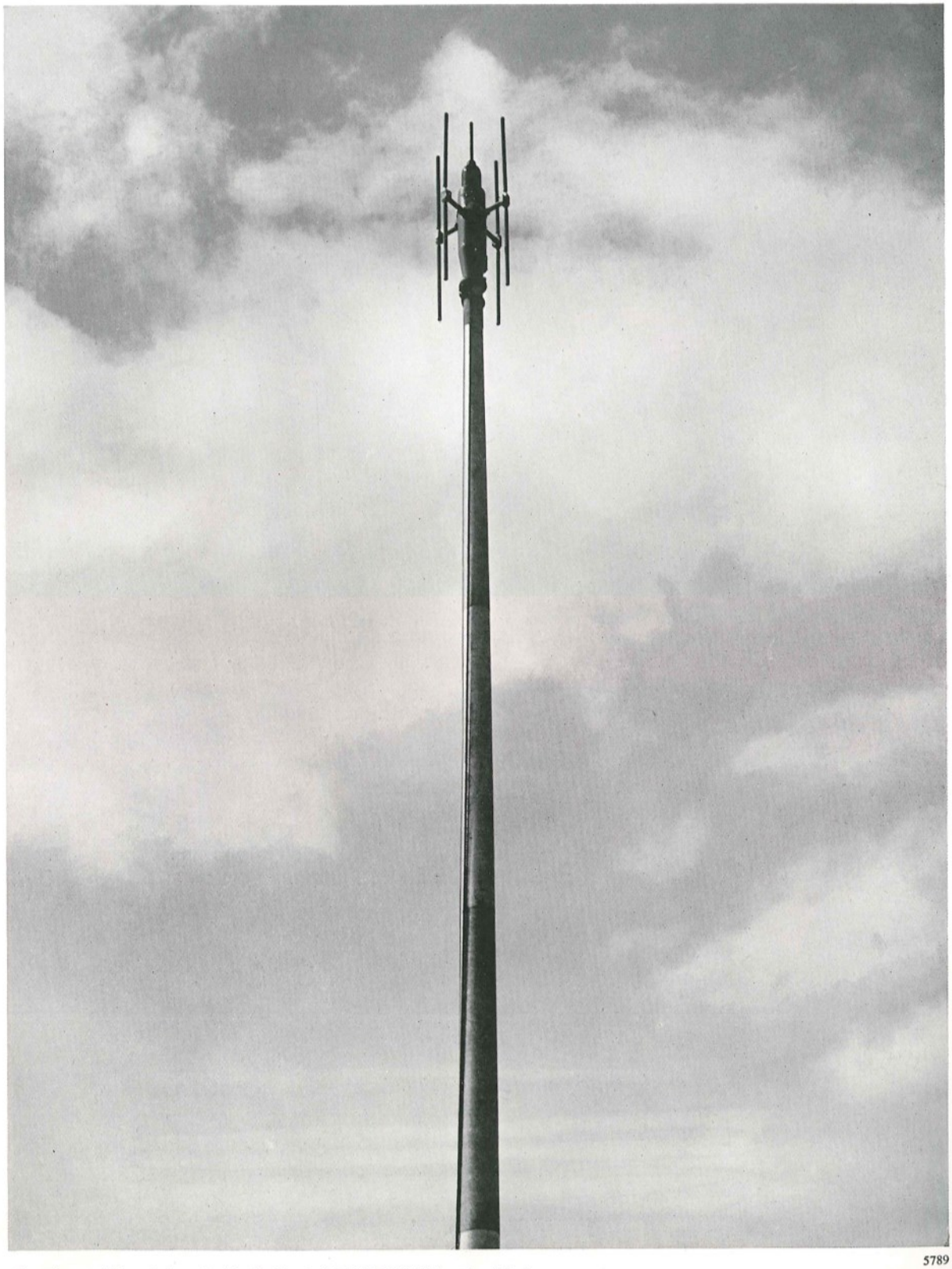

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The elevated H aerial used with the Type AD 200 VHF Direction Finder.

Transportable HF Direction Finder
Type DFP 3

THE TRANSPORTABLE Direction Finder Type DFP 3 has been designed to provide an equipment which, while being readily transportable, combines a high order of performance and bearing accuracy with simplicity of operation and ease of servicing.

FEATURES

Rapidity of sense determination by means of a second loop set at right angles to the main DF loop, enabling 'sensing' to be carried out without moving the main loop once the figure-of-eight minimum has been fixed.

Determination of the position of minimum, either aurally on headphones or visually on the panel meter.

The inclusion of zero-clearing or sharpening circuits.

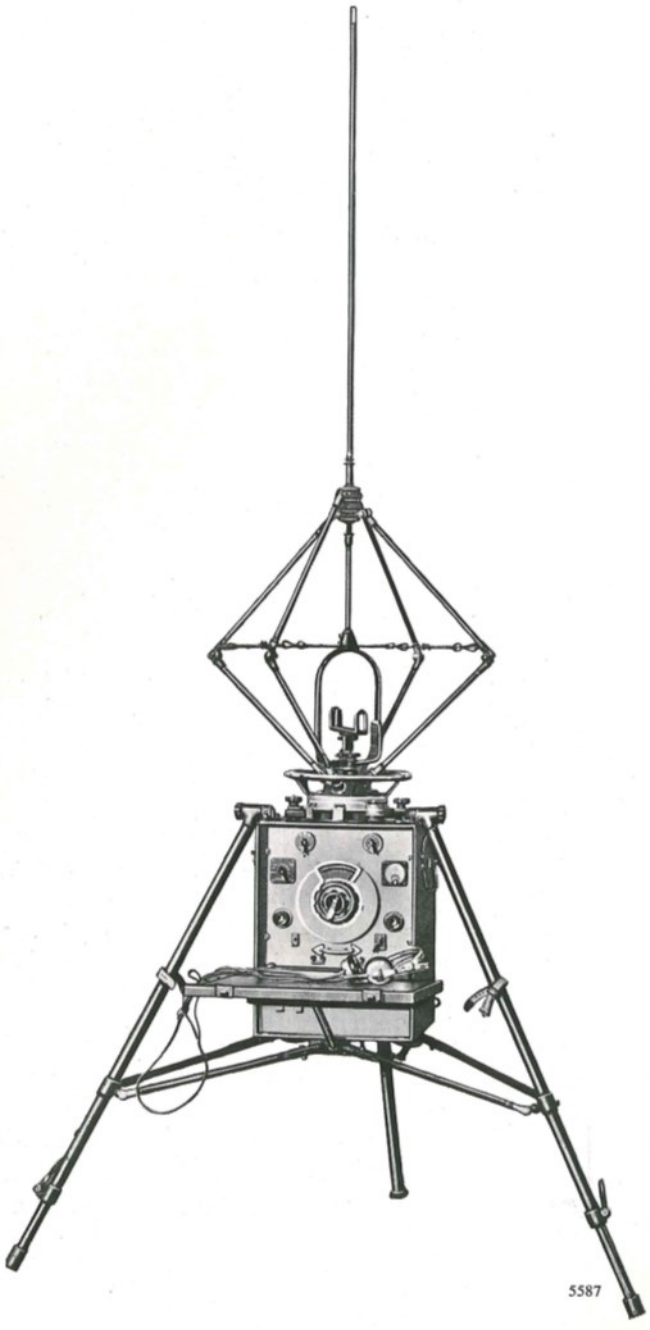
Portability and rapidity of erection. The equipment can be set and put into operation in three or four minutes.

The complete direction-finder packs into three strong cases fitted with carrying handles.

DF RECEIVER

The receiver is strongly constructed and built up in units, any one of which may be rapidly removed from the chassis for servicing or replacement. The chassis is attached to the instrument panel and the whole amplifier is housed in a strong but light case of metal-faced plywood. In operation, the lid of the case may be clipped below the instrument panel for use as a table.

The receiver employs a superheterodyne circuit. Two tuned circuits in the signal-frequency stage and a high value of IF secure good image-



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signal protection. Excellent adjacent-channel selectivity is obtained by the use of four tuned circuits and a crystal filter in the IF unit. Valve spares are kept to a minimum by the use of only two types in the receiver.

A single control tunes both signal-frequency and oscillator circuits simultaneously and rotates the calibrated tuning dial. A shutter linked to the waveband switch ensures that only the range in use is visible to the operator.

The panel meter, in conjunction with an instrument switch, enables all valve anode feeds, HT and LT voltages to be measured. Switched into the output circuit, the meter may be used as a visual indicator of bearing minima. Supply batteries are carried in a drawer below the instrument panel.

For operation, the receiver is slung between the legs of a tripod constructed of steel tubing, and steadied by tie-bars between them and the bottom of the receiver case. The aerial on its mounting is fitted to the top of the case.

AERIAL SYSTEM

The frame aerial developed for use with this equipment combines the highest possible efficiency for an aerial of this type with light weight and ease of erection. The copper tube DF and sense frames are mounted at right-angles to each other and held rigidly in position by spring tensioning devices. All joints are fitted with internal pigtails to ensure good electrical contact and the system is connected to the amplifier by concealed flexible leads and a plug socket arrangement. A stop is fitted, allowing rotation of the aerials through just over 360° only, to prevent damage to the leads.

Loops and vertical aerial are supported on an insulated mounting which also carries the rotating bearing scale and operating handle. This mounting runs in bearings on a cast base which is fitted with a simple device for fitting to the top of the receiver. The base also carries two pointers and clamps for locking the scale and loops while the system is orientated. A suitable orientating device is provided for fixing at the centre of the loops.

ACCESSORY CASE

This carries all the parts and instruments required for the erection, operation, and servicing of the equipment, *viz.*, aerial mounting and base, hand compass, sighting device, spare batteries, a spare set of valves and fuses, two pairs of headphones, and tools.

DATA SUMMARY

Frequency range: 1·5–20 Mc/s in 4 bands.

Sensitivity: For 20 db signal-to-noise ratio, CW field strengths, 1·45–19·3 μV/m.

Selectivity: 3 IF bandwiths. Image-signal protection: 35–80 db.

Reception: CW, MCW, or telephony.

Accuracy: $\pm 2\frac{1}{2}°$ under suitable conditions.

Valves:

Signal-frequency amplifier	Z 21 (met.)
Frequency changer	X 24 (met.)
IF amplifier	Z 21 (met.)
2nd detector and beat oscillator	X 24 (met.)
Output	Z 21 (met.)

Power supplies: LT, either 2 V, 20 AH lead-acid accumulator, or two 2-cell 10 AH alkaline batteries. HT, 120 V dry cell.

Dimensions: (packed for transport):

	Height	Width	Depth	Weight
Instrument case complete	23 in. (58·5 cm)	15½ in. (39·5 cm)	12 in. (30·5 cm)	82 lb (37 kg)
Accessory and battery case complete	19¼ in. (49 cm)	15½ in. (39·5 cm)	12 in. (30·5 cm)	73 lb (33 kg)
Tripod and aerial carrier complete	10 in. dia. × (25·4 cm)	47 in. long (120 cm)		48 lb (22 kg)

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MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED

Head Office: Marconi House, Chelmsford

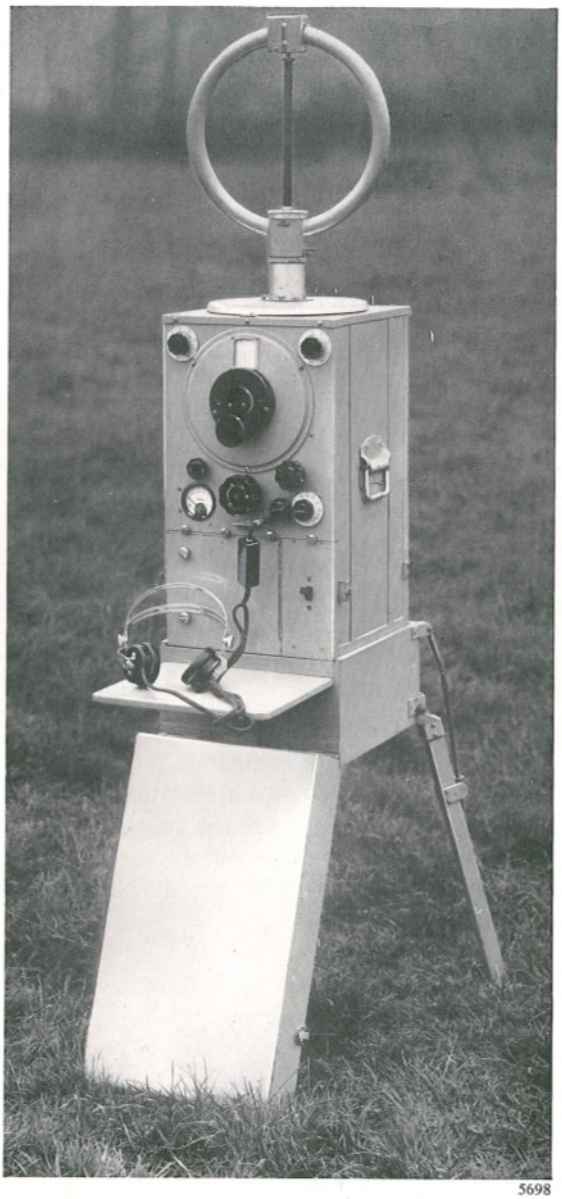
Telephone: Chelmsford 3221. Telegraphic Address: Expanse, Chelmsford

Portable VHF Direction Finder
Type DFP 5

THE TYPE DFP 5 Direction Finding Equipment is intended primarily for field operations in the spheres of aircraft co-operation and intelligence service work. The design, therefore, necessitates a minimum of size and weight, reasonable water-proofing and the facility of rapid set-up. In spite of the limitations imposed by these requirements, the purpose of the equipment is achieved to a high degree of reliability.

In assessing sensitivity, due regard should be given to the frequency range. It is not to be anticipated that an instrument offering such a wide frequency range as the Type DFP 5 direction finder will, throughout its range, rival the sensitivity of an instrument designed for spot-frequency operation.

Exhaustive field tests have demonstrated that the Type DFP 5 equipment is capable of giving bearings of a high degree of accuracy and is of adequate sensitivity.



5698

FEATURES

The equipment employs tuned screened-loop type aerials over the lower frequency ranges and tunable elevated 'H' Adcock type aerials at the higher frequencies. In addition an elevated tunable half-wave horizontal dipole aerial covering the higher frequency ranges forms part of the equipment.

Screened twin parallel-line feeders are employed as the link between the elevated aerials and the receiver input circuit. These feeders are terminated in a tuned circuit at the receiver end.

The method of transfer between the aerial and receiver input circuits takes the form of a

mutual inductive coupling, in which the co-axial mounting of the coupling elements preserves constancy of coupling throughout a complete cycle of rotation of the one with respect to the other. This arrangement avoids the use of slip-ring contacts which are usually a source of considerable trouble at very high frequencies.

The bearing scale is of generous proportions to provide adequate discrimination and is fitted with remote control to avoid the disadvantages of hand-capacity effects.

The DF scale plate is capable of independent orientation. This facility permits adjustment of the scale, so that bearing readings may be taken normally to the points of the compass, quite irrespective of any random aspect of the receiver front to which the scale index marker is attached.

Facilities for metering all valves and supply circuits, and to give output current indication, are provided.

A single unit battery source provides all power supplies to give from 2½ to 3 hours continuous working.

CIRCUIT

The receiver is of the double detection type in which the input voltage is applied directly to the control grid of the mixer valve. Tuning over the full frequency range is achieved by five switched sub-ranges associated with a main tuning control and two-sub-controls.

The intermediate-frequency amplifier operates at a frequency of approximately 5·9 Mc/s and comprises four stages of amplification followed by diode-triode circuits for the second detector and output stages. Audio output for unmodulated signals is catered for by the alternatives of a beat-frequency oscillator or a modulation tone source produced at one of the intermediate frequency amplification stages. These alternatives are included for the reasons, (*a*) a beat-frequency oscillator considerably facilitates weak signal identification during searching operations, but is not reliable for steady-signal reception owing to oscillator drift at very high frequencies, and (*b*) the low-frequency modulation is not ideal for weak signal identification, but is well suited to steady-signal reception when a station has been identified.

DATA SUMMARY

Frequency range: 30–300 Mc/s in 5 switch-selected bands.

Instrument accuracy: ±0·5° under suitable site conditions.

Image suppression: Between 12 db (at 300 Mc/s) and 73 db over whole range.

Valves:

Frequency changer	1–ZA 2
Frequency changer oscillator	1–HA 2
IF amplifiers	4–KTZ 63
2nd detector and output	1–DH 63
Beat frequency oscillator	1–KTZ 63

Power supply: From 6 V battery accommodated in receiver case supplying 2 A to filaments and 2 A to HT generator.

Dimensions (packed for transport):

	Height	Width	Depth	Weight
Instrument Case	2 ft 7 in. (79 cm)	1 ft 4 in. (40·5 cm)	1 ft 2 in. (35·3 cm)	82 lb (37·2 kg)
Spares Case	3 ft 8 in. (112 cm)	1 ft 9 in. (53·5 cm)	1 ft (30·5 cm)	50 lb (22·7 kg)

Marconi

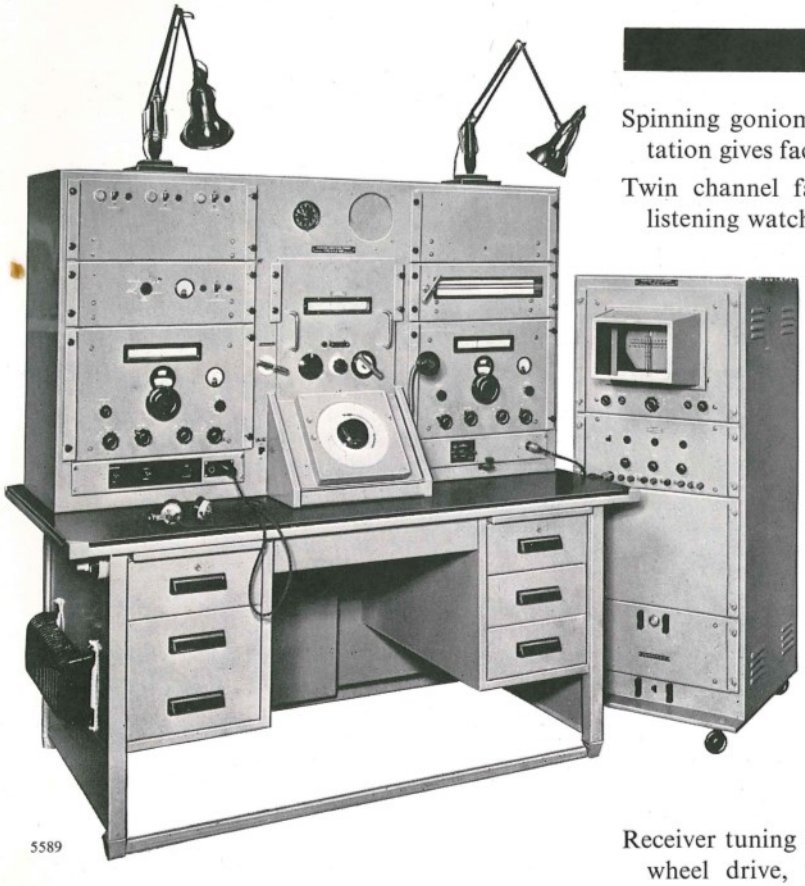
MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED

Head Office: Marconi House, Chelmsford

Telephone: Chelmsford 3221. Telegraphic Address: Expanse, Chelmsford

HF Direction Finding Equipment

Type DFg 26/4



5589

PRIMARILY DESIGNED for interception and civil aviation purposes, the DFg 26/4 equipment embodies a vast experience gained in the technique of wide-band high-frequency direction finding.

The equipment is suitable for direction finding with sense indication on all types of transmission, CW, MCW, telephony or pulse, over the entire frequency band.

FEATURES

Spinning goniometer method of bearing presentation gives facilities for visual indication.

Twin channel facility incorporated, permitting listening watch on two frequencies.

On all types of transmission the bearing may be presented on the screen of a cathode ray oscilloscope.

Facilities are provided for intercommunication with a control centre and for the remote control of an associated transmitter.

A self-contained portable test oscillator permits field calibration checks to be made and facilitates the balancing of the aerial system.

The standard Marconi-Adcock aerial system is employed.

Receiver tuning by means of a single-knob spin-wheel drive, with a directly calibrated frequency scale and a high-discrimination logging scale.

EQUIPMENT

The main cabinet, standing on a steel desk, carries the two receivers with their associated power packs, the DF panel with its goniometer, the line signalling panels, and various subsidiary equipment, including a bearing-correction indicator, a clock and a loudspeaker. The main units slide out on runners, and the DF panel pulls for-

wards and outwards, for easy inspection. The aerial balancing bridge is mounted on the back of the table, and carries the terminations of the concentric feeders connecting the equipment to the mast aerials. A power distribution board is fixed at the back of the table, incorporating a splitter, fuses and several 5-amp. sockets, and an additional mounting board is provided for the termination of telephone lines. Heating panels are fitted to the sides, and two 'Anglepoise' lamps are mounted on the top of the cabinet, providing ample lighting arrangements.

The oscilloscope, together with its associated power packs and accessory equipment, is housed in a steel cabinet fitted with castors, so that its position may be adjusted to suit individual requirements. As in the main cabinet, the various units slide out on runners for inspection, and the cabinet back is removable. The oscilloscope mounts a 12 in. tube, with a horizontal scale calibrated in degrees. The unit has been designed so that wide variations of supply voltage and frequency will not affect accuracy of bearings.

AERIAL SYSTEM

The standard Marconi-Adcock permanent type aerials are used. Four 30 ft tubular steel self-supporting masts are disposed around the DF hut at the corners of a square, the diagonal of which is 20 ft. These masts are insulated from ground and act as aerials. Each mast is connected to the equipment in the hut by a length of steel-armoured low-loss feeder cable which lies on the surface of the ground under the hut. The four masts support an insulated triatic carrying the central vertical aerial, which enters the hut through a roof insulator.

In order to overcome irregularities in site conductivity, a false 'earth' has been devised of copper. This mesh is built of wire in 2 ft squares, and is supported at a height of about a foot by a series of iron stakes driven into the ground. The diameter of the screen is 100 ft.

By the use of this earth screen, good results have been obtained on sites where heretofore direction finding has been impossible.

PULSE DF

The equipment can be used on pulse transmissions. In this case the output of the IF circuit is applied direct to the cathode-ray oscilloscope, the time base of the latter being adjusted so as to coincide with the recurrence rate of the pulses. It is possible to distinguish between direct and indirect signals. The goniometer is used manually.

An angle-bisector device is fitted to the goniometer knob, enabling swing-bearings to be taken without the necessity of looking at the goniometer. Thus the whole of the operator's attention can be concentrated on the pulse images on the screen.

DATA SUMMARY

Frequency range: 1·5 21 Mc/s in 4 bands.

Sensitivity: For 20 db signal/noise ratio:
5·0 to 6·2 μV/m from 1·5 to 3·0 Mc/s.
0·7 to 4·0 μV/m from 3 to 21 Mc/s.

Selectivity: Five pass-band widths between 10,000 c/s and 100 c/s, with crystal filters on the three narrowest bands.

Power supplies: 200–250 V, 50 c/s single-phase AC mains (including heating and lighting).

Power consumption: 2·7 kW approx.

Dimensions:

	Cabinet	*Table*	*Oscilloscope*
Width	62 in. (157 cm)	66 in. (168 cm)	22 in. (56 cm)
Depth	25 in. (64 cm)	34 in. (86 cm)	28 in. (71 cm)
Height	36 in. (91 cm)	30 in. (76 cm)	54 in. (137 cm)

Marconi

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED
Head Office: Marconi House, Chelmsford
Telephone: Chelmsford 3221. Telegraphic Address: Expanse, Chelmsford

VHF Direction Finder *Type AD 200*

WITH THE RAPID EXPANSION of civil flying all over the world, and the consequent increase in the number of aircraft to be handled by each airfield, it has become more and more obvious that planned control of machines in the proximity of a field must be an exact science.

Such 'local' aircraft are handled exclusively in the upper radio frequencies, and the VHF direction finder is the obvious method of keeping a continuous position check on them from the control tower.

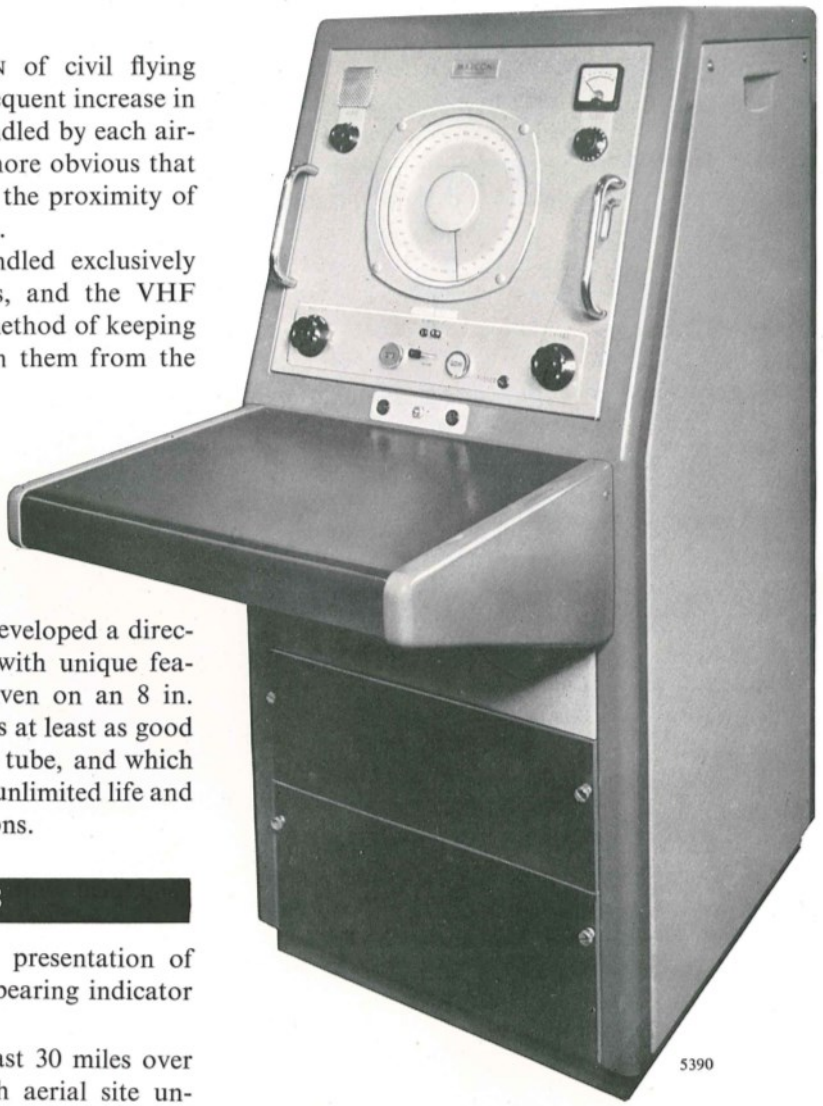
The Marconi Company has developed a direction finder of compact design with unique features. The sensed bearing is given on an 8 in. dia. meter, whose performance is at least as good as the conventional cathode-ray tube, and which has the advantage of practically unlimited life and greatly reduced overall dimensions.

FEATURES

Local or remote instantaneous presentation of sensed bearing on 8 in. dia. bearing indicator meter.

Full remote-control up to at least 30 miles over standard telephone lines with aerial site unattended.

Two independent DF channels can be operated simultaneously from a single aerial system, each with its own presentation.



The local equipment console Type 1562.

Display units may be removed from aerial system by as great a distance as 30 miles.

The apparatus is suitable for 'fixer' and 'homer' stations, and will provide VHF DF identification for airfield control radar equipment.

EQUIPMENT

The site equipment is standard, whether twin or single-channel, with the second receiver acting as an obligatory spare in the case of single-channel equipment.

The Aerial Assembly *Type* 1561 is mounted on a pivoted tubular mast, counterbalanced to facilitate raising and lowering for maintenance, at a height of approximately 30 ft above the ground. It consists of an elevated-H type aerial with a vertical sense element mounted centrally, a capacity goniometer, a 25 c/s tone generator and a driving motor. This arrangement reduces the leads from the aerials to the goniometer to the absolute minimum. Matching units are fitted within the aerial head with coaxial cables brought down inside the tubular mast to the main equipment. The main cable to the driving motor is also contained within the aerial mast. Mast obstruction lighting is fitted.

The Local Equipment Console *Type* 1562. The 'local' equipment is built into a single cabinet. The two receivers, the aerial mixing unit, the modulators and associated oscillators corresponding to a twin-channel equipment are all accommodated in this one console. A single bearing indicator meter for monitoring purposes is common to both channels, and can be switched to either. Aural monitoring is also available on both channels.

The Remote Control and Display Console *Type* 1564 is of similar design to the local equipment and one is required for each channel. These cabinets contain the remote-control circuits, tone filters, demodulators and phase-comparison units, and each is fitted with its own bearing indicator meter. Aural monitoring is provided. Each console is provided with a desk for mounting microphones, etc., and has ample space for writing.

Desk-mounted Bearing Repeater Units *Type* 1566 are available for extending the display to points where space is limited.

DATA SUMMARY

Frequency range: Any one crystal-controlled frequency per channel in the band 118–132 Mc/s.

Receiver bandwith: ±25 kc/s.

Bearing accuracy:

Local (max. *instrumental* error)	±2½°.
Remote ,, ,, ,,	±3°.
Repeater ,, ,, ,,	±3°.

Aerial equipment: Elevated-H system combined with quarter-wave sense aerial.

Power supply: 100–255 V, 50 c/s single-phase AC mains.

Approximate overall dimensions and weights:

Height	Width	Depth	Weight
Aerial Equipment (mast, structure and head)			
32 ft (9·75 m)	—	—	6½ cwt (330 kg)
Local Equipment Console			
4 ft 1 in. (127 cm)	1 ft. 11 in. (59 cm)	3 ft 4 in. (102 cm)	4 cwt (200 kg)
Remote Console			
4 ft 1 in. (127 cm)	1 ft 11 in. (59 cm)	3 ft 4 in. (102 cm)	3 cwt (155 kg)
Repeater Unit			
1 ft 6 in. (46 cm)	1 ft 10 in. (56 cm)	9 in. (23 cm)	20 lb (9 kg)

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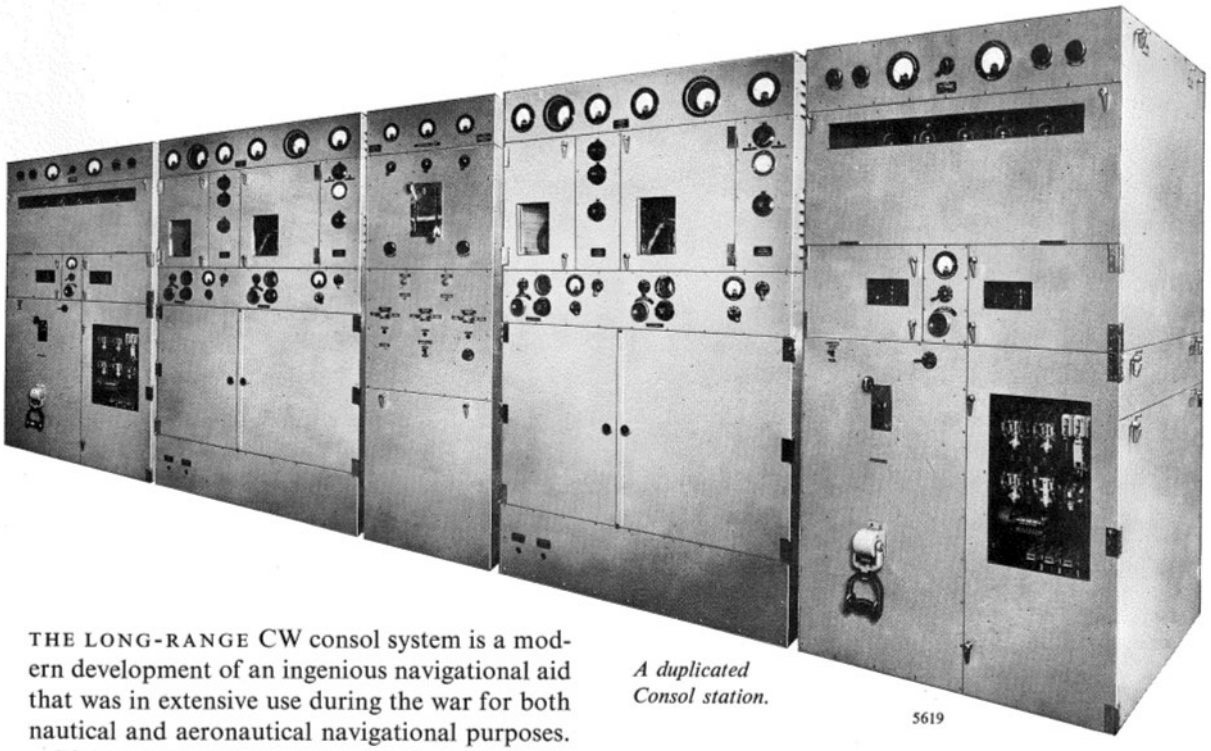
Telephone: Chelmsford 3221. Telegraphic Address: Expanse, Chelmsford

Consol Navigational Aid



A duplicated Consol station.

5619

THE LONG-RANGE CW consol system is a modern development of an ingenious navigational aid that was in extensive use during the war for both nautical and aeronautical navigational purposes.

The system enables accurate bearings to be obtained by a simple method of counting a number of characters and referring to tables or a chart overprinted with great circle bearings with the consol station as origin. An accurate 'fix' is readily obtainable from two suitably placed consol stations. The consol signals can be received on a normal medium-frequency communications receiver.

TECHNIQUE

At a consol station, an automatic medium-frequency transmitter, with special keying and phasing circuits, is arranged to energise an aerial array of three mast radiators which are erected in line. A multi-lobe radiation pattern is produced and the alternate lobes or sectors are characterised by dots and dashes. These are interlocked so that they merge into a continuous tone on the boundary line between two sectors.

The radiated pattern is rotated slowly and the equi-signal between dot and dash sectors moves through one sector's width during the course cycle.

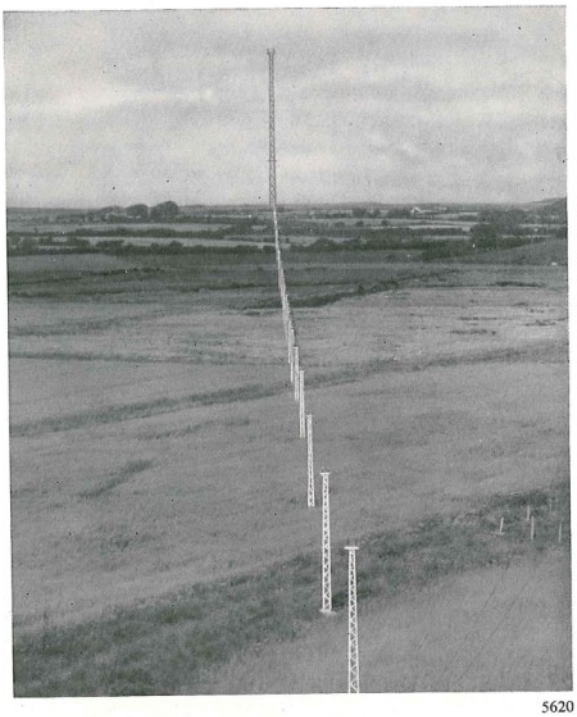
A navigator listening to these signals will first hear the station identification signal followed by a two-second break. Subsequently he will hear a

number of dashes (or dots) followed, due to the rotation of the polar pattern, by a continuous tone of brief duration and a number of dots (or dashes). The bearing of the equi-signal course at the start of a cycle is known and, by counting the number of dots or dashes before the continuous tone is heard, an accurate bearing of the station can be computed.

The cycle, including a period for repetition of the station call sign, takes 40 seconds to complete and the sector width is usually between 10° and 15°.

Any ambiguity that exists, due to several sectors with identical polar patterns, is resolved in practice by an approximate knowledge of the position, obtained by dead reckoning. Positive sector identification can be provided by additional apparatus and aerials at the transmitting station if specially required, although this provision has not been found necessary in practice so far.

Extensive consol networks exist already from stations at Bushmills and Stavanger and at Lugo and Seville. A further station has recently been completed at Ploneis and is equipped with the latest Marconi duplicated installation (as illustrated).



5620

View showing part of the feeder system and one of the 325 ft masts installed by the Marconi Company for the Consol station in Northern Ireland.

DATA SUMMARY

Frequency: Any selected frequency between 255–415 kc/s.

Range: Up to 1500 miles over sea during normal working conditions in temperate latitudes.

Accuracy: Bearing accuracies to $\frac{1}{4}°$ or $\frac{1}{2}°$ are obtainable under normal conditions during daylight. At night, in a zone over 350 and under 500 miles from the station, where the reflected component is comparable with the ground ray, errors of up to 2° may be expected.

Features: Bearings easily and rapidly obtained—the operation of counting the characters and referring to the chart takes less than one minute.

No special apparatus required at receiving end. Remotely-controlled monitoring of transmission.

Marconi

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED

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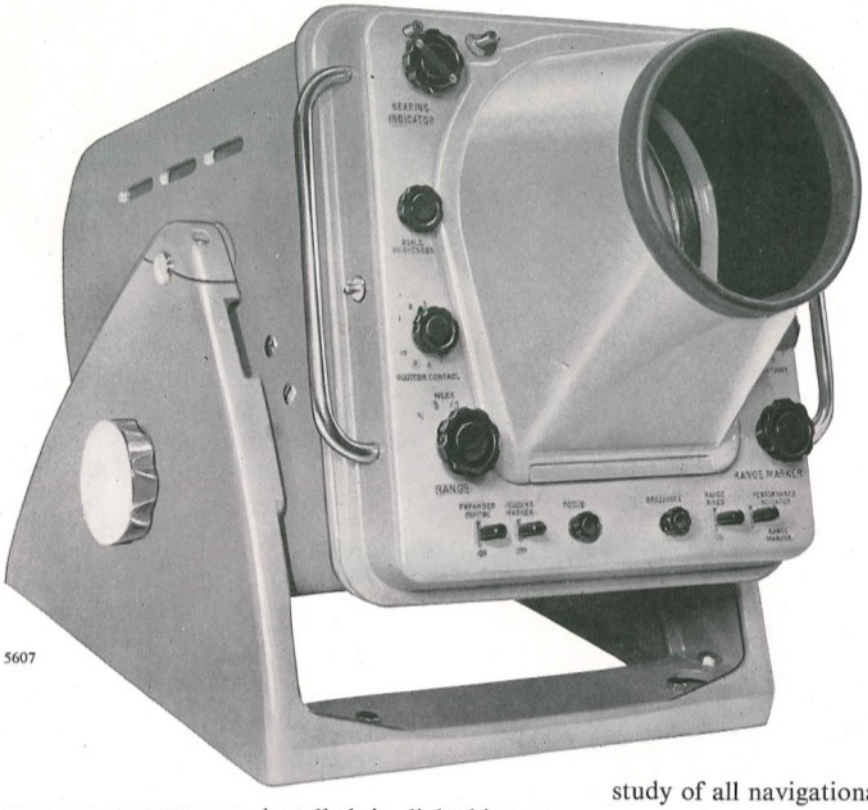
Telephone: Chelmsford 3221. Telegraphic Address: Expanse, Chelmsford

Coastal and Harbour Radar Equipment *Type RR 502* 'Radiolocator IV'



5607

RADAR EQUIPMENT installed in lightships or coast-guard stations enables a strict watch to be kept on shipping in dangerous or restricted waters under all weather conditions and during the hours of darkness.

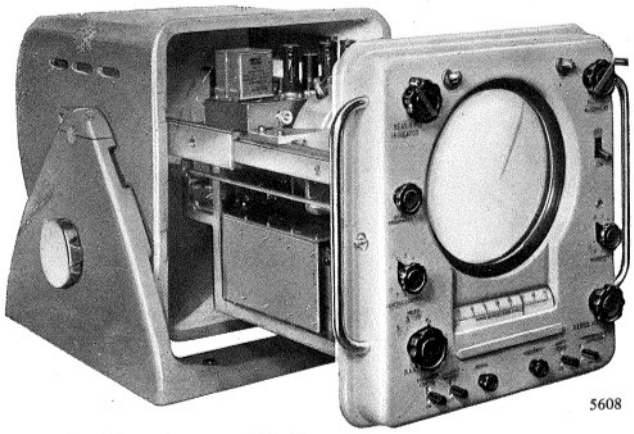
Shore-based radar provides harbour authorities with an accurate and detailed picture of the position and movement of all shipping within the area under their control, thus doing much to reduce delays and hazards due to fog, and assisting materially in the efficient organisation of the port.

The Type RR 502 'Radiolocator' is one of the latest Marconi products, designed after extensive study of all navigational problems, to provide in one equipment, and at a moderate price, facilities to meet all known requirements in these fields of application including remote presentation.

FEATURES

DISPLAY UNIT

Compactly housed in strong light alloy cabinet.
Trunnion mounting with adjustable viewing angle.
Single control for choice of 1, 3, 10, or 40 mile range.
Range scale as well as screen is visible with visor attached, so that target and distance are seen simultaneously.



Display unit opened for inspection.

Simplified controls for rapid, easy operation.
A remote display unit may be fitted.
Facilities for heading marker and/or coupling of gyro compass repeaters.
Display on 9 in. diameter PPI.

AERIAL SCANNER

Scan rate arranged for optimum 'painting' of targets.
Built-in performance indicator, for uniform checking in all installations regardless of structural differences, reduces cost and simplifies fitting.
Can be fitted on elevated mounting if required.
Positive drive of magslip from scanner motor; drift-free alignment of PPI display.
Built-in de-icing apparatus is provided, and may be switched on when necessary.

TRANSMITTER UNIT

Automatic change of pulse length for short and long ranges means higher discrimination and clearer painting of targets.
Automatic frequency control prevents any variation in performance due to frequency drift.
Built-in waveform monitor and comprehensive feed and voltage metering facilities.
Special ventilating and automatic heating system ensures consistent operating temperatures under all climatic conditions.
All units fully accessible from front, so that cabinet may be fitted in narrow space.

GENERAL

Cabinet construction of non-magnetic materials permits installation close to compasses.
Units provided with anti-vibration mountings.
A minimum number of valves employed.
Units easily withdrawn for inspection.
In operation one minute from switching on.

DATA SUMMARY

Frequency band: 9360–9460 Mc/s.

Pulse repetition frequency: 2000 and 750 c/s.

Pulse lengths:
0·2 μs ranges 1 and 2.
1·0 μs ranges 3 and 4.

Beam width: $\pm 1°$ with loss of 6 db.

Ranges: 1, 3, 10 or 40 miles, with a minimum of 30 yards.

Range accuracy: $\pm 2\frac{1}{2}\%$ of the max. range in use.

Bearing accuracy: Within one degree for objects at the max. range of the scale in use.

Peak output power: 60 kW.

Power supply: Motor alternator suitable for operation from AC or DC mains.

Dimensions:

Height	Width	Depth	Weight
Local display unit			
18 in. (46 cm)	19½ in. (49 cm)	31 in. (78 cm)	145 lb (65 kg)
Remote display unit			
18 in. (46 cm)	19½ in. (49 cm)	31 in. (78 cm)	140 lb (63·6 kg)
Transmitter unit			
52 in. (132 cm)	19¾ in. (50 cm)	28 in. (71 cm)	500 lb (227 kg)
Aerial scanner			
27¾ in. (70 cm)	64 in. dia. (163 cm)	26½ in. (67 cm)	255 lb (161 kg)

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