MARCONI

AIRCRAFT RADIO EQUIPMENT

AUTOMATIC DIRECTION FINDER

Type AD.7092

DESCRIPTION, OPERATING
AND SERVICING INSTRUCTIONS
Ref. No. T.2067

Marconi

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED

Head Office: Marconi House, Chelmsford · Telephone: Chelmsford 3221 · Telegraphic Address: Expanse, Chelmsford

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Codes:
Marconi, Western Union, Bentley's, A.B.C. 5th & 6th Editions

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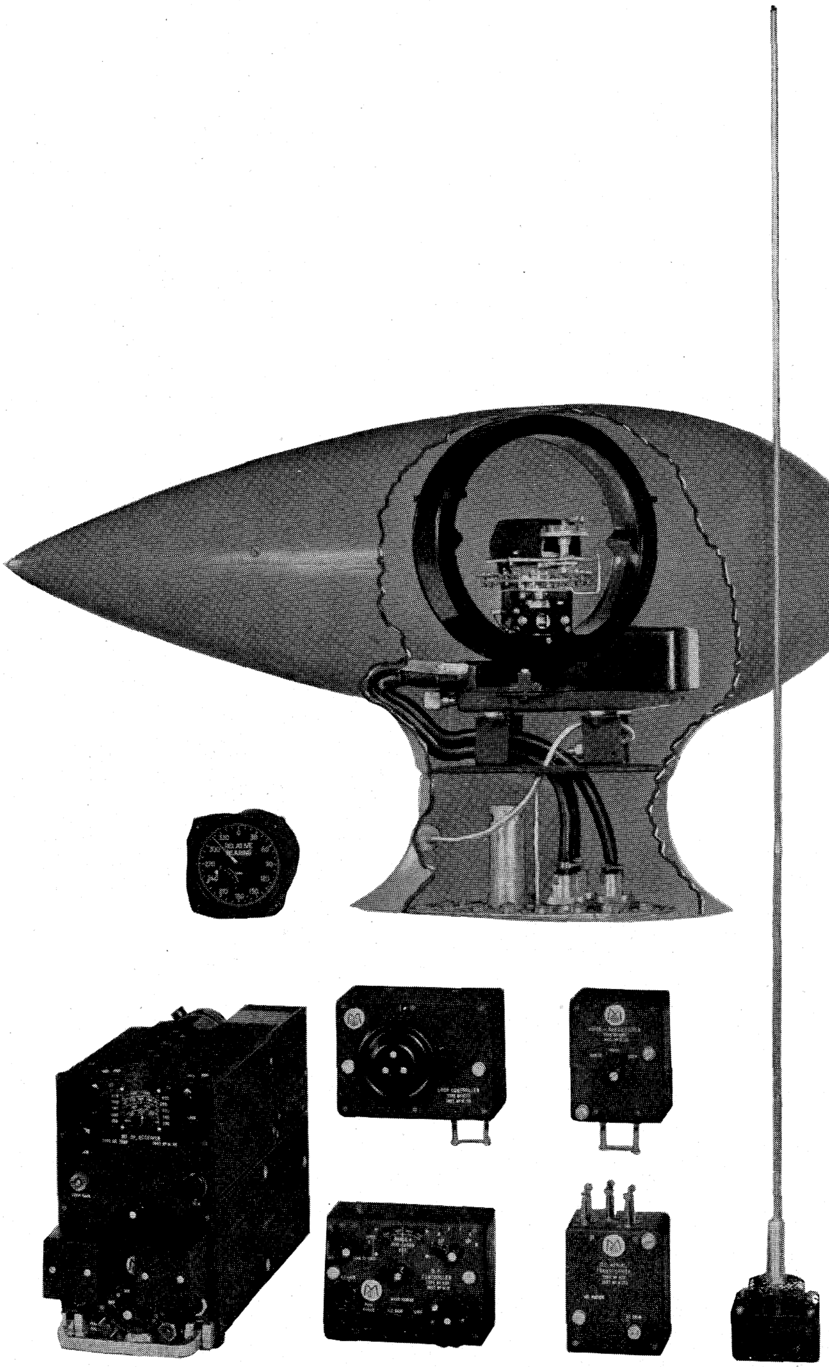

MARCONI AUTOMATIC DIRECTION FINDER TYPE AD.7092
WITH REMOTE CONTROL UNITS

5057

ERRATA

Page	Section	
9	7.1.11	*Delete* "200-580 kc/s" *and insert* "300-580 kc/s."
16	8.8 (c)	*Delete* "Fig. 5," *insert* "Fig. 3."
18	9.2 (a)	*Delete* "about the middle of range 3," *and insert* "at about 1,000 kc/s (range 3)."
	9.3 (d)	*For* "in that it should be" *read* "in that cancellation should be."
20	9.4.3	*For* "electrical curve line," *read* "electrical centre line."
24	9.5	Note regarding night effect should be at the end of this section.
28	11.2	*For* "recommened" *read* "recommended."
38	12.7.6	*Delete this section.*
39	12.7.8	50µF *should read* 50µV.
47	14	Item 752 *should have spare part* ref. "XS.362." ,, 753 ,, ,, ,, ,, ,, "XS.363." ,, 754 ,, ,, ,, ,, ,, "XS.389." ,, 771. *Delete remarks and insert* "For crystal X.1."
59	Fig. 23	"R.107" *should read* "C.107," which should be connected to the cathode of V.16 and not to junction of anode and screen as shown. C.108 should be connected to anode of V.16 and not to cathode as shown.
	Fig. 24	Bearing indicator should have star connections and not delta as shown.
61	Fig. 25	Connection from C.85 to L.26 pin 1 should be to L.26 pin 3.
67	Fig. 31	R.2 connected between C.2 and pin 1 of T.1 should be connected between pins 3 and 4 of T.1. The connection from C.2 to pin 2 of T.1 should be connected to pin 1 of T.1.

MARCONI AIRCRAFT RADIO EQUIPMENT

AUTOMATIC DIRECTION FINDER

TYPE AD.7092

1 INTRODUCTION

The Marconi Receiver, Type AD. 7092 and ancillaries, constitute a complete airborne automatic direction finder, providing the following facilities :—

Automatic relative bearing indication of the source of radio signals, by panel mounted visual indicator, and simultaneous uninterrupted aural reception of modulated or unmodulated signals.

Aural relative bearing determination by normal null signal method, with either remote or direct manual control of the loop.

Aural reception of modulated or unmodulated radio signals, by the use of either a loop or a non-directional whip aerial, the former being sometimes desirable in order to eliminate the effects of precipitation interference.

Radio range reception, with simultaneous " voice " on all the above functions.

The apparatus conforms to the British Standard Specifications for instrument sizes and finishes, and methods of installation in aircraft. Provision is made for either local or full remote control.

The equipment is intended for use in aircraft where the radio station is supplied from a voltage regulator unit giving 19 ($\pm$ 1) volts DC. In the case of aircraft not so fitted, a voltage regulator unit may be supplied for use with the apparatus (see Marconi's Wireless Telegraph Co's Technical Handbook, Ref. T.2009 Voltage Regulator Units).

2 ALTERNATIVE INSTALLATIONS

Installations may be varied to suit the requirements of airline operators, and to provide for all sizes and types of aircraft.

The basic " radio compass," comprises the following units :—

Receiver, Type AD.7092

Loop Aerial, Type 1264

Whip Aerial, Type 137

Aerial Matching Transformer, Type 922

Bearing Indicator, Type 1272

In addition to the equipment listed above the following units may also be supplied if required :—

Receiver Remote Controller, Type 933, with two Type 1263 Controller Switch Drives.

Loop Remote Controller, Type 1273.

Voice/Range Filter, Type 949.

3 TECHNICAL DATA SUMMARY

Frequency Coverage :	150 kc/s—2 Mc/s (4 ranges).
Bearing Presentation :	Visual, on panel mounting azimuth indicator, or aural.
Aerial System :	Motor driven loop with streamlined housing, or without the housing for installation within a canopy. Whip aerial with matching unit.
Error Correction :	Automatically applied quadrantal error correction.
Output :	225 mW into 3 pairs of 150-ohm impedance telephones (as specified by RCEEA).
Sensitivity :	*ADF :* 50 μV/M for $\pm$ 2° bearing accuracy. *Communication :* Fixed Aerial. 10 μV for 10 db S/N on MCW (30% Mod. at 1000 c/s). 1 μV for 10 db S/N on CW (400 c/s bandwidth).
Selectivity :	Adjacent Channel (3 bands). (1) 5 kc/s at 6 db attenuation. (2) 1.5 kc/s at 6 db attenuation. (3) 400 c/s at 6 db attenuation. (crystal). Second Channel, better than 45 db up to 1.5 Mc/s.
A.G.C.	Less than 6 db variation with inputs from 50 μV to 500 mV.
Supply Voltages :	28 Volts DC nominal supply for self-contained HT power unit. 19 ($\pm$ 1) volts DC regulated supply for valve heaters.
Power Consumption :	Total power input : 80 watts.

4 NOMINAL WEIGHTS AND DIMENSIONS OF UNITS

Description	*Height*	*Width*	*Depth*	*Weight*
Receiver, Type 7092	8 in (20.3 cm)	5 in (12.7 cm)	$12\frac{1}{2}$ in (31.7 cm)	15 lb (6.8 kg)
Receiver Controller, Type 933	$3\frac{3}{4}$ in (9.5 cm)	5 in (12.7 cm)	2 in (5.07 cm)	$1\frac{1}{2}$ lb (0.68 kg)
Loop Controller, Type 1273	$3\frac{3}{4}$ in (9.5 cm)	5 in (12.7 cm)	2 in (5.07 cm)	$1\frac{1}{4}$ lb (0.57 kg)
V/R Filter, Type 949	$3\frac{3}{4}$ in (9.5 cm)	3 in (7.6 cm)	2 in (5.07 cm)	$\frac{3}{4}$ lb (0.34 kg)
Aerial Matching Transformer, Type 922	$3\frac{3}{4}$ in (9.5 cm)	3 in (7.6 cm)	2 in (5.07 cm)	$\frac{1}{2}$ lb (0.23 kg)
Controller Switch Drive Type 1263 (2 required)	$1\frac{3}{4}$ in (4.4 cm)	$1\frac{3}{4}$ in (4.4 cm)	2 in (5.07 cm)	1 lb (0.46 kg) (Weight of 2 units)
Loop 8 in. (20.3 cm) diam.	—	—	—	$3\frac{7}{8}$ lb (1.75 kg)
Loop covers, perspex (2 required)	—	—	—	$\frac{1}{2}$ lb (0.23 kg) (Weight of 2 Covers)
Loop Housing complete (streamlined)	$13\frac{1}{2}$ in (34.3 cm)	10 in (25.4 cm)	$27\frac{1}{2}$ in (69.8 cm)	$12\frac{1}{4}$ lb (5.56 kg)
Whip Aerial	3 ft 2 in (96.5 cm)	—	—	1 lb (0.45 kg)
Bearing Indicator $3\frac{1}{8}$ in. (7.9 cm) or $5\frac{1}{4}$ in. (13.3 cm) diam.	—	—	3 in (7.6 cm)	1 lb (0.45 kg)

5 GENERAL DESCRIPTION

5.1 Receiver, Type AD.7092

The receiver case consists of two elongated compartments, mounted one above the other accommodating the basic superheterodyne receiver, and the DF circuits. To the rear of the upper compartment, and external to the receiver, the HT power unit and vibrator assembly are mounted. All controls and fuses are on the front panel of the unit.

Cable connections to the receiver are by plug and socket at the rear of the instrument. The cable connector sockets are secured to the back plate on the standard aircraft radio mounting framework, and make contact with plug connectors on the receiver when the instrument is correctly positioned in the rack.

The internal layout of the receiver and circuit references of components are shown in Figs. 7 to 16.

5.2 Automatic DF Loop, Type 1264.

The loop is a six turn coil, wound on an 8 in. diameter bakelite moulding, electrostatically shielded. Free rotation is provided by ball bearings at the base, electrical connection being by means of silver morganite brushes on the loop and silver plated slip rings on a central tube attached to the base plate. (See Fig, 17).

The central tube is extended towards the loop centre and forms a base on which is mounted the " Desynn " potentiometer for bearing transmission to the panel mounted indicator. Inherent and quadrantal error correction devices form part of this control loop assembly and are arranged to advance or retard the potentiometer sliders to provide the necessary corrections, connections being brought down the central tube to the base of the assembly.

A small two-phase motor located on the baseplate drives the loop through a 100 : 1 reduction gear. The motor transformer is mounted beside it, a bakelite cover being provided to protect the components from dust and damage.

Plugs and sockets at the base of the loop assembly are for cable connection, a hinged arm being provided as a safety device, to lock the connectors in position.

For installation of the loop assembly on the aircraft, a special mounting plate Type 1278 is supplied. This is atttached to the streamlined housing or fuselage, the loop assembly being secured to it by means of a " slide-lock " arrangement and a knurled nut.

5.3 Streamlined Housing, Type 1268.

The loop housing has been designed for use on all types of aircraft including those with pressurized cabins for high altitude flying. It consists of a bakelite moulding, divided horizontally, the two halves being held together by countersunk screws and anchor nuts. It is mounted on a 4 in. cast aluminium neck, bringing the loop centre to approximately 10½ in. above the aircraft skin.

A dehydrator unit is accommodated in the loop neck. It consists of a tubular aluminium container, small holes at the upper end permitting air flow between the container and the loop interior. A copper tube from the base connects with an opening to atmosphere in the neck casting. Fitted in the container is a small tube of silica gel which has been impregnated with cobalt chloride. In use the loop and neck are hermetically sealed by means of rubberized gaskets at the base and by a special sealing compound where the two halves of the loop are joined (see Section 8.7.1.). The only path for air into or out of the loop is then through the copper pipe and silica gel tube, water vapour being extracted by the absorptive action of the silica gel. The tube (usually referred to as a " Breather Unit "), is accessible from within the aircraft by means of a screw cap on the aluminium container, and after certain specified periods must be removed for the reactivation process (see Section 11.1).

Cobalt chloride serves as an indicator of moisture content. The silica gel is dark blue when dry but light blue or pink when sufficient moisture has been absorbed to render reactivation necessary. A toughened glass window at the end of the tube is provided to enable the colour of the contents to be observed.

5.4 Whip Aerial, Type 137 and Transformer Unit, Type 922.

A standard Air Ministry type of whip aerial is used, but modified by the attachment of a small strengthening collar at the base. The transformer unit serves the dual purpose of accurately matching the whip aerial to the input circuits of the receiver and also, if required, serving as a junction box for the whip aerial input to the Beam-approach Receiver. With this arrangement the same aerial may be used for both receivers.

The components of the transformer unit are built into a small case with a detachable cover at the rear, all connections being by means of plugs and sockets at the top. (See Fig. 19). Adjustment of the matching switch S.1 and the trimmer C.1 are by screwdriver slots in the front of the unit.

5.5 Bearing Indicator Type 1272.

A $3\frac{1}{8}$ in. panel mounted instrument, the Type 1272 Bearing Indicator contains two separate movements providing both relative bearing and tuning indication. The relative bearing indicator has a " Desynn " movement and indicates the angular position of the sliders in the loop transmitter potentiometer and gives the relative bearing of the radio station when the loop is at the true null. The scale is graduated every two degrees.

The tuning indicator is a 500 microamp FSD moving-coil meter. It provides in addition to its function as a tuning indicator, a means of accurately matching the inputs from the whip and loop aerials and also gives an indication of proximity to the radio station. A graduated scale is provided for reference purposes.

5.6 Receiver Remote Controller, Type 933.

The remote controller contains all the controls for receiver operation. An illuminated tuning scale is included, tuning being by means of a cranked handle which operates the receiver condensers through a flexible mechanical drive. The drive cable is attached to the receiver backplate and the remote control unit by knurled nuts and self aligning coupling devices. The remaining controls are all electrical, cable connections being by means of plugs and sockets at the base of the unit. (Fig. 20).

5.7 Controller Switch Drive, Type 1263.

When remote operation of the receiver is required, it is necessary to exchange the manual controls on the rotary switches for frequency and system selection by suitable drive motors which can be operated from the remote-control unit. (See Section 8.8.) The controller switch drive, Type 1263, has been designed for this purpose and is easily interchanged with the manual control knobs. The motor consists of a small electro-magnet with a vibrating armature coupled to a ratchet wheel to provide rotary motion (Fig. 32). Suitable components are included in the electrical circuit to provide adequate RF noise suppression. The unit is held in position by means of a spring clip device, silver-plated spring contacts make connection to the receiver. Incorporated in the design is a thermal cut-out, which prevents overheating of the motor should it be left in circuit through a defect. The cut-out operates at 100° C., and once tripped must be re-set by hand. The motor is protected by a cover, held in place by two screws.

5.8 Loop Controller, Type 1273.

For remote hand rotation of the loop a control unit is provided, consisting of a " Desynn " potentiometer transmitter housed in a small case. A large continuously rotatable control knob is provided. Cable connection is by means of a 6-way plug at the base.

5.9 Voice/Range Filter, Type 949.

Intended for use during radio range working, the voice/range filter is a small unit containing a 3-way switch, which in conjunction with suitable filter circuits enables either the voice or the range signal from a simultaneous radio range beacon to be received either separately or both together as required.

6 THEORY OF OPERATION

In the Type AD.7092 Automatic Direction Finder a motor-driven self-aligning loop is employed. The signal voltage picked up by the loop is combined with the output from a non-directional aerial and by means of the circuits described below initiates rotation of the motor to turn the loop to a position of zero signal.

Since the RF voltage picked up by the loop and whip aerials is quite unsuitable for direct operation of the loop motor, a means is provided for translating it into a low-frequency power source which reverses in phase with the loop RF phase as the loop passes through the null points. This is accomplished by reversing the loop output at 110 c/s so that its signal voltage adds to or subtracts from that of the whip aerial, producing 110 c/s modulation. As the loop rotates through the null positions the phase of the RF voltage changes 180° and consequently the phase of the 110 c/s modulation changes 180°. These modulated signals, when amplified provide the required power source for loop motor operation.

The various circuits involved may now be considered. Reference should be made to the simplified circuit diagrams (Figs. 23 and 24).

The loop input is coupled to the grid of V.1. This valve serves to isolate the loop from the balanced modulator circuits and provides some degree of signal amplification. The high anode feed resistance R.79 and stray capacities between anode and earth provide a 90° phase shift of the loop signal. This is necessary owing to the presence of a 90° phase difference between the output from the loop and from the non-directional aerial.

From the loop amplifier the RF voltage passes via a high pass filter, consisting of C.100, R.75 and C.101, to the grid of V.18 and by feed-back action, in opposite phase to the grid of V.17. These valves are made to conduct alternately by suppressor grid control applied by V.16, which in turn is operated by the 110 c/s supply from the vibrator. Thus, the RF current in the common anode circuit is reversed each half cycle of the vibrator frequency. This modulated current is fed via condenser C.62 to the coupling winding shown on L.5, where it is mixed with the input from the non-directional whip aerial.

A conventional superheterodyne circuit follows, with a crystal IF filter available for maximum selectivity. Detected signals are passed to an output stage for aural reception. A proportion of the receiver output is rectified separately and passed to a three-valve amplifier stage consisting of V.13, V.14 and V.15. Condensers C.48, C.50 and C.53 serve for phase shift and also constitute a low pass filter with sharp cut-off above 110 c/s. This prevents noise and modulation components of the received signal from blocking the grids and so hindering the amplification of the 110 c/s voltage. From the loop amplifier the 110 c/s AC output is passed to the two-phase loop motor. The other phase is obtained from the vibrator and is therefore in step with the input to the phase splitter valve V.16. A phase angle of 90° is required between the two phases of this type of motor, and this is provided for by means of the phase shift network mentioned above, in connection with the three-valve amplifier.

The overall gain of the loop motor amplifier circuits is such that the motor will exert its full torque when the loop is only three degrees off the true null. When the loop is further from the null the output to the loop motor is held constant by the limiting effect of valve saturation.

Remote indication of the angular position of the loop is provided by the " Desynn " repeater system, in which the potentiometer in the loop transmits the bearing to a panel mounted indicator. The principle of operation is as follows :—

In the centre of the loop a fixed circular resistance is mounted, this corresponds to the transmitter shown in Fig. 24. Two sliding contacts bear on the resistance at diametrically opposite points and these are attached to the loop so that movement of the loop alters the position of the sliders in relation to the resistance. Three equally-spaced tappings are taken from the transmitter resistance to the remote indicator, which consists of a two-pole permanent magnet rotor pivoted to rotate within a soft iron stator. The stator carries a star connected three phase distributed winding, and the ends of these windings are connected to the tappings on the resistance. The 24-volt supply is connected across the two wiping contacts on the resistance, and the direction and distribution of the currents in the remote indicator windings thus depends upon the position of the contacts on the resistance. The magnetic field produced in the remote indicator stator is in almost perfect synchronisation with the contacts throughout 360°, its direction being shown by the position taken up by the indicator needle on the rotor spindle.

7 CIRCUIT DESCRIPTION

7.1 Receiver Circuits

The basic receiver circuit is a standard superheterodyne with an IF of 110 kc/s. The circuit diagram of the receiver (Fig. 25) should be studied in conjunction with the description below.

The valves used and their funtions are as below :—

Valve	*Function*	*Type*
V.1	Loop Amplifier	CV.138
V.2	RF Amplifier	CV.131
V.3	Mixer	CV.131
V.4	Local Oscillator	CV.138
V.5	First IF Amplifier	CV.131
V.6	Beat Frequency Oscillator	CV.138
V.7	Second IF Amplifier	CV.131
V.8	Detector and Reverse Grid Current Suppressor	CV.140
V.9	ADF Rectifier and AGC Diode	CV.140
V.10	LF Amplifier	CV.131
V.11	Audio Output Valve	CV.138
V.12	Silicon Crystal Valve	CS2A
V.13	First Loop Motor Amplifier	CV.131
V.14	Second Loop Motor Amplifier	CV.131
V.15	Loop Motor Output Valve	CV.136
V.16	DF Switch Valve	CV.138
V.17	DF Modulator Valve	CV.138
V.18	DF Modulator Valve	CV.138

Note :—The radio-frequency circuits are provided with four sets of tuning inductances corresponding to the four ranges of the receiver. Frequency range selection is accomplished by operation of the frequency range control, the wafer switch sections bringing into circuit the selected inductances. The following circuit description applies when the frequency switch is on range 1, but is equally applicable to the three other ranges, if the appropriate circuit references are substituted.

7.1.1 Loop Amplifier.

The signal voltage picked up by the loop is fed through cable BC to the coupling winding on inductance L.1 which is tuned by the first section of the ganged tuning condenser C.23 and connected to the grid of the loop amplifier valve V.1 for amplification and 90° phase shift. The gain of this stage is controlled by varying the cathode bias of V.1 by means of R.76 (loop gain control), R.77 and R.78 providing the standing bias.

7.1.2 Balanced Modulator.

The balanced modulator acts as an electronic reversing switch and is controlled by V.16 which in turn is operated by a 110 c/s AC supply from pin 1 of the vibrator connecting plug. V.16 itself acts as a phase splitting device and applies equal and opposite 110 c/s control voltages to the suppressor of V.17 and V.18 via the condensers C.107 and C.108 respectively.

The signal RF voltage from the loop amplifier is passed to the grid of V.18 via the high pass filter consisting of C.100, R.75 and C.101. This serves to eliminate any LF interference picked up from the supply circuits which might otherwise cause errors in the system.

The grid of V.17 derives its RF voltage entirely from the common cathode impedance formed by R.71 and R.72. This voltage is 180° out of phase with that of V.18, consequently if both valves were allowed to be fully operative the RF anode current in V.17 would be very nearly equal and opposite to that of V.18. When however the anode current of either of the valves is cut off by a voltage supplied to its suppressor, the current in the other anode flows unopposed via C.62 to its coupling winding on L.5. Thus since the valves are alternately rendered conducting and non-conducting the RF current fed to the coupling winding is reversed without change of amplitude every half cycle of the vibrator frequency.

The feedback resistances R.71 and R.72 besides providing the required phase reversal, enable large differences in individual valve characteristics to be accommodated without appreciable effect on the balance of the currents. The resistances R.65 and R.67 serve to limit the suppressor grid current during the positive half cycles.

The signal input from the non-directional whip aerial is mixed with the output from the balanced modulator by means of a second coupling winding on L.5.

The above description applies only when the system switch is in the " Vis " position. In all other positions, i.e., " Omni," " Figure-of-eight," " Left Sense " or " Right Sense," the grid of V.16 is earthed by means of a relay RL.3. Control of the suppressor grids of V.17 and V.18 is then provided manually by means of the switch wafer S.11R, which connects either grid, or both, to earth.

7.1.3 RF Amplifier.

The whip aerial is connected via cable Z to the DF aerial transformer (see Section 7.5.2.) and from thence the signal voltage is passed by a cable (K) and relay R.L.2 to the coupling winding on L.5. The control relay R.L.2 operates when the system switch is moved to the " Figure-of-eight " position and serves to disconnect the aerial from the receiver, condenser C.24 being inserted in place of the aerial capacity. The second section of the ganged tuning condenser C.22 tunes L.5, which is connected to the grid of V.2. Inductances L.17 and L.18 in conjunction with C.28 in the anode circuit of this valve serve as an IF rejector to eliminate any tendency for IF break-through. The amplified signal voltage is passed through C.136 to a further tuned circuit consisting of L.9 and ganged condenser C.21, connected to the grid of the mixer valve V.3.

7.1.4 Local Oscillator and Mixer.

V.4 connected as a triode serves as a local oscillator, the grid being coupled by C.29 to the ganged condenser C.20 which tunes inductances L.13. A conventional cathode tapped oscillator circuit is used.

Mixing is accomplished by cathode injection, the oscillator voltage being fed to the cathode of V.3 via C.127.

7.1.5 IF Amplifier.

Two stages of valve amplification are used in the IF amplifier (V.5 and V.7). Selectivity is provided in the first place by the coupled tuned inductances L.19—L.22 ; L.23—L.24 and L.25—L.26. These circuits are mutually coupled in the first two cases by means of a small coupling winding connected in series with the primary tuning condenser and closely coupled to the secondary winding. Two degrees of selectivity are obtained by connecting this winding via either the whole or part of the primary tuning condenser. For very narrow bandwidth the circuits L.19 and L.22 are replaced by L.20 and L.21 which are coupled by means of a split electrode crystal X1. This type of crystal has the advantage over the more usual type in that it will operate in a circuit having one side earthed and does not require neutralizing.

L.25 and L.26 have a fixed degree of inductive coupling. L.25 carries additional windings for feeding the AGC diode in V.9, and the crystal rectifier valve in V.12 for feeding the signal strength meter.

Switch wafers S.7, S.8 and S.9 perform the necessary IF selectivity switch operations. The bandwidths provided are 5 kc/s, 1.5 kc/s and 400 c/s.

The receiver HF gain control varies the IF gain by operating in the cathode circuits of V.3, V.5 and V.7.

7.1.6 Audio Detector and Reverse Grid Current Suppressor.

Detection of the audio signals is provided by one diode of V.8, audio volts developed across R.28 are passed to the grid of V.10 via filter circuits C.64, R.30, C.63, R.31. The other diode in V.8 is connected across the AGC line and serves to by-pass any reverse grid current which may appear.

7.1.7 Beat Frequency Oscillator.

For the reception of keyed CW stations, the BFO valve V.6 is provided. This functions as an electron coupled oscillator, the main tuned circuit consisting of L.27 and C.32.

The condensers C.31 and C.32 form a grid capacity tap to increase the stability of oscillation. Tuning is performed by means of an adjustable core in L.27. Variation of frequency for heterodyne note control is provided by saturation of a mu-metal yoke which forms part of the magnetic circuit of L.27 and the necessary control of saturation is obtained by means of R.63, which is a 10,000—ohm potentiometer connected in series with R.14 and L.28 across the stabilized 19 volt supply, the resistance R.15 supplying a polarizing current through L.28, the amount of variation obtainable is about $\pm$ 1.5 kc/s. Injection of the heterodyne voltage into the audio detector diode of V.8 is provided by means of the small self capacity of the suppressor grid of V.6.

7.1.8 LF and Audio Output Stages.

A first stage of LF amplification is provided by the variable mu valve V.10. The audio volume control R.62 serves to control its gain by cathode bias variation. Some degree of LF AGC is obtained by means of R.103 which forms part of the audio detector load and is arranged to bias the grid of V.10. Condensers C.58 and C.59 provide coupling between the anode of V.10 and the grid of the output valve V.11. The use of two condensers in conjunction with a resistance R.36 is to ensure that no DC leakage occurs to the grid of V.11 which would otherwise cause grid blocking.

Negative feed back is provided by R.37 connected between the output transformer (T.1) secondary and the output grid.

7.1.9 AGC Diode and ADF Detector.

As described in Section 7.1.5 an additional coupling winding on the primary of the IF transformer L.25, L.26 is connected to one cathode of the double-diode valve V.9. This serves as the AGC diode. The potential divider R.26 and R.22 provides some 18 volts delay. Full AGC is applied to the HF (V.2) mixer (V.3) and 1st IF valve (V.5) via R.1, R.5 and R.10 respectively, and half AGC volts to the second IF stage (V.7) via R.19 in conjunction with R.102 and R.61.

The normal AGC time constant is approximately half a second, but when the ADF is used for radio range working a greatly increased time constant is required. This is obtained by operation of the " pull-range " switch S.13, which closes relay R.L.1 and connects condenser C.73 across the AGC line and earth. The effect is to alter the AGC time constant to approximately 10 seconds.

The other pair of electrodes in valve V.9 are used to provide signal voltage rectification for feeding the loop motor amplifier circuits. A proportion of the voltage developed at the anode of V.7 is passed through C.99 to the diode, the cathode being earthed. The rectified voltage is fed to the grid of V.13 via RF filter circuits and the control relay RL.3. This relay in addition to the function described in section 7.1.2. also serves to disconnect the rectifier from the loop motor amplifier circuits, when the system switch is in the " Omni," " Figure of-eight " or " Sense " positions.

7.1.10 Loop Motor Amplifier.

A first stage of LF amplification for loop motor operation is obtained by V.13. A high degree of smoothing and filtering is incorporated in these circuits to eliminate any unwanted frequencies which might otherwise interfere with the operation of the system. Condensers C.48 and C.50 serve for frequency discrimination and produce a 90° phase shift of the 110 c/s voltage. Coupling between the anode of V.13 and the grid of V.14 is provided by C.51 and C.52 in conjunction with R.51 to obviate DC leakage.

The second stage of amplification is provided by V.14, with a similar circuit to that of V.13 and the 110 c/s voltage is fed from the anode to the grid of the loop motor amplifier output valve V.15. The anode of this valve and the screen grid are connected to HT positive via cable AJ (pins 4 and 7 respectively) and connections in the loop. The HT supply is taken to the loop via pin 3 of cable AJ and reaches pin 4 (anode) via the loop motor transformer (see Fig. 26). The HT path to the screen grid of V.15 via the loop is provided so that disconnection of the loop will break both anode and screen circuits simultaneously and thus prevent damage to the valve.

7.1.11 Switch Operation.

The functions of the various switches used to operate the receiver are summarised below.

(*a*) **Frequency Range Switch**

The frequency range switch consisting of wafers S.1, S.2, S.3, S.4 and S.5 selects the four sets of RF inductances providing the following ranges.

Range 1	150—300 kc/s
Range 2	~~200—580~~ kc/s 300 - 580 kc
Range 3	580—1100 kc/s
Range 4	1100—2000 kc/s

(*b*) **System Switch**

The system switch uses wafers S.10 and S.11. It has six positions as follows :—

Off, Omni, Visual, Figure-of-eight, Left Sense, Right Sense.

The various circuit changes effected by operation of the switch are described below.

Position 1 (" *Off* "). Relay RL.4 open and power supply disconnected from receiver.

Position 2 (" *Omni* "). In this and the remaining five positions, relay RL.4 is closed and the receiver is in operation. The balanced modulator valve suppressors are biased to beyond cut off (switch wafer S.11.R) and the DF switch valve grid is earthed (switch wafer S.10.R and relay RL.3). In this position the vertical aerial is connected and both HF and LF gain controls are operative. By virtue of the fact that RL.3 is closed, the loop controller, if fitted, is operative, though it is not of course required.

Position 3 (" *Visual* "). In this position DF is fully automatic. The modulator valves and both gain controls are operative.

Position 4 (" *Figure-of-eight* "). The suppressor grid of V.17 is earthed (switch wafer S.11.R) and the DF switch valve V.16 grid is earthed (switch wafer S.10.R and relay RL.3). The grid of V.13 is connected via pin 1 of cable AJ to the loop controller which provides an artificial 110 c/s signal to operate the loop motor. The vertical aerial is disconnected (switch wafer S.11.R and relay RL.2) and the whip aerial capacity is replaced by condenser C.75 (470 $\mu\mu$f). The LF gain control is short-circuited (switch wafers S.11.F and S.11.R), and the HF gain control only is operative.

Position 5 (" *Left Sense* "). As for position 4 but with whip aerial connected in circuit via RL.2 released by switch wafer S.11.R.

Position 6 (" *Right Sense* "). As for position 5 but with suppressor grid of V.18 earthed instead of V.17. (Switch wafer S.11.R).

(*c*) **R/T. C.W. Selectivity Switch.**

This switch consists of wafers S.6, S.7, S.8 and S.9 and has the following positions :—

Position 1	R/T	5.0 kc/s	I.F.	bandwidth
Position 2	R/T	1.5 kc/s	„	„
Position 3	R/T	0.4 kc/s	„	„
Position 4	C.W.	0.4 kc/s	„	„
Position 5	C.W.	1.5 kc/s	„	„
Position 6	C.W.	5.0 kc/s	„	„

Radio Range Switch.

The Radio Range Switch S.13 controls relay RL.1 which connects on 8 mfd. condenser across the AGC circuits and increases the time constant to 10 seconds.

Light switch

The Light Switch S.12 connects a dial lamp Lp. 1 to the 28 volt D.C. supply.

7.1.12 Vibrator Unit.

The 28V DC supply is fed to the vibrator unit via pin 6 on the connecting plug, and is passed via the filter choke CH.5 to the resistance R.88. The vibrator is designed for an input of 12—14 volts, and this resistance provides the necessary voltage drop. The supply then passes to the vibrator coil (Vb.1) and from thence via the driving contacts to earth. The combination C.26, C.27 and R.89 serves to prevent undue sparking at the contacts. Immediately after they open, contact 1 earths the supply end of the driving coil. On the return, contact 1 opens and the 10 μF condenser C.26 together with the choking effect of the vibrator coil, prevents any appreciable voltage rise on the driving contacts before they close.

The earthed moving vibrator contact (5) oscillates between contacts 4 and 6 which are connected to each end of the transformer (T.2) primary respectively. The centre tap of this winding is connected to the 28V DC supply and the effect is to cause a reversal of the current and the resulting flux in the transformer at the frequency of the vibrator (110 c/s). C.131 and C.130 in conjunction with R.104 serve as a buffer circuit on the primary T.2. Smoothing and noise filtering is provided on the transformer secondary by CH.4, C.91, C.90 and CH.5, C.88 and C.87. The 110 c/s output with 28 volts DC superimposed is taken via pin 4 on the connector plug to pin 8 on cable AJ for connection to the loop motor terminals.

The HT supply is connected to pin 3 of the connector plug, and is taken to a filter circuit, then via vibrator contact 4 and the moving contact 5 to earth. The 110 c/s voltage variation at the junction of R.101 and R.87 is passed through the condenser C.109 and a noise filter, to pin 1 on the connector plug and from thence to the grid of the switch valve V.16.

7.1.13 Power Supplies.

The power supplies of 19 volts DC (regulated) and 28 volts DC (nominal battery voltage) are connected to the receiver via pins 3 and 4 of plug M respectively. The 19-volt supply is fused at 4 amps (F.2) and the 28 volts supply at 10 amps (F.1). Both supplies are controlled by relay RL.4 which is operated by switch wafer S.10 on the system switch spindle. The 19-volt supply is used for valve heating, for operation of the on/off Relay RL.4 and the radio-range relay RL.1. The 28-volt supply operates the manual/auto relay RL.3, the vertical aerial relay RL.2, the vibrator unit for AC supply, and the rotary transformer for HT supply. Suitable HF filtering is provided in the primary and secondary circuits of the rotary transformer. The nominal output of this machine is 250 volts DC, and it is fused for 150 mA (F.3).

7.2 Remote Controller Circuits.

Full remote operation of the receiver is provided by remote controller, Type 933. All controls on the front panel of the receiver are duplicated on the remote controller, and the methods by which these various controls perform their allotted functions are detailed below. Reference should be made to the circuit diagram of the receiver and remote controller (Figs. 25 and 28).

7.2.1 Switches.

As described below in Section 8.8, the system switch on the main instrument is locked in the " off " position when the receiver is fitted for remote control. In this position all switch contacts on wafers S.10 and S.11 are " open circuit," thus isolating the local controls. Referring to the receiver circuit diagram Fig. 25, it will be seen that all circuits in which the respective switch wafers operate are also connected to pins on plugs P and Q which connect the receiver to the remote controller. In this unit two sides of a single wafer switch (S1 in Fig. 28) perform the same functions as the now disconnected switch wafers in the receiver.

In the case of the switches for frequency range and RT/CW bandwidth selection, these functions are still performed by the switches in the main instrument, but operated by small drive motors, each controlled by means of an identically marked selector switch (S.2 and S.3) in the remote controller. The circuit and operation of the motors is described fully in Section 7.5.1.

The radio range and light switches are simply connected in place of the corresponding switches in the receiver, via cable Q.

7.2.2 Control Potentiometers.

The HF and LF gain controls and the " het." control potentiometers are identical to their counterparts in the main instrument. Control of the receiver circuits is effected via cable Q in conjunction with the system switch S.1.

7.2.3 Tuning Control

For remote tuning of the receiver a mechanical drive cable is used, the slow motion tuning scale in the main instrument being duplicated in the controller.

7.3 Loop Circuits.

The loop is connected via cable BC to the receiver RF stages, and the loop motor circuits are connected to the receiver via cable AJ. One winding of the motor connects to the vibrator unit, and the other winding connects to the secondary of a transformer T1 (Fig. 26) mounted on the loop. The primary of this transformer is connected through plug AJ (pins 4 and 3) to the anode circuit of the loop motor amplifier output valve (see Section 7.1.10). Condenser C.1 on the primary winding serves to improve the power factor of the 110 c/s output from the receiver.

As previously described in Section 7.1.12, the supply to the loop motor circuits is 110 c/s AC with 28 volts DC superimposed. The DC voltage does not enter the motor circuits but is used to operate the " Desynn " repeater system, which provides remote indication of the loop position. Connection is made to the potentiometer slider, and the three tappings from the potentiometer are taken through cable BA to the bearing indicator terminals A1, A2 and A3.

The output from the receiver IF stage to the signal strength indicator, is passed through cables AJ and BA, and is connected to terminal D2 on the indicator.

7.4 Loop Controller Circuits.

The " Desynn " potentiometer R.1 (Fig. 21) is connected in parallel with the main transmitter potentiometer in the loop, via cable AY. The 28-volt input to the loop " Desynn " transmitter is obtained via pin 8 (plug AJ) which connects to the loop motor windings, and therefore carries the 110 c/s AC voltage superimposed. This voltage is taken from the sliders of R.1 to the primary of transformer T.1 via the DC blocking condenser C.1. The resistance R.2 serves as a voltage limiter to prevent saturation of the transformer iron. The secondary of the transformer connects through the condenser C.2 via cables AY, BA and AJ to relay RL.3 in the receiver. When the receiver system switch is in any position other than the ADF position (" Vis "), this relay connects the 110 c/s voltage from the loop controller to the grid of the first valve (V.13) of the loop motor amplifier stage. This artificial " signal " causes the loop motor to turn and rotate the loop until the sliders in its transmitter potentiometer are electrically at right angles to the sliders (6 and 7) in the loop controller potentiometer (R.1). At this position no voltage appears across them and the loop motor stops. Movement of the remote controller knob will therefore result in a corresponding movement of the loop until the sliders in the two " Desynn " potentiometers are again at right angles.

7.5 Ancillaries.

7.5.1 Controller Switch Drive Circuits.

The method of operation of the Type 1263 Controller Switch Drive is shown in the functional diagrams (Figs. 1A and B). When the coil is energised it attracts a pivoted armature, the movement of which opens a pair of contacts in the coil circuit. Retractor springs then return the armature to its original position thus closing the coil circuit again. This cycle continues as long as the circuit is alive.

The oscillatory movement of the armature is converted into rotary motion by means of a pawl and ratchet wheel on one side of the magnet assembly.

In addition to its primary driving function the ratchet wheel also actuates a pair of contacts (referred to as " Off/Normal " in Fig. 1B) every 30° of rotation (every tenth tooth). This pair of contacts is in the motor circuit and is used in conjunction with an auxiliary wafer on the switch shaft to stop the motor at the selected position. The switch wafer has a number of contacts spaced 30°, or multiples of 30° apart, connected by control lines to the remote selector switch.

The operation of the complete remote control system is as follows :—

Assume that the selector knob is turned to position 4. The circuit is then completed and the motor begins to ratchet. As soon as three teeth are moved, the circuit is completed through the " off-normal" contacts, and the motor continues to run until the auxiliary switch wafer reaches position 4 and the " off-normal " contacts open.

RF noise suppression has been achieved by connecting the interrupter contacts between the two halves of the coil, and to earth through condensers C.1 and C.2. The voltage across each coil is limited by two wire-wound resistances R.1 and R.2. A thermal overload cut-out is incorporated in the motor. It consists of a bi-metal strip which is arranged to open the interrupter contacts when the temperature of the motor reaches 100°C. This condition may be reached if the motor is left in circuit or is unable to find a " home " position. To re-set the cut-out, the motor cover is removed, and the cut-out spring is lifted, until the bi-metal strip springs back into its normal position.

7.5.2 DF Aerial Transformer Circuits.

The circuit diagram of the DF aerial transformer is shown in Fig. 29. The whip aerial connects to plug Z and plug K connects the output to the receiver. A third plug AK is provided for connection to the Marconi Beam-approach Receiver, Type AD.86 (See Section 5.4).

The aerial connection from plug Z is taken to the junction of L.1 and C.5. The inductance L.1 presents a high impedance to the frequencies in use on the MBA receiver, and prevents loss of input to that instrument. C.5 serves to isolate the MBA circuits from the DF aerial circuits. Capacity matching of the whip aerial to the input circuit of the ADF receiver is provided by condensers C.2, C.3 and C.4, either of which may be selected by operation of the switch S.1. A fine adjustment of the capacity in circuit is provided by the variable air spaced condenser C.1.

7.5.3 Voice/Range Filter Circuits.

The voice/range filter operates in the receiver audio output. It contains LF filter circuits controlled by a three way switch S.1 (Fig. 3). In the first switch position (" Range") the tapped chokes CH.1, CH.2 and condensers C.3, C.4 form an acceptor circuit passing only the 1,000 c/s range signals.

When the switch is in the second positon (" Voice ") CH.3, C.3 and C.4 are connected to form a series circuit, CH.1, C.1, CH.2, C.2, become tapped parallel circuits, instead of series circuits, and the network becomes a rejector circuit. In this position the 1,000 c/s range signals are attenuated and the R/T signals are clearly audible.

In the third position of the switch (" Both ") the filter circuits are shorted out and the telephones are connected direct to the receiver output.

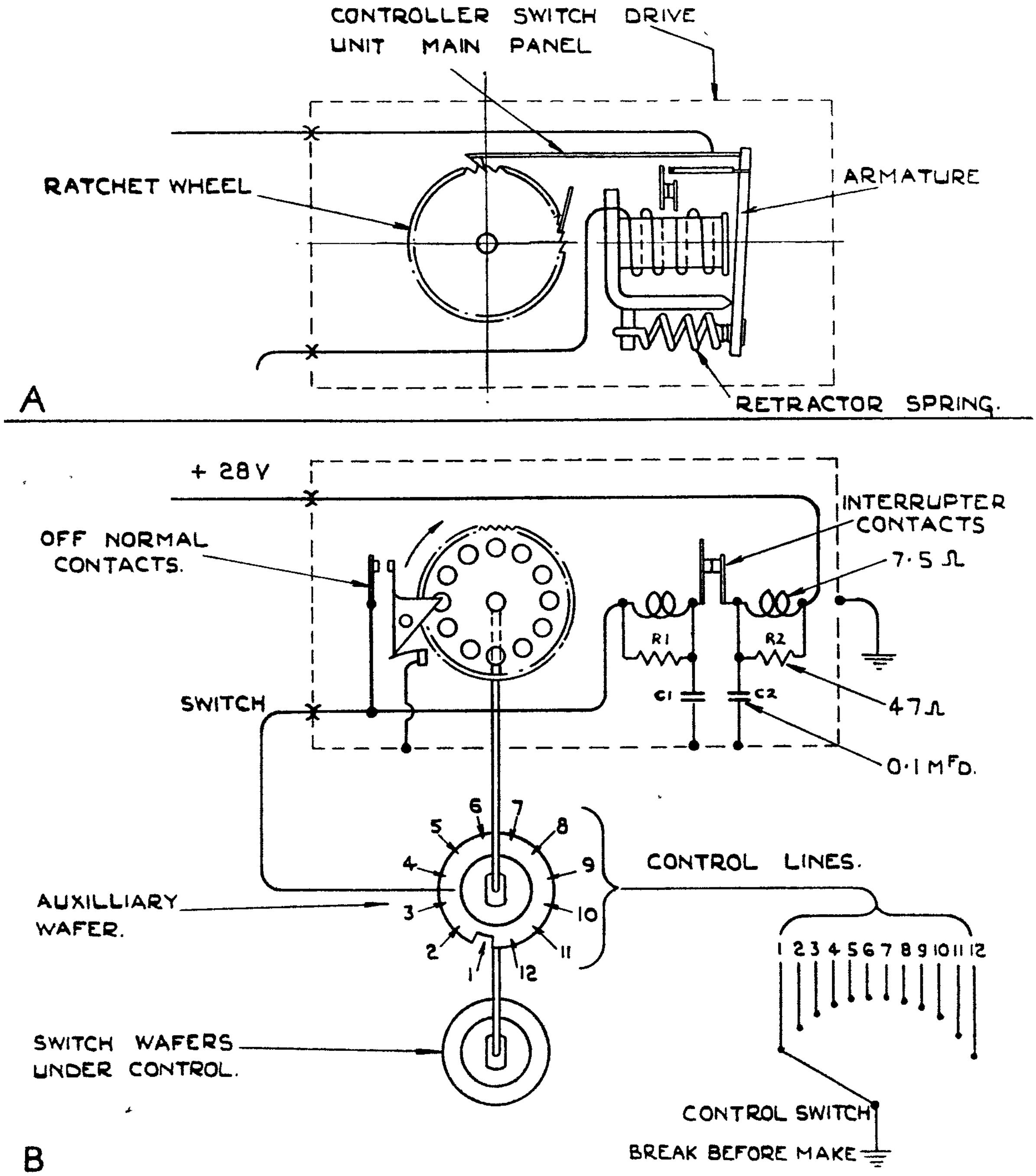

FIG. 1. CONTROLLER SWITCH DRIVE TYPE 1263.
FUNCTIONAL DIAGRAM.

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8 INSTALLATION

8.1 General Instructions.

It is emphasized that all installation work should be carried out or supervised by experienced aircraft contractors. This is to ensure that the airframe is not weakened in any way or the movement of flying controls impaired.

The aircraft electrical and ignition systems must be adequately bonded and shielded to ensure efficient operation of the equipment. Excessive local electrical interference will reduce receiver sensitivity and the accuracy of bearing indication.

8.2 Position of the Suspension Rack.

The positioning of the suspension rack will depend upon whether the receiver is to be locally or remotely controlled. A maximum distance of 30 ft. is permissible between the remote controller and the receiver. When positioning the suspension rack and the remote-control box it should be borne in mind that the fitting of right angle bevel drives to the mechanical drive cable should be avoided whenever possible.

A further restriction may be imposed by cables BC and K. The maximum allowable length for these are 20 ft. and 15 ft. respectively.

Sufficient space should be allowed above the suspension rack to permit free movement of the apparatus on the shock proof mounting. It is important that both suspended and fixed portions of the rack should be well bonded to the metal or main earth of the aircraft.

8.3 Positioning of Aerial Units.

8.3.1 Whip Aerial.

Whenever possible, the whip aerial should be mounted above the aircraft fuselage, but if it is necessary to instal the whip below the fuselage, adjustment of the DF circuits (Sections 9.2 and 9.3) will have to be performed in the air. This is owing to the shielding effect of the fuselage when the aircraft is on the ground. The whip should preferably be positioned at least six feet distant from other aerials or conductors. A maximum cable capacity of 300 pF is permissible between the whip aerial and receiver and this corresponds to 15 feet of uniradio 32 cable.

8.3.2 DF Aerial Transformer.

On aircraft in which the whip aerial serves for both DF and beam-approach reception, the DF aerial transformer should be mounted as close to the base of the whip as is conveniently possible. This instruction normally applies when ADF equipment only is fitted, but if pin 2 on the socket for cable Z is connected to earth, the DF aerial transformer may then be located at any convenient position between the aerial and the receiver. The overall cable length should not exceed 15 ft.

8.3.3 Loop Aerial.

The loop housing should be mounted above the aircraft, as close as possible to the fore and aft centre line of the fuselage and so far as is practicable from the nose or tail of the aircraft. Mounting of the loop below the fuselage is strongly deprecated as quadrantal errors are generally variable in this position and as in the case of the whip aerial, with the loop mounted in this position, it will be necessary to adjust the DF circuits, and to calibrate the loop, in the air.

It should be positioned as far as is practicable from the engines, metal masses, or conductors. The mounting should be so arranged that the loop will be level when the aircraft is in normal flight. Fig. 35 gives details of the base fixing centres. A rubberised gasket should be fitted between the base of the loop neck and the aircraft skin.

Where it is desired to instal the loop within the aircraft in a canopy, the streamlined housing is not required, but the above remarks regarding the positioning of the loop will still apply. The loop base plate should be mounted so that the plug and socket connectors are towards the rear of the aircraft.

A loop cable length of 20 ft. is standardised, and this will limit the distance between the loop and the receiver. Where the loop is less than 20 ft. from the receiver, the full cable length must still be used, the excess cable being accommodated in the form of a bight within the cable sheathing.

8.4 Loop Wiring Connections to Secure Correct DF Sense.

The positioning of the whip and loop aerial (*i.e.*, above or below the aircraft fuselage) will clearly affect the DF sense. This is catered for by modification to the internal wiring of the loop cables, and also by alteration of connections to the loop motor. Instruction for the latter is given on a label affixed to the inside of the loop motor cover.

In the normal method of cable connection, each pin or socket on the cable termination is numbered and is connected to a correspondingly numbered pin or socket at the opposite end of the cable, but in the case of loop cables " BC " and " BA " where internal modifications have been made to the wiring, this will no longer apply.

The following table gives details of loop cable pin connection for all possible aerial positions :—

Aerial Positions	Cable BC Pins	Cable BA Pins	Loop Motor Connections
Loop above fuselage / Whip above fuselage	1 to 1 & 3 to 3	1 to 1A & 2 to 2A	Normal
Loop below fuselage / Whip above fuselage	1 to 1 & 3 to 3	1 to 2A & 2 to 1A	Reversed
Loop below fuselage / Whip below fuselage	1 to 3 & 3 to 1	1 to 2A & 2 to 1A	Reversed
Loop above fuselage / Whip below fuselage	1 to 3 & 3 to 1	1 to 1A & 2 to 2A	Normal

Note :—The cables are normally delivered from the factory wired for the particular aircraft installation concerned, but it is important that the cable wiring should be checked during installation.

8.5 Cables.

The interconnecting cables are provided with plugs and sockets. To ensure adequate protection against corrosion, it is recommended that a thin coating of vaseline be applied to the pins on the former before installation.

All electrical cables must be cleated and firmly secured to the airframe, no bend should be of less than 2 in. radius. The flexible drive cable for receiver tuning should be run as straight as possible to reduce friction, bends should not be of less than 6 in. radius. Sufficient slack should be left at the rear of the receiver so that the cables will not interfere with the action of the shockproof mounting.

8.6 Ancillaries.

8.6.1 Bearing Indicator.

The location of the combined bearing and signal strength indicator should be such that the entire scale is visible to the operator. All connections are by means of screw terminals at the rear of the case. Fig. 2 shows the method of cable connection for a loop mounted above the fuselage. For other positions of the loop, the leads to terminals A1 and A2 may be reversed (see Section 8.4). When more than one indicator, Type 1272, is fitted, the connections are so arranged that the signal strength meters are in series, and the bearing indicators are in parallel.

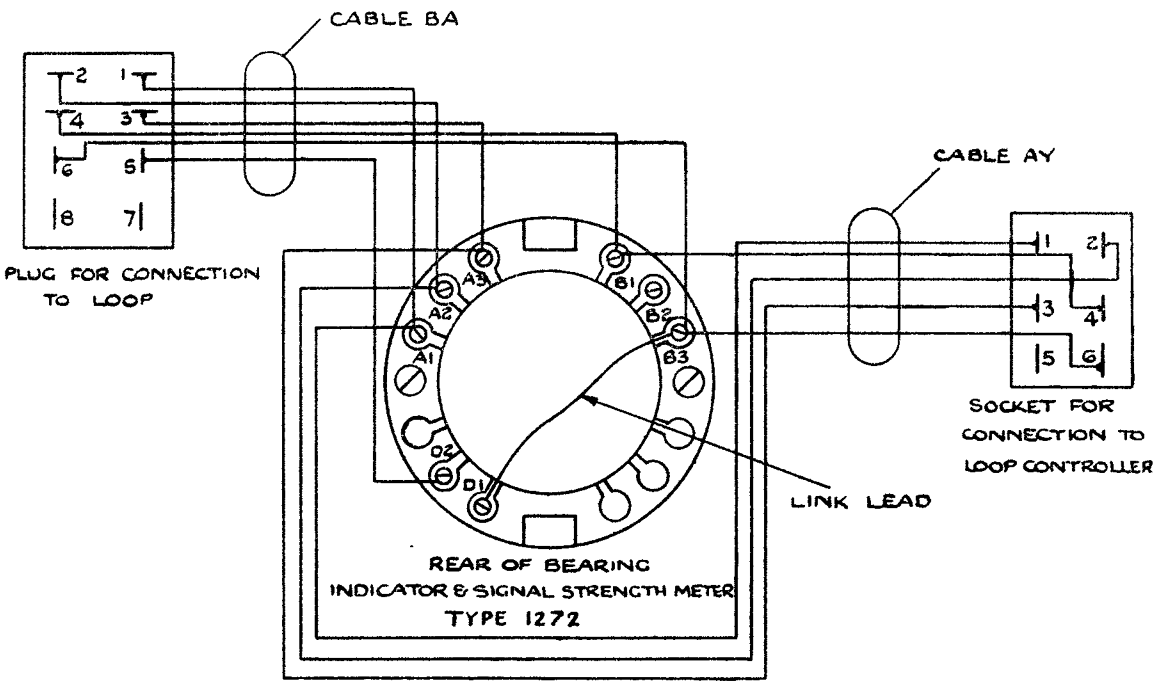


FIG. 2. BEARING INDICATOR TYPE 1272. 5077

8.6.2 Remote Controller.

The remote controller may be installed in any position convenient for operation, provided that the maximum length for the control cable is not exceeded (see Section 8.2).

8.6.3 Loop Control Unit and Voice/Range Filter.

The loop controller and the voice/range filter may be located in any position where the controls will be accessible to the operator.

8.7 Inspection and Fitting of Main Units.

Before fitting each unit in its respective mounting, a thorough inspection should be made to ensure that no damage has occurred to the instrument in transit.

8.7.1 Loop.

The loop is secured to the mounting plate by means of a slide-lock arrangement, a knurled nut and two 4BA captive screws (see Fig. 17). When fitting or removing the loop, care should be taken to see that the two captive screws are well clear before attempting the sliding movement.

Where a streamlined loop housing is used, the top half of the housing is secured to the lower half by means of 10 counter-sunk 2BA screws. The joint should not be sealed until all the loop adjustments have been carried out. When these are complete, however, it should be sealed by an approved method to prevent the ingress of moisture. The most suitable material is Berry Wiggin Kingsnorth Compound No. 1026, obtainable from Marconi's Wireless Telegraph Co. Ltd. About 2 ozs. of the compound will be required per seal. A small quantity should be applied to the mating edges of the loop before the two halves of the loop are brought together.

8.7.2 Receiver.

Immediately before the receiver is fitted into the racking the tuning scale in the remote controller should be set to the same frequency as that indicated on the receiver scale. The instrument should then be pushed well home in the suspension rack to ensure that all plugs and sockets at the rear are in full contact.

8.8 Conversion of Manually Operated Receiver to Remote Control.

Should it be necessary at any time to instal a receiver equipped for manual operation, in an aircraft where remote control is required, the method of receiver conversion is described below :—

(*a*) Set the three switches for frequency, RT/CW, and system selection in their extreme anti-clockwise position.

(*b*) Remove knob from the system switch, by removing the central screw and remove the two screws securing the engraved plate beneath. This plate is now reversed and the securing screws replaced. It will be noted that the only engraved position now shown is " Remote ". If the knob is replaced and secured by the screw it will point to this position and a stop on the plate will prevent it from being moved accidentally.

(*c*) Remote controller switch drives have now to be fitted to the switches for frequency and RT/CW selection. The procedure in each case is as follows :—

1. Remove knob and undo screws retaining engraved cover, this reveals the click mechanism mounted on small brackets. Detach the click mechanism and brackets by removing their securing screws.
2. Fit the controller mounting bracket to the front panel with the screws supplied with the instrument ($\frac{1}{4}$ in. 6 BA). The bracket is mounted with the transverse tie strap which is farthest from the panel on the same side as the engraving " +28V " (see Fig3[illegible]), and with the tie strap which is nearest to the panel on the same side as the engraving " switch ". The ratchet wheel coupling on the controller motor should now be aligned with the switch shaft couping on the receiver (the ratchet wheel may be set to exactly the right angle by turning it until a line engraved on the motor body appears through one of the holes on the periphery), and the controller fitted in position. Care should be taken to ensure that the spring supports on the motor engage in the mounting bracket.
3. Slide cover over the motor and secure by means of the two fixing screws. These should be 9/32 in. countersunk 6 BA. (If this length is exceeded the motor will be damaged.)

(*d*) Finally fit receiver into the mounting framework. Switch on at remote-control unit, then move frequency and RT/CW selection knobs in turn, making sure that the controller switch drive motors on the receiver follow correctly. Test all other controls and check receiver operation.

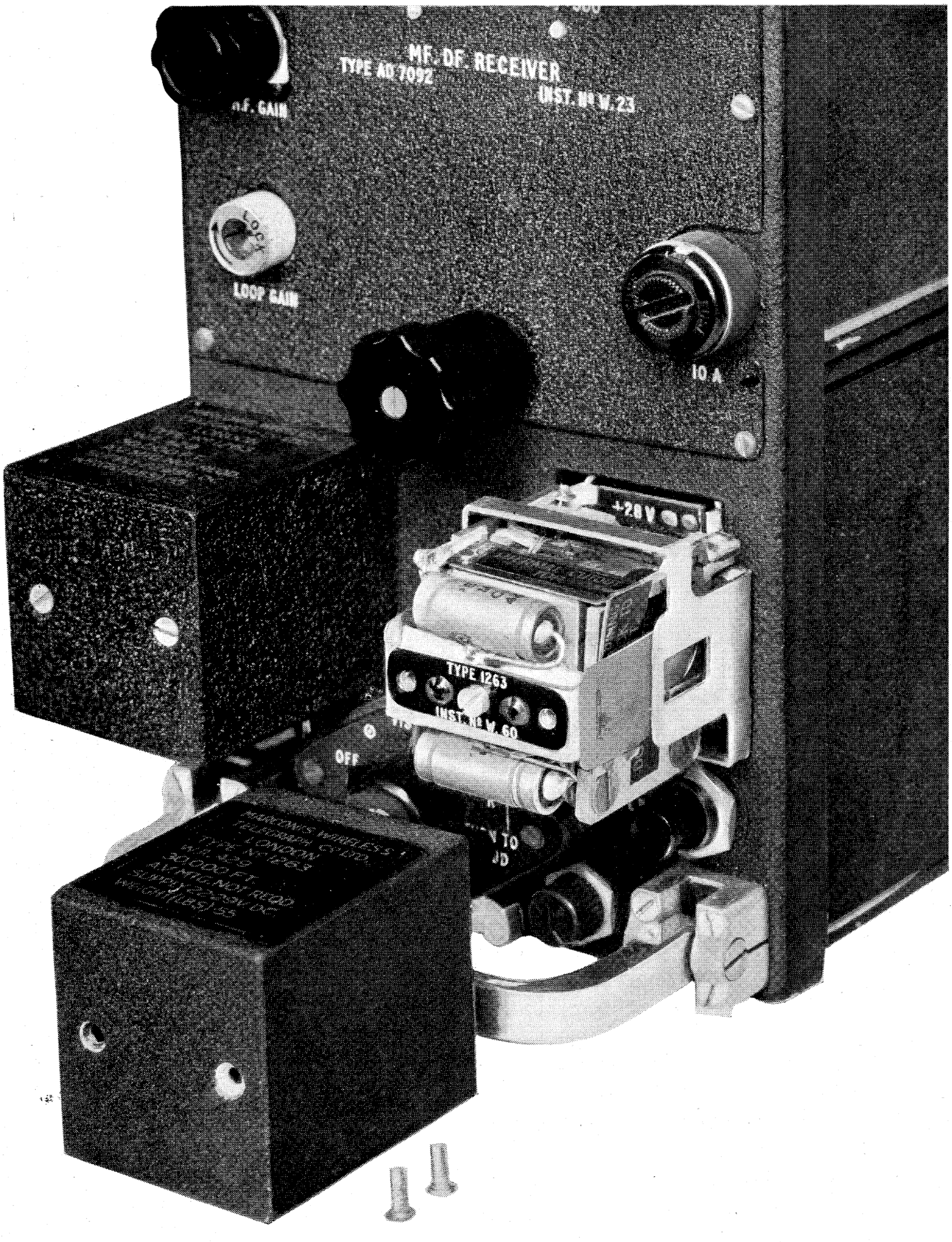


FIG. 3. CONTROLLER-SWITCH DRIVE TYPE 1263, FITTED TO RECEIVER. COVER REMOVED. 5058

9 PREPARATION FOR USE

When the equipment has been installed in the aircraft a thorough examination should be made to ensure that all cables are connected correctly and all units secure in their mountings. Battery voltage and the polarity of connections should also be checked.

9.1 Alignment of Tuning Scales.

In the case of remotely controlled installations, it is necessary to ensure that the tuning scale in the remote controller is aligned correctly with that in the receiver.

Alignment of the tuning scales in the remote-control box and receiver should normally be performed as described in Section 8.7.2, but an arrangement is provided on the remote-control box which permits the tuning scales to be aligned without disconnection of the mechanical drive cable.

When the two small grub screws on the face of the tuning control knob are released, the drive and tuning scale can be moved independently. Movement of the tuning scale is effected by turning a small knob behind the main tuning control.

9.2 Vertical Aerial Matching.

Accurate matching of the aerial system to the input circuits of the receiver is *essential* for the satisfactory operation of the equipment. Adjustment of the whip aerial input is performed as follows :—

(*a*) Select a suitable station, preferably about ~~the middle of Range 3~~ 1000 Kc, turn system switch to " Figure-of-eight ", and rotate the loop to a null position.

(*b*) Turn system switch to " Sense " position, and adjust the DF aerial transformer matching control and trimmer, until a maximum indication is obtained on the signal strength meter, adjusting the HF gain control as required to maintain the needle near the centre of the scale.

Note :—After adjustment of the DF aerial transformer controls by the method described above, it is advisable to remove the rear cover of the unit and ascertain the position of the trimming condenser vanes. If the vanes are partly in mesh, no further adjustments need be made, but if the vanes are completely in mesh or completely out of mesh, then in the former case the matching control switch should be turned one step in an anti-clockwise direction and in the latter case one step in a clockwise direction. The trimmer should then be readjusted until maximum signal strength indication is obtained.

9.3. Adjustment of Pre-set Loop Gain Control.

The loop gain control is located on the front panel of the receiver and should be adjusted as follows :—

(*a*) With receiver tuned to a suitable station as in 9.2, turn system switch to " Figure-of-eight " and rotate the loop to a null position.

(*b*) Turn system switch to a sense position and adjust HF gain control to a convenient scale reading on the tuning indicator (Note scale reading).

(*c*) Turn system switch back to " Figure-of-eight " position and rotate loop 25° from the null point. Adjust loop gain control until meter reads the same as in (*b*) above. Lock the control spindle.

(*d*) The loop and vertical aerial voltages are now approximately equal at 25° off course and provided the phase relationship is correct should cancel one another in one of the " Sense " positions of the system switch.

Operate switch and check that cancellation is obtained in one of the " Sense " positions.

Offset the loop 25° on the other side of the null and check that cancellation occurs in the other sense position. This test also checks the sense itself in that ~~it~~ cancellation should be on the same hand as the loop has been turned.

(*e*) Turn system switch to ADF position and note bearing shown on indicator. Rotate the loop 175° from this position and release. Note that loop returns to null position—time taken should be between 3 and 5 seconds, depending upon the strength of the signals. Check that bearing indicator follows, and that final bearing shown is the same as previously.

(*f*) Rotate loop 175° in opposite direction and check time taken to return to null and final bearing as before.

9.4 Loop Adjustment on a Prototype Installation.

In order to ensure accurate DF bearing indication throughout 360°, it is necessary to adjust certain corrector devices in the loop centre, to compensate for error due to RF circulating currents in the aircraft structure. This is normally referred to as quadrantal error. As a means of assessing the direction and extent of the error, it will be necessary on all prototype installations on aircraft to plot a quadrantal error curve.

9.4.1 Loop Alignment and Pointer Adjustment.

As a first step towards the preparation of a quadrantal error curve, it will be necessary to check that the quadrantal error scale (Fig. 18) is parallel with that portion of the Desynn potentiometer arm which rests against the QE slide, when the plane of the loop is at right angles to the axis of the fuselage.

The loop covers should be removed and the field alignment dial (Fig. 18) examined, the + zero mark on the scale should be set opposite the datum line on the outer ring. If not, the screw marked Field Alignment Clamp should be loosened and the scale turned until the setting is at + zero, and the clamp screw tightened down. The loop is then rotated until the quadrantal error corrector mechanism is towards the rear of the aircraft and the plane of the loop is exactly at right angles to the axis of the fuselage. This may be checked by means of a jig or a small mirror. For the latter method a pocket mirror is secured to the flat side of the loop towards the rear of the aircraft by means of a clip or elastic band. Some object is then chosen to indicate the centre line of the aircraft, such as the tail fin or a piece of distinctive tape attached to the centre of the rear bulkhead of the fuselage. An observer stands towards the rear of the aircraft and the loop is moved until the reflection of the observer's eye and the object indicating the centre line of the aircraft are in vertical alignment with the centre of the loop.

When the loop has been positioned with its plane at right angles to the axis of the fuselage, the QE slide should still be parallel with the potentiometer arm. If however, an error is indicated the screw marked " Loop Alignment Lock " in Fig. 17 is loosened and the knurled screw, marked " Loop Alignment Adjusting Screw," turned until the QE slide and potentiometer arm are again parallel. The locking screw should then be gently tightened down. Care must be taken to ensure that the position of the loop is not disturbed while these adjustments are made.

With the loop still held in this position the receiver system switch should be turned to " Vis," and the HF gain control to the minimum setting. The bearing indicator needle should now point to the zero index. Any small error in the reading is due to inaccuracy in the bearing indicator itself, and may if required be eliminated by the method outlined in the supplement to this handbook, dealing with adjustment to the Desynn bearing transmission system.

9.4.2 Taking the QE Correction Curve.

The method adopted for taking the QE curve will depend upon the facilities available. The greatest care must be exercised throughout if the best result is to be obtained. Since the operation consists of measuring at various angles, the difference between the bearing shown on the bearing indicator and the correct relative bearing of the radio transmitter concerned, any mistakes in assessing this angle will falsely appear on the correction curve as errors due to the aircraft structure.

To avoid errors due to night effect, it is essential that the calibration be performed at least 2 hours after sunrise or before sunset.

It would appear obvious at first sight that an aircraft should be calibrated in the air, but it must be remembered that in flight the accuracy of the observed DF bearing and also the assessment of the correct bearing is limited by the rapid change of the bearing due to the aircraft's speed. This, together with minor personal and other errors, restricts the accuracy of the comparison of the two observations to 1° or 2°. It is easy to see, therefore, that when such discrepancies are superimposed on a quadrantal error of, say, only 7° the curve will be distorted to such an extent that it will bear but little resemblance to the theoretical curves described below.

To minimise these discrepancies, several ingenious methods of calibration have been devised, such as that in which a calibrating transmitter is erected at the end of a long straight road and the aircraft then flown over the road on zigzag courses which intersect this clearly defined line of bearing at various predetermined angles. Even this, however, does not overcome the necessity for taking the DF bearing at a precise moment (*i.e.*, when directly over the road), nor the discrepancies in measuring the compass course at that moment.

On the other hand, several difficulties arise when calibrating on the ground. In this instance the worst condition probably arises when the DF loop is mounted below the fuselage in an aircraft having a retractable undercarriage. The aircraft is not in " flight trim " and, moreover, the close proximity of wheels and wheel struts to the DF loop frequently influences the shape of the error curve during calibration only. In such instances there is no practical alternative to calibration in the air.

When the loop is mounted above the fuselage, however, it may be safely assumed that the wheels will have little or no effect in either the up or down position. This circumstance therefore favours calibration on the ground where the " correct bearing " can be accurately assessed and the DF bearing measured with precision.

A clear site must always be selected for a ground calibration, otherwise the close proximity of power lines, hangars, ferro-concrete runways, etc., may completely upset the results. The suitability of a calibrating site should preferably be confirmed beforehand by taking check bearings of a number of transmitters and comparing the readings obtained with their actual geographical bearings. This can best be done with the aid of a portable direction finder, before moving the aircraft into position for the " swing ". If a site error is found to exist and no alternative error-free site is available, it may still be possible to obtain satisfactory results if the error is due to refraction at some distant point, because such an error will remain constant and can therefore be allowed for when assessing the " correct relative bearing ". If, however, the error is found to be due to the proximity of overhead wires, hangar doors, or some other such variable factor, then the error will fluctuate. Such a site is quite useless for accurate calibration and an alternative site must be found.

Even on a good calibration site errors may be found in the QE curve if the angular rotation of the aircraft is measured with the aid of a magnetic compass. These irregularities may be due to errors in the compass itself, to sighting errors or to deviation errors caused by ferrous metal, drainpipes, or submerged power cables. Any such errors naturally add to the difficulties of assessing the " correct relative bearing ".

It is very important that the calibration should be performed on a number of different frequencies throughout the range of the receiver. Any serious variations between the maximum errors on the different frequencies is usually a sign that the resonant frequency of some portion of the aircraft structure or aerial system is dangerously near to the tuning band of the receiver and may call for resiting or repositioning of the loop.

When the results of a calibration have finally been plotted, the QE curve should be critically examined to see if it is reasonably regular and symmetrical. If it is not, then the loop site should be examined to see if there is any peculiarity in the installation, such as aerials or projection near the loop which could legitimately account for the irregularities. If an irregularity cannot be accounted for, the calibration should be repeated forthwith on a different station or a different frequency. If the second calibration produces a differently shaped curve, then the installation is unreliable and the cause must be sought and eliminated. Distortion errors of this nature must not, however, be confused with the smaller random errors of a degree or less due to personal errors, etc., for even with the best of facilities, and the greatest of care, an overall checking accuracy of $\pm\frac{1}{2}^\circ$ is a very good figure to obtain. One is perfectly safe therefore in averaging out a $\frac{1}{2}^\circ$ ripple on a curve, but irregularities of 3° or 4° call for serious investigation.

9.4.3 Analysis of QE Correction Curve.

Three types of error may be shown by the QE curve, and these are as follows :—

Quadrantal Error :—Average peak amplitude of the correction curve above the zero datum line.

Loop Alignment Error :—Vertical displacement of the curve above or below the zero datum line.

Field Alignment Error :—Horizontal displacement of the curve along the zero datum line.

Quadrantal error only may be shown, but it may also appear in combination with loop alignment and field alignment errors. Errors due to loop alignment will not be present if the loop has been correctly aligned with respect to the aircraft fuselage as described in Section 9.4.1. Field alignment errors are due to the loop being installed to one side of the centre line of the aircraft so that it is not operating in the electrical ~~curve~~ CENTRE line of the re-radiated radio frequency field. Correction curves for quadrantal, loop and field alignment errors are shown in Fig. 4.

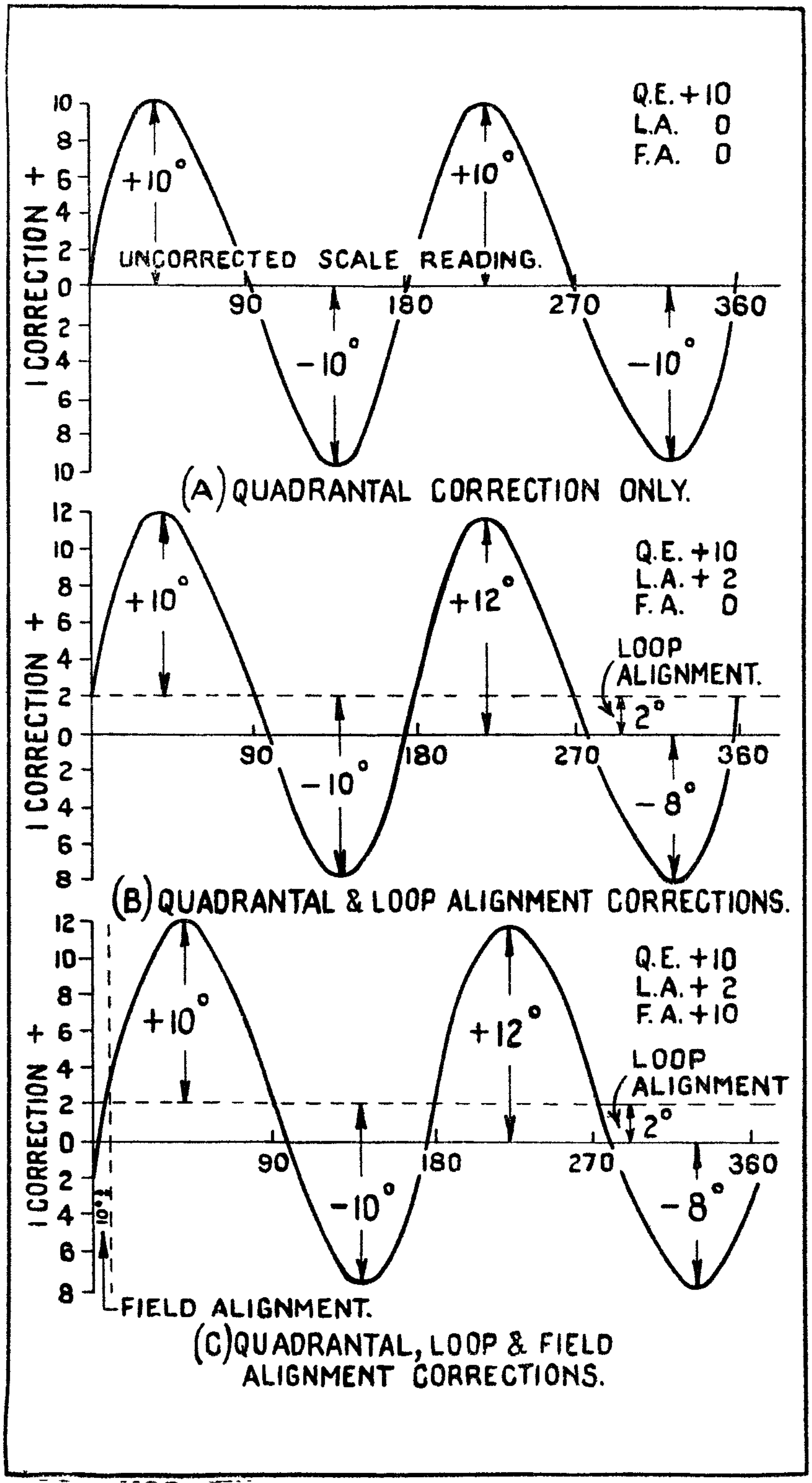


FIG. 4. LOOP ERROR CORRECTION CURVES. 5075

All corrections are normally +ve in the 1st and 3rd quadrants and – ve in the 2nd and 4th quadrants

	D.F. Scale Reading or	Reciprocal	MAXIMUM CORRECTIONS AMPLITUDE 1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°
1st and 3rd Quadrants	0	180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5 or	185	.17	.36	.55	7.5	.95	1.16	1.38	1.60	1.83	2.07	2.33	2.60	2.87	3.15	3.45	3.76	4.08	4.41	4.76	5.12
	10	190	.35	.70	1.09	1.47	1.86	2.27	2.70	3.13	3.58	4.07	4.55	5.05	5.57	6.11	6.67	7.25	7.85	8.47	9.12	9.78
	15	195	.50	1.03	1.57	2.13	2.70	3.29	3.90	4.53	5.17	5.83	6.52	7.22	7.95	8.70	9.47	10.27	11.08	11.91	12.77	13.65
	20	200	.65	1.32	2.01	2.71	3.43	4.18	4.93	5.72	6.52	7.33	8.17	9.03	9.91	10.81	11.71	12.67	13.61	14.59	15.58	16.59
	25	205	.78	1.57	2.38	3.20	4.05	4.90	5.78	6.68	7.58	8.52	9.47	10.42	11.39	12.38	13.36	14.39	15.42	16.45	17.51	18.57
	30	210	.88	1.77	2.67	3.59	4.52	5.47	6.42	7.38	8.37	9.35	10.35	11.37	12.39	13.41	14.43	15.48	16.52	17.57	18.61	19.66
	35	215	.95	1.90	2.87	3.83	4.83	5.82	6.82	7.82	8.83	9.83	10.86	11.88	12.90	13.91	14.93	15.97	16.97	18.00	19.00	20.00
	40	220	.99	1.98	2.99	3.97	4.98	5.98	6.99	8.00	9.00	10.00	11.00	11.99	12.98	13.97	14.95	15.91	16.87	17.83	18.77	19.70
	45	225	1.00	2.00	3.00	4.00	4.98	5.97	6.95	7.92	8.89	9.85	10.80	11.75	12.68	13.60	14.51	15.41	16.30	17.17	18.03	18.89
	50	230	.98	1.97	2.92	3.88	4.83	5.77	6.70	7.62	8.53	9.43	10.31	11.18	12.03	12.88	13.71	14.52	15.32	16.11	16.88	17.63
	55	235	.93	1.85	2.77	3.67	4.55	5.42	6.28	7.12	7.95	8.76	9.55	10.33	11.10	11.87	12.60	13.32	14.02	14.72	15.39	16.05
	60	240	.86	1.70	2.53	3.35	4.13	4.92	5.68	6.43	7.16	7.88	8.58	9.27	9.93	10.58	11.22	11.85	12.46	13.05	13.63	14.20
	65	245	.76	1.50	2.23	2.93	3.62	4.29	4.95	5.59	6.22	6.82	7.42	8.00	8.56	9.11	9.62	10.17	10.68	11.17	11.65	12.12
	70.	250	.63	1.25	1.85	2.45	3.01	3.56	4.10	4.62	5.13	5.63	6.11	6.58	7.03	7.48	7.90	8.33	8.73	9.12	9.51	9.88
	75	255	.49	.97	1.43	1.88	2.32	2.74	3.15	3.55	3.95	4.32	4.68	5.03	5.38	5.71	6.03	6.35	6.65	6.95	7.23	7.52
	80	260	.33	.66	.98	1.27	1.57	1.86	2.14	2.41	2.67	2.92	3.16	3.40	3.63	3.86	4.07	4.28	4.49	4.68	4.87	5.05
	85	265	.15	.30	.47	.65	.80	.95	1.10	1.20	1.34	1.50	1.60	1.71	1.81	1.95	2.05	2.15	2.25	2.35	2.45	2.55
2nd and 4th Quadrants	90	270	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	95	275	.15	.30	.47	.65	.80	.95	1.10	1.20	1.34	1.50	1.60	1.71	1.81	1.95	2.05	2.15	2.25	2.35	2.45	2.55
	100	280	.33	.66	.98	1.27	1.57	1.86	2.14	2.41	2.67	2.92	3.16	3.40	3.63	3.86	4.07	4.28	4.49	4.68	4.87	5.05
	105	285	.49	.97	1.43	1.88	2.32	2.74	3.15	3.55	3.95	4.32	4.68	5.03	5.38	5.71	6.03	6.35	6.65	6.95	7.23	7.52
	110	290	.63	1.25	1.85	2.45	3.01	3.56	4.10	4.62	5.13	5.63	6.11	6.58	7.03	7.48	7.90	8.33	8.73	9.12	9.51	9.88
	115	295	.76	1.50	2.23	2.93	3.62	4.29	4.95	5.59	6.22	6.82	7.42	8.00	8.56	9.11	9.62	10.17	10.68	11.17	11.65	12.12
	120	300	.86	1.70	2.53	3.35	4.13	4.92	5.68	6.43	7.16	7.88	8.58	9.27	9.93	10.58	11.22	11.85	12.46	13.05	13.63	14.20
	125	305	.93	1.85	2.77	3.67	4.55	5.42	6.28	7.12	7.95	8.76	9.55	10.33	11.10	11.87	12.60	13.32	14.02	14.72	15.39	16.05
	130	310	.98	1.97	2.92	3.88	4.83	5.77	6.70	7.62	8.53	9.43	10.31	11.18	12.03	12.88	13.71	14.52	15.32	16.11	16.88	17.63
	135	315	1.00	2.00	3.00	4.00	4.98	5.97	6.95	7.92	8.89	9.85	10.80	11.75	12.68	13.60	14.51	15.41	16.30	17.17	18.03	18.89
	140	320	.99	1.98	2.99	3.97	4.98	5.98	6.99	8,00	9.00	10.00	11.00	11.99	12.98	13.97	14.95	15.91	16.87	17.83	18.77	19.70
	145	325	.95	1.90	2.87	3.83	4.83	5.82	6.82	7.82	8.83	9.83	10.86	11.88	12.90	13.91	14.93	15.97	16.97	18.00	19.00	20.00
	150	330	.88	1.77	2.67	3.59	4.52	5.47	6.42	7.38	8.37	9.35	10.35	11.37	12.39	13.41	14.43	15.48	16.52	17.57	18.61	19.66
	155	335	.78	1.57	2.38	3.20	4.05	4.90	5.78	6.68	7.58	8.52	9.47	10.42	11.39	12.38	13.36	14.39	15.42	16.45	17.51	18.57
	160	340	.65	1.32	2.01	2.71	3.43	4.18	4.93	5.72	6.52	7.33	8.17	9.03	9.91	10.81	11.71	12.67	13.61	14.59	15.58	16.59
	165	345	.50	1.03	1.57	2.13	2.70	3.29	3.90	4.53	5.17	5.83	6.52	7.22	7.95	8.70	9.47	10.27	11.08	11.91	12.77	13.65
	170	350	.35	.70	1.09	1.47	1.86	2.27	2.70	3.13	3.58	4.07	4.55	5.05	5.57	6.11	6.67	7.25	7.85	8.47	9.12	9.78
	175	355	.17	.36	.55	.75	.95	1.16	1.38	1.60	1.83	2.07	2.33	2.60	2.87	3.15	3.45	3.76	4.08	4.41	4.76	5.12

FIG. 5. TABLE OF CORRECTIONS FOR PURE QUADRANTAL ERRORS.

All analysis of quadrantal error correction curves is based upon the theoretical quadrantal error correction curve which is derived from the formula :—

$$\text{Tan } \theta = a \tan \phi.$$

Where θ = the correct bearing.
ϕ = observed bearing.
a = constant for any particular aircraft.

Fig. 5 gives a table of angles worked out on this basis, from which the theoretical quadrantal error correction curve may be plotted for any degree of maximum error up to 20°. It is thus possible to select a curve which will approximate to the reading obtained by the calibration " swing ". The points should not in general deviate more than ±2° from the curve.

In the majority of cases the above method of error compensation will be relatively straightforward, but when difficulty is experienced a more complete analysis must be made, and that is outside this brief description. For further information on the subject see " Calibration of Swing Loop and Bellini Tosi Direction Finders " by F. P. Best and J. H. Moon, published by Marconi's Wireless Telegraph Co. Ltd.

9.4.4 Setting Up Loop Correctors.

To provide a record of the appropriate loop corrector settings, a correction chart is supplied with the equipment for mounting near the loop base plate on which the QE and field alignment corrections may be inscribed. Fig. 6 shows the printed card with corrector settings for quadrantal and field alignment error obtained from Fig. 4 duly entered.

MARCONI A.D.F. LOOP TYPE 1264
AIRCRAFT TYPE *Kiwi* No. *33*
IMPORTANT : CONSULT HANDBOOK BEFORE MAKING CORRECTIONS.
CORRECTOR SETTINGS :–
Q.E. (0-15° SCALE) : *+10°*
FIELD ALIGNMENT SCALE : *10° White*
AUTHORISED BY : *M.W.T.Co.*

FRONT.

CUADRO A.D.F. MARCONI TIPO 1264
TIPO PARA AVIONES No.
IMPORTANTE : REFIÉRASE AL CUADERNO ANTES DE HACER CORRECCIONES
AJUSTES DEL CORRECTOR
E.C. (0-15° ESCALA) ;
ESCALA DE ALINEACIÓN DE CAMPO ;
AUTORIZADO POR ;
CADRE A.D.F. MARCONI TYPE 1264
TYPE POUR AVIONS No.
IMPORTANT : CONSULTEZ LIVRET AVANT DE FAIRE LES CORRECTIONS
RÉGLAGES DU CORRECTEUR
E.Q. (0-15° ECHELLE)
ECHELLE D'ALIGNEMENT DE CHAMP
AUTORISÉ PAR ;

REVERSE.

FIG. 6. FACSIMILE OF QUADRANTAL CORRECTION CHART.

The loop correction mechanism is shown in Fig. 18. To adjust for quadrantal error the screw marked " Quadrantal Error Compensator " is turned until the datum line comes opposite the appropriate figure.

Provision is made for positive and negative first quadrant corrections. For the majority of aircraft a positive first quadrant setting is required and the loop is normally adjusted for this condition when it leaves the factory. Should it be necessary to adjust the loop for negative first quadrant correction, the screw marked " Field Alignment Clamp," Fig. 18, is loosened and the field alignment hub and dial turned through 180° until the black (negative) scale is opposite the datum line on the outer ring.

To set the corrector for field alignment error, the position of the field alignment hub and dial is adjusted until the required figure on the scale is opposite the datum line on the outer ring. It will be noted that the field alignment scale is numbered 0-20° on either side of the zero index and is coloured white and blue, this is to prevent ambiguity when the appropriate error corrections are entered on the correction chart. Fig. 37 shows specimen QE curves with appropriate settings on the field alignment dial for normal and inverted loop positions. After setting up the field alignment correction, the clamp screw should be gently tightened down.

Note :—The adjustable circular cam situated below the " Desynn " potentiometer is pre-set at the factory to compensate for errors in the potentiometer and the screw settings around the periphery must on no account be disturbed.

All diagrams show Q.E. eccentric slide parallel with potentiometer arm. In this position no Q.E. correction is being added (or subtracted) to bearing transmission information. Settings shown are not effected by negative 1st quadrant Q.E. conditions.

9.5 Loop Adjustment of Subsequent Fitting when Correction Factors are Known.

Experience has shown that different aircraft of the same type have substantially the same quadrantal errors when fitted with a well positioned loop and the same type of direction finder, and also that these errors when once correctly determined will remain just as constant as those of a ship—provided, of course, that no alterations are made to the airframe or new aerials, etc., rigged in the vicinity of the DF loop. When a fleet of similar aircraft are fitted with the same type direction finder it should therefore only be necessary to calibrate accurately the first two or three. If these trial calibrations show the required symmetry of errors, then a standard correction chart can be prepared. On subsequent installations, therefore, it is merely necessary to align the loop correctly with respect to the axis of the aircraft fuselage as described in Section 9.4.1 and then set the correction mechanism to the figures shown on the standard chart.

In all cases a final check should be made to ensure that the loop corrector mechanism has been adjusted accurately and that the loop is aligned properly with respect to the axis of the fuselage.

The aircraft should preferably be positioned on a compass base for this operation and it should be located as far as is possible from sources of bearing error, such as hangars, metal pipes and overhead wires or other aircraft.

The bearing from the compass base of suitable radio stations should be ascertained by geographical means or, if possible, by means of a portable DF apparatus ; the latter method is much to be preferred and must be carried out before bringing the aircraft to the base.

Note :—To avoid bearing errors due to night effects, it is important that all DF check bearings are obtained at least 2 hours after sunrise or before sunset.

The aircraft is turned until the nose points towards a selected radio station and the axis of the fuselage is in line with it.

The receiver is then switched on and tuned to the station. If the loop has been correctly aligned with respect to the axis of the fuselage, the bearing indicator will read 0°. A further test is then made by tuning the receiver to other radio stations spaced at different points around the aircraft and checking the bearing obtained.

9.6 Loop Dehydrator Unit.

The streamlined loop housing is provided with a dehydrator unit (see Section 5.3). When all loop adjustments have been made, and the housing has been completely sealed, a silica gel breather unit must be fitted into the container in the loop neck. This is accessible by removing the screw cap situated immediately below the loop (inside the aircraft skin).

Before inserting the breather unit, the colour of the contents should be checked (the silica gel crystals should be dark blue in colour), and the end of the tube turned until the air holes are fully open. When the unit is in position, the screw cap should be replaced and screwed well home.

10 OPERATING INSTRUCTIONS

10.1 Controls.

The functions of the various controls are clearly indicated on the receiver front panel and on the remote-control box.

The frequency range switch has four positions. Operation of the switch brings into circuit the required tuning inductances, and also moves a shutter and cursor on the tuning dial into alignment with the base line of the frequency scale in use.

Radio stations should be tuned in with the system switch at " Omni ". Tuning may be by aural or visual methods. In the latter case tune for maximum deflection of the tuning indicator. Identification of keyed CW stations is obtained by operation of the RT/CW switch, variation of the beat frequency of the internal modulation circuit being provided by the control marked " het ".

The RT/CW switch also serves as an IF selectivity control. Switch positions are indicated by engraved lines of three different widths, showing bandwidth selected.

Two small push-pull switches are provided marked " Light " and " Pull Range " respectively. The former controls illumination of the tuning scale, and the latter is for operation when radio range flying (see Section 10.2 (*e*)).

10.2 Homing.

For homing operation, tune in the required radio station as described in Section 10.1, then proceed as follows :—

(*a*) Switch to " Vis " and turn HF gain control to maximum.

(*b*) Turn aircraft in direction shown by the bearing indicator pointer until the bearing indicator needle is at the zero index, the aircraft will then be pointing towards the radio station.

(*c*) Adjust LF gain control to a position giving satisfactory headset volume.

(*d*) Maintain bearing indicator pointer at zero until aircraft arrives over station.

(*e*) The receiver has excellent AGC but it may be used on a radio range course which is being flown aurally, provided the switch marked " Pull Range " is pulled out. This alters the AGC time constant from ½ second to 10 seconds, at which value there is no appreciable spreading of the beam. Some indication of the cone of silence can be obtained on the tuning indicator, but since automatic DF may be used when range flying, passage over the station is clearly indicated by reversal of the bearing indication.

With this method of homing the effect of a cross wind will cause the aircraft to fly in a curved path towards the radio station, and co-ordination with ground fixes or airports along the route will be difficult or impossible. It is, therefore, usually more expedient to fly a straight course by setting the aircraft heading to compensate for wind drift. The angle of drift should be ascertained by means of a drift recorder and the aircraft turned until the needle on the bearing indicator pointer is off zero by the number of degrees of drift in the direction required. In the absence of a drift recorder, the drift may be ascertained by trial and error, in which case it should be borne in mind that when alteration of course to maintain the bearing indicator needle at zero causes an increase of the magnetic compass reading, a drift to port is indicated. Similarly a decreasing magnetic bearing indicates a starboard drift.

Note :—Whenever the equipment is used for ADF operation (*i.e.*, with the system switch at " Vis ") the HF gain control must be set at maximum, otherwise the ADF circuits cannot function properly.

10.3 Direction Finding.

To operate as an automatic direction finder, tune receiver on " Omni " to radio station required as described in Section 10.1 and proceed as follows :—

(*a*) Switch to " Vis ", and turn HF gain control to maximum.

(*b*) Adjust LF gain control for satisfactory headset volume.

(*c*) Read relative bearing from indicator. Ascertain magnetic heading of aircraft as shown on compass, and convert to true bearing by application of deviation and variation corrections. Add bearing indicator reading to true bearing of aircraft from north. If result is over 360° subtract 360 from total. To obtain station-to-aircraft bearing from north subtract or add 180° to final figure (*i.e.*, add 180° to bearings below 180° and subtract 180° from bearings over 180°).

(*d*) To obtain a fix, bearings should be taken or two of more known radio stations in quick succession. Stations chosen should subtend an angle of at least 30° apart, measured from the aircraft. Position lines from the radio stations are then plotted on a map. The intersection of the lines is the position of the aircraft at the time of observation. To ensure accuracy the aircraft must be held on a steady course while the bearings are taken.

(*e*) Corrections for quadrantal error are applied automatically in this equipment and need not be considered when taking bearings.

10.4 Loop Aerial Reception.

Noisy reception may sometimes occur owing to interference caused by charged particles of rain or snow. Under these conditions better reception may be obtained by operation on the loop aerial. The system switch should be turned to the " Figure-of-eight " position, and the loop rotated by means of the remote hand control (now operative), until maximum signal strength is obtained. Under these conditions the LF gain control is inoperative and gain control should be adjusted by means of the HF control.

10.5 Loop Direction Finding.

Direction finding or homing may be accomplished with the loop aerial only. The loop is rotated to a position of minimum headset volume, and the bearing read from the indicator. It should be borne in mind that two " null " points will be obtained 180° apart and it will be necessary to select the correct bearing by reference to the compass reading or by aural sense determination as described below.

10.6 Aural Sense Determination.

(*a*) With receiver in operation on loop aerial only (" Figure-of-eight ") rotate loop to a null position.

(*b*) Turn aircraft or loop to the left.

(*c*) Rotate system switch to position marked " L " and then to position " R ". Repeat several times and ascertain in which position the loudest signal is obtained. The caption " turn to loud " is an instruction to turn either the loop or the aircraft in the direction indicated to bring it on course. Since in this case the loop has been turned to the left from the on course condition the instruction should clearly be " turn to right ", and the sense is therefore correct if the loudest signal is obtained in the " R " position.

If the loop had been turned to the right in the first place the loudest signals should be obtained in the " L " position.

10.7 Precautions During Operation.

When taking bearings aurally, the width of null obtained will depend upon the strength of signals. The HF gain control should be used to adjust the null to a convenient width.

For ADF operation, the HF gain control must be at maximum.

The loop should not be in the null position when flying on a radio range course, or fading of signals may be mistaken for the cone of silence. On loop type radio range stations, operation of the receiver on loop only (" ∞ ") is not advised as signals may increase instead of indicating a silent zone when passing over the station.

Care should be taken to tune the receiver very accurately when receiving strong signals or bearing errors may occur.

Night effect is present at all times, but is especially bad at sunrise and sunset. It may be detected by unsteadiness of bearings. The operator should average the fluctuations to obtain the correct reading. Sometimes an increase in the height of the aircraft will improve bearings. Stations operating on the lower frequencies are the least liable to this effect.

When obtaining aircraft position fixes, at least three station bearings, which will plot on a map as a triangle, should be used.

If very severe precipitation interference occurs, it will be necessary to obtain DF bearings aurally with the receiver on loop aerial (system switch to position marked " ∞ ") to obtain accurate direction finding.

11 MAINTENANCE

11.1 Routine Inspections.

Routine ground tests should be applied to the equipment at regular periods by a qualified radio engineer.

As a general rule a full visual inspection should be made every 24 hours, followed by a functional ground test.

Visual inspection should include the following checks :—

(*a*) Check the mountings of main units.

(*b*) Inspect all plugs and cables for security.

(*c*) Examine headset leads.

(*d*) Inspect the loop dehydrator (Streamlined Housing Type 1268 only). Unscrew the base of the dehydrator unit and remove the silica gel tube. If the crystals appear light blue or pink in colour, the tube should be replaced by a fresh tube of activated silica gel. Before fitting the latter in position, the cover ring at the base should be turned until the air holes at each end of the tube are open.

To re-activate the silica gel, the tube (with air holes open) is placed in an oven and heated to a temperature of 350°-400° Fahrenheit. (It is inadvisable to exceed this temperature or the activity of the silica gel may be impaired.) The heating is continued until the crystals become deep blue in colour. After a further two hours, the tube is removed from the oven and allowed to cool. The small holes at each end are then closed by turning the cover ring at the base. This prevents moisture being absorbed by the active element, while the tube is in storage.

For functional ground tests the aircraft should be positioned at least 200 ft. distant from any buildings, power lines, or conductors, which might cause inaccurate bearing indication.

The following checks should be made :—

(*a*) Check operation of all controls.

(*b*) Test dial lamps.

(*c*) Check sensitivity of receiver by tuning to known weak radio stations.

(*d*) Check operation of receiver on loop and whip aerials.

(*e*) Check ADF operation. The accuracy of bearing indication should be checked by tuning to radio stations, the bearings of which are already known, selecting stations which will provide bearings from several different points in relation to the heading of the aircraft.

11.2 Overhaul of Equipment.

It is ~~recommened~~ RECOMMENDED that all main units be removed from the aircraft for overhaul every 100 flying hours and the checks and tests detailed below applied to the equipment.

11.2.1 General.

All covers should be removed, and the interior and exterior of each unit cleaned thoroughly. Wiring and soldered joints should be inspected and all nuts and bolts checked for security.

11.2.2 Receiver.

(*a*) Inspect rotary transformer brushes and commutators. The latter should be cleaned with rag moistened with carbon tetrachloride or, if very dirty, fine glass paper may be used (do not use emery paper). The bearings of this machine are packed with grease at the factory and should run for 1,000 hours without attention. After this period it is recommended that the armature be removed and the bearings examined and re-packed with low temperature grease, *e.g.*, A.M. Spec. DTD. 577.

(*b*) Operate receiver on all ranges, using signal generator and output power meter. Test for microphony by lightly tapping each valve cover in turn. Test all control switches and check both LF and HF gain controls for noisy operation. Rotate tuning control and examine dial drive mechanism, if lubrication is necessary use anti-freeze grease sparingly. Check that receiver performance does not deviate appreciably from figures quoted in Section 12.7. Check AGC time constant in both positions of the " Pull Range " switch. If receiver is remotely controlled, remove controller switch drives and inspect visually.

(*c*) Examine plug connectors and check that pins are not corroded. If necessary, grease slightly with vaseline.

(*d*) Check security of valves and valve covers.

11.2.3 Loop.

(*a*) Inspect and clean as described in Section 11.2.1.

(*b*) Check that loop rotates freely and that error corrector mechanisms are functioning satisfactorily. If lubrication of gear spindles or cam followers is necessary, apply *anti-freeze* grease (A.M. Spec. DTD. 577) *very sparingly*. The motor and main loop bearings are packed with grease at the factory and do not require further lubrication. Examine " Desynn " potentiometer for wear. If the wiper arms and winding appear dry, grease sparingly (the recommended lubricant is Intava 659). Inspect loop slip rings and brushes.

(*c*) Examine plug connector pin for signs of corrosion. If necessary, grease slightly with vaseline.

Note :—If a replacement loop is to be fitted into an aircraft it is important that the motor cover be removed and the connections checked for correct rotation. Instructions are given on a label attached to the inside of the cover.

11.2.4 DF Aerial Transformer, V/R Filter and Loop Controller.

Clean and inspect these units as described in Section 11.2.1. Check connection plug pins for corrosion. If necessary, apply vaseline sparingly.

11.2.5 Remote Controller.

Inspect as described in Section 11.2.1. Test in conjunction with receiver and check operation of all switches. Rotate tuning control and check for free movement of remote tuning and dial drive mechanism. If necessary, lubricate sparingly with anti-freeze grease. Check LF and HF gain controls for noisy operation. Test dial lamps. Examine plug pins for corrosion.

11.2.6 Bearing Indicator.

Inspect visually and test in conjunction with remainder of equipment.

12 FAULT FINDING AND SERVICING

The fault location chart (Fig. 33), together with the lists of voltage measurements and component values below, will be of assistance to the service engineer, in tracing any defects which may occur in the equipment.

12.1 Typical Voltage Measurements.

Conditions of Test :—

Avometer Model 7 or similar instrument (1,000V range, unless otherwise stated).
Input Voltages : 28V DC (Rotary Transformer) ;
19V DC (Heaters).
Frequency : 1,500 kc/s (Range 4).
HF Gain : Max. (unless otherwise stated).
LF Gain : Max. (unless otherwise stated).
System Switch : Visual (unless otherwise stated).
Selectivity : CW (crystal).

All measurements positive to earth.

Valve	Anode (Volts)	Screen (Volts)	Suppressor (Volts)	Cathode* (Volts)	
V1	75	80	—	1.1 — 2.2	(Vary loop gain control)
V2	130	130	—	1.6	
V3	40	40	—	0.9 — 7.6	(Vary HF gain control)
V4	150	150	150	0	
V5	110	110	—	1.7 — 19	(100V Range ; Vary HF gain control)
V6	90	90	—	0	
V7	215	210	—	4.3 — 19	(100 VRange ; Vary HF gain control)
V8	—	—	—	0	
V9	—	—	—	15	(100V Range ; Pin 5)
V10	30	30	—	1 — 1.8	(System SW at "0," Vary HF gain control)
				0.9	(System SW at "∞")
V11	230	140	—	1.6	
V13	10	10	—	0.4	
V14	30	45	—	1.3	
V15	225	230	—	12	(100V Range)
V16	140	140	140	80	(1,000V Range)
V17	200	200	35	110	(1,000V Range)
V18	200	200	35	110	(1,000V Range)

* 10V Range, unless otherwise stated.

12.2 Component Values (in Order of Circuit Reference).

12.2.1 Condensers.

RECEIVER TYPE AD.7092

Circuit Reference	Value	Circuit Reference	Value	Circuit Reference	Value
C1	4.5—30 pF	C19	1800 pF	C37	330 pF
C2	,,	C20	187.2 pF	C38	83 pF
C3	,,	C21	,,	C39	390 pF
C4	,,	C22	,,	C40	83 pF
C5	,,	C23	,,	C41	330 pF
C6	,,	C24	470 pF	C42	.05 μF
C7	,,	C25	Not used	C43	0.1 μF
C8	,,	C26	10 μF	C44	1.0 μF
C9	,,	C27	5 μF	C45	0.1 μF
C10	,,	C28	220 pF	C46	Not used
C11	,,	C29	5 pF	C47	1.0 μF
C12	,,	C30	Not used	C48	.005 μF
C13	,,	C31	47 pF	C49	0.1 μF
C14	,,	C32	440 pF	C50	.01 μF
C15	,,	C33	100 pF	C51	.01 μF
C16	,,	C34	390 pF	C52	Not used
C17	440 pF	C35	390 pF	C53	.002 μF
C18	900 pF	C36	390 pF	C54	0.1 μF

12.2.1 **Condensers** (*Contd.*).

RECEIVER TYPE AD.7092

Circuit Reference	Value	Circuit Reference	Value	Circuit Reference	Value
C55	.01 μF	C82	5 μF	C109	.01 μF
C56	.002 μF	C83	,,	C110	Not used
C57	Not used	C84	,,	C111	100 pF
C58	.01 μF	C85	5 pF	C112	Not used
C59	.01 μF	C86	,,	C113	100 pF
C60	5 μF	C87	5 μF	C114	Not used
C61	0.1 μF	C88	,,	C115	,,
C62	.01 μF	C89	.001 μF	C116	,,
C63	100 pF	C90	12 μF	C117	,,
C64	,,	C91	,,	C118	,,
C65	,,	C92	Not used	C119	8 μF
C66	0.1 μF	C93	.001 μF	C120	Not used
C67	,,	C94	,,	C121	.05 μF
C68	,,	C95	,,	C122	0.1 μF
C69	,,	C96	1.0 μF	C123	5 μF
C70	,,	C97	.05 μF	C124	,,
C71	,,	C98	0.1 μF	C125	Not used
C72	1.0 μF	C99	50 pF	C126	10 μF
C73	8 μF	C100	,,	C127	0.1 μF
C74	.05 μF	C101	,,	C128	Not used
C75	0.1 μF	C102	1.0 μF	C129	,,
C76	1.0 μF	C103	Not used	C130	0.1 μF
C77	0.1 μF	C104	.001 μF	C131	,,
C78	1.0 μF	C105	1.0 μF	C132	15 pF
C79	0.1 μF	C106	.001 μF	C133	.01 μF
C80	,,	C107	0.1 μF	C134	15 pF
C81	5 μF	C108	.05 μF	C135	,,
				C136	.01 μF

DF Aerial Transformer Type 922		Loop Controller Type 1273		Voice/Range Filter Type 949		Loop Type 1264	
Circuit Reference	Value	Circuit Reference	Value	Circuit Reference	Value	Circuit Reference	Value
C1	100 pF Max.	C1	0.5 μF	C1	.05 μF	C1	0.1 μF
C2	70 pF	C2	.01 μF	C2	.05 μF		
C3	140 pF			C3	1.0 μF		
C4	140 pF			C4	1.0 μF		
C5	22 pF						

12.2.2 Resistances and Potentiometers.

RECEIVER TYPE AD. 7092

Circuit Reference	Value	Circuit Reference	Value	Circuit Reference	Value
R1	100 k Ω	R37	1 M Ω	R73	560 k Ω
R2	470 Ω	R38	470 Ω	R74	560 k Ω
R3	47 k Ω	R39	Not used	R75	560 k Ω
R4	220 Ω	R40	27 k Ω	R76	10 k Ω
R5	100 k Ω	R41	Not used	R77	470 Ω
R6	4.7 k Ω	R42	2.2 M Ω	R78	100 k Ω
R7	22 k Ω	R43	100 k Ω	R79	100 k Ω
R8	1 M Ω	R44	10 k Ω	R80	10 k Ω
R9	560 k Ω	R45	560 k Ω	R81	100 k Ω
R10	100 k Ω	R46	5.6 M Ω	R82	Not used
R11	22 k Ω	R47	1.5 k Ω	R83	,,
R12	30 Ω	R48	68 k Ω	R84	Not used
R13	1 M Ω	R49	220 k Ω	R85	100 k Ω
R14	3.3 k Ω	R50	2.2 M Ω	R86	100 k Ω
R15	27 k Ω	R51	5.6 M Ω	R87	100 k Ω
R16	33 k Ω	R52	1.5 k Ω	R88	60 Ω
R17	10 k Ω	R53	68k Ω	R89	10 Ω
R18	22 k Ω	R54	560 k Ω	R90	Not used
R19	100 k Ω	R55	2.2 M Ω	R91	,,
R20	3.3 k Ω	R56	220 k Ω	R92	,,
R21	1 k Ω	R57	560 k Ω	R93	,,
R22	27 k Ω	R58	1 M Ω	R94	470 Ω
R23	1 M Ω	R59	680 Ω	R95	100 k Ω
R24	1 M Ω	R60	Not used	R96	Not used
R25	150 k Ω	R61	560 k Ω	R97	68 k Ω
R26	330 k Ω	R62	100 k Ω	R98	68 k Ω
R27	1.5 k Ω	R63	10 k Ω	R99	68 k Ω
R28	330 k Ω	R64	33 k Ω	R100	47 k Ω
R29	220 k Ω	R65	560 k Ω	R101	47 k Ω
R30	100 k Ω	R66	220 k Ω	R102	560 k Ω
R31	1 M Ω	R67	560 k Ω	R103	560 k Ω
R32	470 k Ω	R68	560 k Ω	R104	4.7 Ω
R33	4.7 k Ω	R69	560 k Ω	R105	560 k Ω
R34	680 k Ω	R70	4.7 k Ω	R106	Not used
R35	470 k Ω	R71	220 Ω	R107	2.2 k Ω
R36	2.2 M Ω	R72	22 k Ω		

Loop Controller		D.F. Controller	
Circuit Reference	Value	Circuit Reference	Value
R1	Desynn Potentiometer	R1	10 k Ω
R2	1,000 Ω	R2	100 k Ω
		R3	33 k Ω

12.3 Removal of Receiver Sub-Assemblies.

12.3.1 Rotary Transformer and Filter Assembly.

The rotary transformer is removed from its mounting plate by unscrewing the two captive securing screws. The filter assembly is situated below the mounting plate, which may easily be detached by removing the countersunk screw nearest to each corner.

12.3.2 Vibrator Assembly.

The vibrator assembly is secured in its case by means of three cadmium plated 6 BA countersunk screws visible on the right-hand side of the receiver (see Fig. 7) and identified by spot facing. If these are removed, the assembly may be detached from its case by applying pressure to the vibrator through the aperture on the side nearest to the rotary transformer. It may be an advantage in the case of some receivers to remove the rotary transformer, as this will enable greater pressure to be applied.

12.3.3 BFO Assembly.

The BFO assembly is secured to the main chassis by means of two screws which are accessible from the left-hand side of the receiver. Before these are removed, the connecting wires from the assembly to the main chassis must be unsoldered.

12.3.4 1st and 2nd IF Inductance Assembly.

Before removing the IF inductance assembly, the switch wafer spindle must be withdrawn from the chassis. This is accomplished by removing the selectivity switch knob from the front panel and the click plate assembly beneath. All connecting wires must be unsoldered from the assembly and the four securing screws (accessible from the left-hand side of the chassis) removed.

12.3.5 Oscillator, Mixer, RF and Loop Inductance Assemblies.

The range switch spindle must be withdrawn from the receiver chassis before any of the RF inductance assemblies can be moved. The method of switch spindle removal is the same as for the selectivity switch described in Section 12.3.4 above. Each inductance assembly is held in place by four screws which are accessible from the right-hand side of the receiver. All connecting wires must be unsoldered from each assembly before it can be removed from the chassis.

In the case of the loop inductance assembly, it is advisable to first remove the RF inductance unit before attempting to unsolder any connections, otherwise difficulty may be experienced in unsoldering the screened loop input leads which pass through the chassis and are connected to the wafer switch contacts. On this assembly a 5μF condenser is attached to the front of the switch panel and the two connections to this component must also be removed before the assembly can be detached completely from the receiver.

12.3.6 Relay Assembly.

It is necessary to remove the rotary transformer before attempting to detach the relay assembly from the receiver. With one exception, the connections to the unit are all flexible and long enough to permit the assembly to be moved clear of the receiver chassis without disconnection. The only connection which must be unsoldered is the polythene insulated lead from the 470 pF condenser mounted on the right-hand side of the main tuning condenser. The assembly is secured to the top panel of the receiver case by means of four black buttonhead screws and if these are removed, it may be moved away from the panel in a rearward direction, partly into the rotary transformer aperture and then sideways away from the receiver chassis.

Care should be taken when replacing the assembly to ensure that the connecting cable form is tucked well into the tray above the main tuning condenser and is not pinched by the relay assembly when the latter is secured in position.

12.3.7 Hinged Valve Deck Assembly.

If the pivot screw at each end of the hinged valve deck is unscrewed, the complete assembly may be withdrawn for servicing. All connections are long enough to permit the assembly to be moved clear of the chassis without disconnection.

12.3.8 System Switch.

To detach the system switch on the front panel, the knob and escutcheon plate must be removed and the switch cover detached by unscrewing the two countersunk securing screws. The switch mounting plate will then be seen, held in position by two cheesehead screws. If these are removed, the complete switch may be drawn forward through the panel.

12.4 Procedure for Dismantling and Re-assembling the Loop.

12.4.1 Dismantling.

No difficulty should be experienced in dismantling the Type 1264 loop if the following sequence of operations is adhered to. Reference should be made to Fig. 27 :—

1. Remove the perspex covers by unscrewing the two 6 BA securing bolts.
2. Detach the Desynn potentiometer cover by releasing the screw clamps at each side.
3. Remove the tension spring from the potentiometer arm.
4. Unscrew the three 8 BA cheesehead screws securing the potentiometer moulding to the QE compensator assembly. Lift the potentiometer carefully and disconnect the five flexible leads.
5. Remove the cam pivot bracket by unscrewing the two 8 BA cheesehead securing screws beneath the pivot bracket support.
6. Remove the tension spring from the compensator assembly.
7. Loosen the three grub screws on the triangular boss, immediately below the compensator plate.
8. Remove the whole of the compensator assembly by unscrewing the corrector cam disc beneath it in an anti-clockwise direction. (Extreme care should be taken to ensure that the adjusting screws around the periphery of the cam are not disturbed in any way, as they are pre-set at the factory to compensate for irregularities in the Desynn potentiometer).
9. Unsolder the three flexible brush leads from the terminals and remove the two 6BA nuts and bolts securing the brush gear to the loop moulding.
10. Remove the brush holder and detach the clamp plate on the opposite side of the slip rings.
11. Remove the two 6BA cadmium plated, countersunk screws, securing the loop moulding to the centre stem. These are situated at the base of the loop moulding immediately below the brush aperture, one on each side of the moulding.
12. The loop moulding may now be removed from the centre stem by lifting it gently upwards and twisting it from side to side. The centre stem may be prevented from turning by holding the large Tufnol gear wheel, visible beneath the loop base plate.
13. Remove the three bakelite covers from the loose base plate. The motor cover is secured by a single captive 6BA screw. Four 6BA screws secure the centre cover. To release the plug and socket cover, two 6BA screws on the upper side and three 8BA screws beneath the baseplate must be removed.
14. Lift the centre stem and gear from the spindle. The slip rings and connections are now exposed. From this stage onwards the further dismantling of the loop is quite obvious, the remaining parts being secured direct to the baseplate.

12.4.2 Re-Assembly.

For re-assembly of the loop the reverse sequence to that described above should be followed. It is important, however, that the following points should be borne in mind :—

(*a*) When fitting the loop moulding to the centre stem the loop should be positioned so that the wide slot in the stem tube is opposite the brush holder position.

(*b*) The brush holder must be fitted with the yellow marking towards the base of the loop. When placing the brush holder in position, the brushes should be held back within the holder by applying slight tension to each brush lead and holding the leads with the fingers as they grip the brush holder.

(*c*) When securing the compensator assembly the cam ring should be tightened down and then unscrewed slightly until the position of the quadrantal error scale is as shown in Fig. 27 (*i.e.*, parallel to the loop baseplate). The three grub screws in the central boss should then be tightened.

(*d*) The Desynn potentiometer connections are as follows :—

Colour		*No.*
White	connect to	1
Green	,, ,,	2
Yellow	,, ,,	3
Brown	,, ,,	+6
Black	,, ,,	−7

When the potentiometer is fitted, its position must be adjusted until the ridge in the moulding beside the yellow mark on the winding is opposite the lower brush (negative) as shown in Fig. 27.

Note :—If when finally testing the loop after overhaul a slight discrepancy is noted in the bearings shown on the bearing indicator, it may be found necessary to readjust slightly the position of the potentiometer until accurate bearings are obtained.

12.5 Special Test Unit Type 1322.

In order to facilitate the testing and alignment of the receiver circuits, a special test unit has been designed. By the use of this instrument, conditions of operation on both the non-directional and the loop aerial may be effectively simulated.

(*a*) **Front Panel.** A tuning meter with a full scale deflection of 0.5mA is situated on the front panel of the unit. Three switches are provided for selecting the required test conditions, and at the base of the panel two connector plugs enable the unit to be connected to the receiver via the appropriate cables (*i.e.*, cables BC and K). A third connector plug is provided for a special test cable (BA/28) from the loop aerial to the test unit. This lead carries the current for the tuning meter, which is fed via cable AJ from the receiver to the loop. For certain simple tests, where the loop aerial is not required, cable AJ may be plugged straight into the test unit, thus supplying the meter directly. Terminals are also provided on the front panel for the signal generator connections.

(*b*) **Vertical Aerial Circuit.** A circuit diagram of the unit is shown in Fig. 36. The vertical aerial circuit consists of a 10 pF series condenser (C.1) to represent the effective aerial capacity, and a shunt adjustable capacity of approximately 200 pF maximum (C2 and C3), to simulate the capacities of the aerial rods and leads. This capacity is adjusted and pre-set at the factory to match the unit to a standard cable K. A switch is provided to enable the vertical aerial simulator to be switched in or out of circuit as required.

(*c*) **Loop Circuit.** The input from the signal generator is fed via an attenuating and phasing network to a small coupling coil in the centre of two equivalent loop windings. The total series inductance equals the loop inductance. A switch marked " L/R " permits the coupling coil connections to be reversed with respect to the loop windings, resulting in a 180° phase change of the input to the receiver, which is equivalent to reversing the loop direction. A further switch is provided which enables separate resistances in the attentuating network mentioned above to be selected as required. Resistances are provided which reduce signals to a level equivalent to " off course" positions of 1°, 3°, 10°, 25° and 90°. No provision is made in this unit to simulate the capacity and inductance of the loop lead. The receiver should therefore be connected to the test unit *via* the standard cable (BC).

When in use with this instrument the signal generator attenuator will read μV per metre.

12.6 Circuit Alignment Procedure.

The receiver circuits are accurately aligned at the factory before delivery and are designed to retain alignment over a long period. The service engineer should ascertain that any deterioration of receiver performance is not due to valve ageing or component defects, before disturbing inductance or condenser trimmer settings.

It is important that correct supply voltages to the receiver are maintained throughout the alignment procedure. These are 28 volts DC and 19±(1) volts DC, measured at the receiver back plate.

12.6.1 Apparatus.

The following apparatus will be required :—

(*a*) Signal Generator (the performance figures quoted in Section 12.7 were obtained with a signal generator having a source impedance of 10 ohms).
(*b*) BFO (Marconi Instruments Type TF.894, or similar, with step-down transformer—see Sections 12.6.7 and 12.7.15).
(*c*) Output Power Meter (Marconi Instruments Type TF.340 or similar).
(*d*) Test Unit Type 1322 (see Section 12.5).
(*e*) Headphones.
(*f*) Trimming tools as supplied.
(*g*) .01μF Condenser.
(*h*) 1MΩ Resistor.

12.6.2 IF Alignment.

In the procedure for IF alignment described below it will be noted that alignment of the IF circuits in the narrow bandwidth (crystal) position of the selector switch is performed with the aid of the signal strength meter provided in the special test unit. This is equivalent to the tuning indicator in the bearing indicator Type 1272, which is a 0.5 mA FSD instrument and indicates 0.1 mA when the pointer is at the first division of the scale. AGC commences to operate when the meter reads approximately 0.1 mA and therefore for alignment purposes the meter reading should not be allowed to rise above that value. The use of this meter eliminates the possibility of tuning to false peaks, which may be obtained (owing to the extremely high selectivity of the IF circuits) if alignment is attempted using modulated signals and the usual output power meter.

The method of alignment is as follows :—

(*a*) Set signal generator scale to 110 kc/s, modulated 40% at 400 c/s and connect via 0.1μF condenser to the grid of V.3 (Mixer).
(*b*) Turn both LF and HF gain controls to maximum and set selectivity switch to R/T broad bandwidth position. The system switch may be set to any " on " position.
(*c*) Tune L26, L25, L24, L23 and L19 in that order for maximum indication on the output power meter.
(*d*) Set selectivity switch to narrow bandwidth (crystal) position. Switch off modulation on signal generator, and turn down HF volume control until signal strength meter indicates approximately 80 microamps.
(*e*) Check signal generator scale setting (110 kc/s). Tune L20, L 21, L23, L24 and L25 in that order, reducing the output from signal generator when necessary so that tuning meter does not rise above 0.1 mA.
(*f*) Set selectivity switch to intermediate (1 kc/s) position, without disturbing the signal generator scale from the setting found in the crystal position (110 kc/s). Tune L19 and L22, using signal strength meter, as for narrow bandwidth position.
(*g*) Switch on signal generator modulator (400 c/s) and tune L26 for maximum indication on output power meter.

12.6.3 BFO Alignment.

(*a*) Connect signal generator via 0.1μF condenser to grid of V.3 and switch off modulation.
(*b*) Turn selectivity switch to CW, intermediate (1.5 kc/s) position, and set " Het " control to the " 9 o'clock " position of its travel.
(*c*) Adjust L28 for zero-beat in telephones.

12.6.4 Oscillator Alignment.

With signal generator connected via 0.1μF condenser to the grid of V3, and selectivity switch at CW, intermediate (1.5 kc/s) position, adjust trimmers listed below at the frequencies shown for maximum indication on output power meter :—

Frequency (*Mod.* 30% *at* 400 *c/s*)	*Range*	*Trimmer*
150 kc/s	R1	L13
300 kc/s	,,	C13
300 kc/s	R2	L14
580 kc/s	,,	C14
580 kc/s	R3	L15
1100 kc/s	,,	C15
1100 kc/s	R4	L16
2000 kc/s	,,	C16

12.6.5 Mixer and IF Trap Circuit Alignment.

Connect signal generator via 0.1 μF condenser to the grid of V2 and with selectivity switch at the 1.5 kc/s position, adjust trimmers listed below at the frequencies shown to maximum indication on output power meter :—

Frequency (*Mod.* 30% *at* 400 *c/s*)	*Range*	*Trimmer*
158	1	L9
270	1	C9
315	2	L10
520	2	C10
610	3	L11
1000	3	C11
1150	4	L12
1800	4	C12

Note :—Care should be exercised when adjusting C12 on Range 4, as movement of the trimmer may tend to pull the oscillator frequency. The adjustment should be made in conjunction with the main tuning condenser, each being varied until maximum output meter indication is obtained.

To align the IF trap circuit, the signal generator should be set at 110 kc/s, and inductances L17 and L18 adjusted until the receiver output is reduced to a *minimum*.

12.6.6 Loop and RF Circuit Alignment.

For alignment of the loop and RF circuits the special test unit Type 1322 is used. The procedure is as follows :—

(*a*) Connect signal generator to the appropriate terminals on the test unit and turn switch marked " Loop " to the 25° position. The " L/R " switch should be set at the " Left " position.

(*b*) Connect cables BC and AJ (or BA/28 from the loop) from the receiver to the test unit.

(*c*) Set receiver system switch at " Figure-of-eight " position. Adjust HF gain control until approximately 80 microamps is indicated on the test unit meter. Set loop gain control at quarter turn from maximum.

(*d*) Adjust RF and loop circuit trimmers in the order given below at the frequencies stated. (It is important that the test unit meter indication should not rise above 0.1 mA during this operation.)

The signal generator attenuator must be adjusted repeatedly, as the circuits are brought into alignment to maintain the meter reading below that figure.

Frequency kc/s (*Mod.* 30% *at* 400 *c/s*)	*Range*	*RF Trimmers*	*Loop Trimmers*
158	R1	L5	L1
270	,,	C5	C1
315	R2	L6	L2
520	,,	C6	C2
610	R3	L7	L3
1000	,,	C7	C3
1155	R4	L8	L4
1800	,,	C8	C4

Note :—The final adjustment of the loop circuits should be carried out with the object of obtaining the best possible " sense " operation. This will follow if the loop and vertical aerial voltages induced in the 1st RF tuned circuits are equal and opposite both in phase and amplitude when the loop is 25° off course. During the preliminary adjustment of the loop circuits, they are tuned to maximum amplitude response. Further adjustments of the tuning can considerably affect the phase relationship of the loop and vertical aerial voltages without noticeably altering the amplitude. Final adjustment of the loop circuits must therefore be performed on a phase basis.

With the test unit switches in the "Left" and "25 °" positions specified above, a complete cancellation both in amplitude and phase should be obtained with the receiver system switch in the " L " sense position. Adjust the loop trimmer for phase and the loop gain control for amplitude to achieve this result. This final adjustment is best carried out with a modulated signal, as the disappearance of the modulation at the point of cancellation is a very clear indication of correct adjustment.

12.6.7 Alignment of Voice/Range Filter Circuits.

For this operation a step down transformer must be connected to the BFO output terminals, so that the effective output impedance is reduced to 20 ohms.

Connect BFO via transformer to plug AT pin 3 on voice/range filter and connect output power meter to pin 1. Set BFO frequency scale to 1020 c/s, and voice/range filter switch to " Both ". Adjust input level until 300 mW output is indicated on meter. Turn filter switch to " Range " position and adjust the 3 chokes (CH.1, CH.2 and CH.3) for maximum response.

This adjustment automatically sets the filters for the " Voice " position also.

12.7 General Performance Tests.

The following performance tests should be applied to the receiver, after making any major repairs at circuit adjustments, or when it is suspected that the performance of the equipment has appreciably deteriorated.

12.7.1 LF Gain.

With receiver in operation and LF gain control at maximum, connect BFO output between the grid of V10 and earth. Inject 60 mV at 1000 c/s. Receiver output should then be approximately 225 mW into 33 ohms.

12.7.2 LF Response.

With BFO connected as above, inject 100 mV at 1,000 c/s and adjust LF gain control until output is 100 mW. Alter BFO frequency scale and note db's change in receiver output. Typical response figures are as follows :—

Frequency (c/s)	100	500	1,000	5,000	10,000
Output Variation (db)	−9	−1.3	0	−1.8	−3

12.7.3 IF and HF Gain.

Connect signal generator (set at 110 kc/s Mod. 30% at 400 c/s) via 0.1 μF condenser to the grid of each IF valve in turn. The input required for an approximate output of 100 mW into 33 ohms (or for an indication of 80 micro-amps on signal strength meter) is given below for each valve. The receiver selectivity switch should be set at the intermediate (1.5 kc/s) position, the system switch at " Omni ", and the LF and HF gain controls at maximum.

Valve	*Input*
2nd IF Grid (V7)	< 100,000 μV
1st IF Grid (V5)	<800 μV
Mixer Grid (V3)	<23 μV

Set signal generator scale to 150 kc/s and tune receiver to that frequency. Inputs required for 100 mA output should then be as follows :—

Valve	*Input*
Mixer Grid (V3)	<40 μV
RF Grid (V2)	< 5 μV

It will be noted that the sensitivity figures quoted above for the 1.5 kc/s position of the selectivity switch will be reduced by approximately 1 db and 6 db when the switch is in the 400 c/s (crystal) and 5 kc/s positions respectively. If the sensitivity of the receiver is found to be higher in the 5 kc/s position, the coupling coil (L24) connections should be reversed.

12.7.4 IF Bandwidth Check.

(*a*) Connect signal generator via 0.1 μF condenser to the grid of V3. Set frequency scale at 110 kc/s and switch off modulation. Adjust attenuator for 100 μV input to the receiver.

(*b*) Set receiver selectivity switch at the 5 kc/s position (CW) and adjust HF gain control until tuning meter needle is below first scale division (80 micro-amps).

(*c*) Detune signal generator, then return frequency scale slowly until tuning meter indicates a maximum. If necessary, adjust HF gain control to prevent pointer rising above the first scale division. Note signal generator readings on the vernier scale.

(*d*) Increase input from signal generator by 6 db. Detune in the same direction as before, then return scale slowly until tuning indicator needle is again at the first division (80 microamps). Note signal generator vernier scale reading.

(*e*) Continue movement of signal generator scale in the same direction until the tuning indicator needle is once again at the first division of the scale. Note vernier scale reading on signal generator.

(*f*) Repeat (*d*) and (*e*) with 60 db increase of input from signal generator.

The above tests should also be performed with the selectivity switch in the 1.5 kc/s and 400 c/s positions. From the readings obtained the IF bandwidths may now be computed. Typical bandwidth figures are as follows :—

Selectivity Switch Position	*Total Bandwidth* 6 db	60 db
Broad	3.5– 6 kc/s	13–18 kc/s
Intermediate	1.2–1.7 kc/s	7– 9 kc/s
Crystal	0.35–0.6 kc/s	3.7– 5 kc/s

The method of signal generator adjustment described above, if performed carefully, eliminates errors due to backlash in the tuning control.

12.7.5 Signal/Noise Ratio, Loop.

(*a*) Connect receiver to special test unit, turn system switch to loop " ∞ " position, and set selectivity control at the intermediate (1.5 kc/s) position on R/T.

(*b*) Connect signal generator to the appropriate terminals on the test unit (frequency and attenuator settings as below, modulation 30% at 400 c/s).

(*c*) Set test unit switches to the " 90 " and " Loop " positions.

(*d*) Adjust HF gain control for an output of 50 mW.

(*e*) Switch off modulation on signal generator and note setting of attenuator.

(*f*) Increase signal generator output until meter again reads 50 mW. Note attenuator setting. This should show an increase of more than 20 db over previous position.

Frequency kc/s :—	150	300	300	580	580	1,100	1,100	2,000
Range :—	1	1	2	2	3	3	4	4
Inputs to provide S/N ratio of 20 db to be not greater than (μV)	900	500	450	350	300	200	180	120

12.7.6 BFO Check.

With signal generator connected as in Section 12.7.5 and test unit aerial switch at " Vert ", set receiver system switch to " Omni " and selectivity switch to 5 kc/s, R/T position. Adjust LF gain control until output is, say, 5 mW. Switch off modulation on signal generator and turn receiver selectivity switch to the 5 kc/s CW position. Adjust " Het " control until a beat note of 1,000 c/s is obtained. Reading on output meter should then show an increase of approximately 10 db.

12.7.7 Second Channel Attenuation.

With signal generator scale at suitable frequency (see table below) and receiver connected to test unit as in Section 12.7.5, set receiver system switch at " Omni " and selectivity switch at the 1.5 kc/s position. Adjust HF gain control until tuning meter indicates 80 micro-amps. Set signal generator scale to image frequency (*i.e.*, increase scale reading by 220 kc/s) and adjust attenuator until tuning meter again indicates 80 micro-amps. Note the increase in signal generator output in db. Typical figures are given below for various frequencies :—

Frequency :—	150	300	300	580	580	1,100	1,100	2,000
Range :—	R1	R1	R2	R2	R3	R3	R4	R4
Second Channel attenuation (db) :—	80	60	70	50	70	50	55	36

12.7.8 AGC Performance.

With signal generator, test unit and receiver connected and set up as in Section 12.7.5, adjust attenuator for an input of 50 µV. Turn receiver LF gain control until an output of 10 mW is obtained. Adjust attenuator setting for 100,000 µV input. The increase in receiver output should not exceed 50 mW.

12.7.9 IF Rejection Ratio.

With signal generator set at any convenient frequency and test unit and receiver connected as in Section 12.7.5, tune receiver and adjust gain controls for a convenient output level, say 50 mW. Note attenuator setting. Set signal generator frequency scale to 110 kc/s, and adjust attenuator until the receiver output is the same as previously. The attenuator setting now obtained should indicate an increase in input of more than 80 db.

12.7.10 Aural Performance.

Signal generator and receiver connected to test unit, modulation on (30% at 1,000 c/s). Set test unit switches at " Vert ", " 25° " and " L " positions respectively and receiver system switch to left sense position. Note reading on output power meter. Move system switch to right sense position and compare reading on output power meter. An increase of 20 db in output should be obtained when the switch is in the latter position.

12.7.11 Motor Amplifier Performances.

Remove vibrator unit from receiver and connect BFO output via a 1-megohm resistance to the grid of V13. Connect output meter to plug AJ (pins 4 and 3) and connect pin 7 to pin 3 to complete the HT + connection to the screen of V15 (care should be exercised to ensure that the anode circuit of V15 is not interrupted while HT is connected to the screen or the valve may be damaged). Turn both LF and HF gain controls to minimum. Under these conditions an input of 1 volt at 150 c/s should provide an output of 500 mW into 10,000 ohms. This output should decrease by 10 db, 22 db and 5 db at 500 c/s, 1,000 c/s and 50 c/s respectively.

12.7.12 ADF Performance.

Connect signal generator to test unit and set frequency scale at test frequency (see below). The modulation should be switched *OFF*. Set test unit switches at " Vert ", " 3° " and " R " respectively. Connect automatic loop to receiver by means of cable AJ and connect receiver to test unit via cable BC. Set receiver system switch to " Vis " position, and selectivity switch to the 5 kc/s position.

Adjust signal generator attenuator for an output of 100,000 µV. The loop should now revolve in an anti-clockwise direction viewed from the apex. Under these conditions maximum torque should be obtained, and the loop should make one complete revolution in under 5 seconds. Turn test unit L/R switch to the left position and the loop should now revolve in a clockwise direction.

Switch on modulation on signal generator (100% at 1,000 c/s), loop speed should not reduce appreciably. Loop should make one revolution in under 7 seconds.

Turn test unit loop switch to " 25° " and " 90° " positions, and signal generator output to 100 µV, loop speed should remain unchanged.

Set test unit loop switch to " 1° " position and signal generator output to 600 µV. Loop should revolve slowly at about 1 revolution per minute. Turn test unit loop switch to " 0 " and set signal generator attenuation for 100,000 µV output. Loop should remain steady in one position.

12.7.13 Radio Range Performance.

With receiver and signal generator connected as in Section 12.7.12 above, set receiver dial at 150 kc/s and system switch to " Omni ". Turn HF and LF gain controls to maximum. Switch radio range switch to " Range " and note output level of noise (say 200 mW). Switch on signal generator and set scale at 150 kc/s and attenuator at 100,000 µV. Switch off signal generator and note time taken for the noise output to reach the same level as before. The time taken should be at least 10 seconds.

12.7.14 Test for Condenser Microphony.

Conditions of test as in Section 12.7.12. Set signal generator attenuator for 100,000 µV output and switch off the modulation. Mistune receiver slightly and listen for a singing note of approximately 1,000 c/s. If this is found to be strongly maintained it indicates a microphonic ganged tuning condenser.

12.7.15 Voice/Range Filter Performance.

Connect BFO via step down transformer (see Section 12.6.7) to pin 3 of plug AT on voice/range filter and output meter to pin 1. Set BFO frequency scale to 1,020 c/s and note outputs obtained when the filter switch is in the " Voice " and " Range " positions.

At the frequencies stated the attenuation of output with reference to that obtained at 1,020 c/s should be as follows :—

(Switch at " Range " position)

$>$ 6 db at frequencies below 860 c/s and above 1,300 c/s.
$>$ 10 db „ „ „ 780 c/s „ „ 1,500 c/s.
$>$ 20 db „ „ „ 640 c/s „ „ 2,800 c/s.

The attenuation of output with reference to 300 mW should be as follows :—

(Switch at " Voice " position)

$<$ 2 db at frequencies below 500 c/s and above 2,000 c/s.
$<$ 6 db „ „ „ 680 c/s „ „ 1,350 c/s.
$<$ 26 db „ 1,020 c/s.

13 RECOMMENDED FLIGHT SPARES

It is recommended that the following spares should be carried in the aircraft :—

Description	*Ref. No.*	*Qty.*
Valve	CV131	2
Valve	CV138	1
Valve	CV136	1
Valve	CV140	1
Fuse 10 amp.	XF.10	3
Fuse 4 amp.	XF.19	3
Fuse 150 mA	XF.16	3
Dial Lamp	XL.10	3

14 COMPREHENSIVE LIST OF MAIN UNITS AND COMPONENTS

SUMMARY OF CONTENTS

Note :—In the following tables condensers, resistances and potentiometers are arranged under their appropriate headings in ascending order of value. By first obtaining the value of the component from the tables on pages 29, 30 and 31 it can easily be located in the tables below.

Miscellaneous items are listed in alphabetical order.

When ordering spare main units the full instrument type numbers should be quoted. In the case of ancillaries and components, the spare-part reference number only need be given.

1 Main Units and Ancillaries.

Item No.	Description	Dwg. No.	Qty. Used per set	Remarks	Spare Part Ref. No.
1	Receiver Type AD7092	W19051 Sh. 1 Ed. A	1		
2	Loop DF Type 1264	W16792 Sh. 1 Ed. A	1		
3	Baseplate for Loop Type 1278	W18039/B Sh. 1 Ed. A	1		
4	Stremlined Housing for Loop Type 1268	W16995 Sh. 1 Ed. A	1	For externally mounted loop	
5	Whip Aerial Type 137	D3/A/2123/C	1		XA10
6	D.F. Aerial Transformer Type 922	W14966 Sh. 1 Ed. A	1		
7	Bearing Indicator Type 1272	W20611/C Sh. 1 Ed. A	1—3		
8	D.F. Controller Type 933	W15260 Sh. 1 Ed. A	1	For remotely controlled receivers.	
9	Loop Controller Type 1273	W18179 Sh. 1 Ed. A	1		
10	Voice/Range Filter Type 949	W17490 Sh. 1 Ed. A	1		
11	Controller Switch Drive Type 1263	W16783 Sh. 1 Ed. A	2	Complete Unit for 12 position switch selection	XSA115
12	Controller Switch Drive Type 1263A	W16783 Sh. 1 Ed. B	2	Motor Type 1263 without Cover and mounting Bracket	XSA254
13	Backplate for Receiver Type 936	W14953/B Sh. 1 Ed. A	1		
14	Valve Release Tool	W15950/C Sh. 1 Ed. A	1		XT41
15	Cable, Mechanical Drive, complete with end connectors (Cable AR).	W13862 Sh. 1 Ed. AR	1	For remotely controlled receivers.	
16	Cable, complete with end fittings, connecting DF Aerial Transformer to Receiver (Cable K).	W13862 Sh. 1 Ed. K	1		
17	Cable, complete with end fittings, connecting whip aerial to DF aerial transformer (Cable Z).	W13862 Sh. 1 Ed. Z	1		
18	Cable, complete with end fittings, connecting Receiver to Operator's Mixing Box (Cable L).	W13862 Sh. 1 Ed. L	1		
19	Cable, complete with end fittings, connecting Receiver to Regulator Unit (Cable M).	W13862 Sh. 1 Ed. M	1		
20	Cable, complete with end fittings, connecting Receiver to DF controller (Cable P).	W.13862 Sh. 1 Ed. P	1		
21	Cable, complete with end fittings, connecting Receiver to DF controller (Cable Q).	W13862 Sh. 1 Ed. Q	1	Length as required	See Note below.
22	Cable, complete with end fittings, connecting DF Loop to Receiver (Cable BC).	W13862 Sh. 1 Ed. BC	1		
23	Cable, complete with end fittings, connecting DF Loop to Receiver (Cable AJ).	W13862 Sh. 1 Ed. AJ	1		
24	Cable, complete with end fittings, connecting Loop Controller to Bearing Indicator (Cable AY).	W18622	1		
25	Cable, complete with end fittings, connecting Receiver to Voice/ Range Filter (Cable AT).	W13862 Sh. 1 Ed. AT	1		
26	Cable, complete with end fittings, connecting DF Loop to Bearing Indicator (Cable BA).	W13862 Sh. 1 Ed. BA	1		
27	Hood Assembly, 12 way, for protection of unused plugs.	W17228/C Sh. 1 Ed. A	1		XH8
28	Hood Assembly, 8 way, for protection of unused plugs.	W17228/C Sh. 1 Ed. B	1		XH29

Note : When ordering replacements the cable references (i.e. " Cable K ", " Cable Z," etc.) should be quoted. In the case of aircraft other than the De Havilland " Dove," a suffix number is added to indicate the cable length (" K/1," " Z/1," etc.) and this, and/or the aircraft type, should also be given.

2 Condensers.

Item No.	Description	Capacity	Tolerance	V.D.C. Wkg.	Circuit Refs.		Remarks	Spare Part Ref. No.
					Receiver	Other Units		
101	Silvered Ceramic	5μμF	±20%	—	C29, C85	—		XCX82
102	Protected Silver Mica	15μμF	± 2%	350	C132, 134, 135	—		XCX184
103	Protected Silver Mica	22μμF	±10%	350	—	C5 (DF Ae Trans.)		XCX33
104	Trimmer, with bracket	30μμF (Max)	—	—	C1—16 incl.	—		XCX86
105	Protected Silvered Mica	47μμF	± 5%	350	C31	—		XCX176
106	Moulded Mica	50μμF	±10%	—	C99	—		XCX179
107	Moulded Mica	50μμF	+100—0%	—	C100, 101	—		XCX202
108	Protected Silvered Mica	70μμF	±10%	350	—	C2 (DF Ae Trans.)		XCX164
109	Protected Silvered Mica	83μμF	± 2%	350	C38, 40	—		XCX173
110	Protected Silvered Mica	100μμF	± 5%	350	C33	—		XCX14
111	Ceramic, through mounting	100μμF	+50—25%	—	C63, 64, 65, 111, 113	—		XCX182
112	Trimmer	100μμF (Max)	—	—	—	C1 (DF Ae Trans.)		XCX162
113	Protected Silvered Mica	140μμF	±10%	350	—	C3, 4 (DF Ae Trans.)		XCX163
114	Variable, Air spaced, 4 gang	187.2μμF	—	—	C20, 21, 22, 23	—		XCX88
115	Protected Silvered Mica	220μμF	± 2%	350	C28	—		XCX181
116	Protected Silvered Mica	330μμF	± 2%	350	C37, 41	—		XCX172
117	Protected Silvered Mica	390μμF	± 2%	350	C34, 35, 36, 39	—		XCX174
118	Protected Silvered Mica	440μμF	± 2%	350	C17, 32	—		XCX171
119	Silvered Mica, wax finish	470μμF	± 2%	—	C24	—		XCX185
120	Protected Silvered Mica	900μμF	± 5%	350	C18	—		XCX170
121	Min. Tubular, metal cased (T.C.C.)	.001μF	±20%	500	C89, 93, 94, 95	—		XCX186
122	Min. Tubular, metal cased (Dubilier)	.001μF	±20%	500	C104, 106	—		XCX180
123	Protected, Silvered Mica	.0018μF	± 5%	350	C19	—		XCX169
124	Min. Tubular, metal cased	.002μF	±20%	500	C52, 53, 56	—		XCX187
125	Min. Tubular, metal cased	.005μF	±20%	500	C48	—		XCX188
126	Min. Tubular, metal cased	.01μF	±25%	350	C50, 51, 55, 58, 59, 62, 109, 133, 136	C2 (Loop Cont.)		XCX6
127	Min. Tubular, metal cased	.05μF	±25%	250	C42, 74, 97, 108, 121	C1, 2 (V/R Filter)		XCX30
128	Min. Tubular, metal cased	0.1μF	±25%	150	C43, 45, 49, 54, 61, 66, 67, 68, 69, 70, 71, 75, 77, 79, 80, 98, 107, 112, 122, 127, 130, 131	C128 (Loop) 2 Located in Cont. SW. Drive		XCX29
129	Min. Tubular, metal cased	0.5μF	±25%	150	—	C1 (Loop Cont.)		XCX127
130	Min. Tubular, metal cased	1μF	±25%	150	—	C3, 4 (V/R Filter).		XCX166
131	Min. Electrolytic	1μF	—	350	C44, 47, 72, 76, 78, 96, 102, 105	—		XCX178
132	Min. Electrolytic	5μF	—	50	C27, 60, 81, 82, 83, 84, 87, 88, 123, 124	—		XCX26
133	Min. Electrolytic	8μF	—	275	C73, 119	—		XCX177
134	Min. Electrolytic	10μF	—	25	C26, C126	—		XCX11
135	Min. Electrolytic	12μF	—	50	C90, 91	—		XCX23

3 Resistances and Potentiometers.

Note : Owing to the various methods of wattage rating applied to resistances by different manufacturers, it is recommended that all replacements be obtained from Marconi's W/T Co. who will then ensure that the correct types are supplied.

Item No.	Type	Resistance ohms	Toler- ance	Rat- ing Watts	Circuit Refs.		Remarks	Spare Part Ref. No.
					Receiver	Other Units		
201	Wirewound	4.7	±10%	3	R104		Wattage ratings	XRX229
202	Wirewound	10	± 5%	1	R89	—	given are	XRX113
203	Wirewound	30	± 5%	3	R12	—	arbitrary	XRX226
204	Wirewound, vitreous	50	± 5%	2	—	2 in. cont. SW Drive	figures quoted by manu-	XRX96
205	Wirewound, vitreous	60	± 5%	5	R88	—	facturers.	XRX284
206	Wirewound	100	± 5%	3	R82,83	—	See Note above.	XRX227
207	Carbon	220	±10%	½	R4, 71	—		XRX71
208	Carbon	470	±10%	½	R2, 38, 77, 94	—		XRX98
209	Carbon	680	±10%	½	R59	—		XRX72
210	Carbon	1K	±10%	½	R21	R2 (Loop Cont.)		XRX89
211	Carbon	1.5K	±10%	½	R27, 52, 47	—		XRX100
212	Carbon	2.2K	±20%	⅛	R107	—		XRX262
213	Carbon	3.3K	±10%	½	R14, 20	—		XRX73
214	Carbon	4.7K	±10%	½	R6, 33, 70	—		XRX74
215	Carbon	10K	±10%	½	R17, 44, 80	—		XRX101
216	Potentiometer, carbon track, spindle length 1⅜″	10K	—	—	R63	R1, (DF Cont.)		XRX244
217	Potentiometer, carbon track, spindle length 13/16″ with slot	10K	—	—	R76	—		XRX243
218	Carbon	22K	±10%		R7, 11, 18, 72	—		XRX76
219	Carbon	27K	±10%	½	R15, 22, 40	—		XRX235
220	Carbon	33K	±10%	½	R16	—		XRX77
221	Potentiometer, carbon track (Anti log law)	33K	±25%	—	R64	R3. (DF Cont.)		XRX247
222	Carbon	47K	±10%	½	R3, 100, 101	—		XRX224
223	Carbon	68K	±10%	½	R48, 53, 97, 98, 99	—		XRX231
224	Carbon	100K	±20%	½	R1, 5, 10, 19	—		XRX79
225	Carbon	100K	±10%	½	R30, 43, 78, 79, 81, 85, 86, 87, 95	—		XRX102
226	Potentiometer, carbon track spindle length 1⅜″	100K	—	—	R62	R2 (DF Cont.)		XRX245
227	Carbon	150K	±20%	½	R25	—		XRX225
228	Carbon	220K	±10%	½	R29, 49, 56, 66	—		XRX88
229	Carbon	330K	±10%	½	R26, 28	—		XRX80
230	Carbon	470K	±10%	½	R32, 35	—		XRX86
231	Carbon	560K	±10%	½	R9, 45, 54, 65, 67, 68, 69, 73, 74, 75	—		XRX230
232	Carbon	560K	±20%	½	R61, 102, 105	—		XRX232
233	Carbon	560K	±20%	⅛	R57, 103	—		XRX233
234	Carbon	680K	±10%	½	R34	—		XRX85
235	Carbon	1M	±20%	½	R8, 13, 23, 24	—		XRX83
236	Carbon	1M	±20%	⅛	R31, 37, 58	—		XRX263
237	Carbon	2.2M	±20%	½	R36, 42, 50, 55	—		XRX84
238	Carbon	5.6M	±20%	½	R46, 51	—		XRX228

4 Chokes and Transformers

Item No.	Description	Dwg. No.	Circuit Refs.		Remarks	Spare Part Ref. No.
			Receiver	Other Units		
301	Transformer	ED9/2775/C Sh. 1 Ed. B	—	Tl (Loop Cont.)		XSA313
302	Transformer	ED9/2855/C Sh. 1 Ed.A	—	Tl (Loop)		XSA314
303	Choke LF	ED9/2622/C Sh. 7 Ed. A	—	CH1 and CH2 (V/R Filter)		XSA30
304	Choke LF	ED9/2622/C Sh. 7 Ed. B	—	CH3 (V/R Filter)		XSA31
305	Transformer (Audio output)	ED/2613/C Sh. 1 Ed. A	T1	—		XSA70
306	Transformer (Vibrator Power)	ED9/2759/C Sh. 1 Ed.A	T2	—		XSA286
307	Choke HF	W14579/C Sh. 1 Ed. A	—	L1 (DF Ae Trans.)		XSA256
308	Choke HF/LT	W15948/C Sh. 1 Ref. 1	CH1, CH2	—		XSA43
309	Choke HF/HT	W20492/C Sh. 1 Ed. A	CH3	—		XSA258

5 Valves.

Item No.	Type Ref.	Description	Circuit Ref.	Remarks
401	CV131	Min. HF pentode, Variable Mu 131	V2, 3, 5, 7, 10, 13, 14	
402	CV136	Min. LF pentode 136	V15	
403	CV138	Min. HF pentode 138	V1, 4, 6, 11, 16, 17, 18	
404	CV140	Min. double diode 140	V8, 9	
405	CS/2/A	Crystal rectifier valve CS/2/A	V12	

6 Cables.

Item No.	Description	Refs. of Cable Connectors in which used	Remarks	Spare Part Ref. No.
501	Cable—Code VAB/10B (9/.012″ or 23/.0076″ T.C.—black PVC—O/D .102″)	L, M, P, AJ, AT, BA		XC42
502	Cable—Code VAB/12B (16/.012″ or 40/.0076″ T.C.—black PVC—O/D .145″).	M.Q.		XC43
503	Cable—Code VAB/15B (16/.012″ or 40/.0076″ T.C.—black PVC—O/D .240″).	Z		XC167
504	Cable—Code VAB/34B (9/.012″ or 23/.0076″ T.C.—black PVC—O/D .122″).	AJ	Cable lengths will depend upon the particular installation layout.	XC166
505	Cable—Code VQB/1E (9/.012 or 23/.0076″ T.C.—Flat twin blue PVC—T.C. braided O/A to .102″ ×.204″).	Q, BA		XC81
506	Cable Uniradio 32/PVC sheath .230″ O/D—1/.022″ P.C.W.	K		XC41
507	Cable—23/.0076″ T.C. Telcothene insulated to O/D of .093″. Tinned copper braided O/A	BC, AJ		XC84
508	Cable Sheath 7 mm 1/D, 1mm wall, black micoflex dura-tube grade S12	K, AT, L		XS86
509	Cable Sheath 10 mm 1/D, 1mm wall	M, BA		XS59
510	Cable Sheath 13 mm 1/D, 1mm wall	P, Q, BC, AJ		XS56

7 Plugs and Sockets.

Item No.	Description	Remarks	Spare Part Ref. No.
601	Plug 2-way P302 AB	" AB " denotes panel mountings	XP17
602	Plug 4-way P304 AB	" CCT " denotes connecting cable termination	XP5
603	Plug 4-way P304 CCT		XP67
604	Plug 6-way P306 AB		XP4
605	Plug 6-way P306 CCT		XP35
606	Plug 8-way P308 AB		XP6
607	Plug 8-way P308 CCT		XP68
608	Plug 12-way P312 AB		XP55
609	Plug 12-way P312 CCT		XP73
610	Socket 2-way S302 AB		XS61
611	Socket 2-way S302 CCT		XS55
612	Socket 4-way S304 AB (Modified)		XS101
613	Socket 4-way S304 CCT		XS11
614	Socket 6-way S306 AB		XS9
615	Socket 6-way S306 CCT		XS13
616	Socket 8-way S308 AB		XS100
617	Socket 8-way S308 CCT		XS12
618	Socket 12-way S312 CCT		XS10

8 Miscellaneous.

Item No.	Description	Location and Circuit Ref. or Quantity Required		Remarks	Spare Part Ref. No.
		Receiver	Other Units		
701	Armature Assembly for controller switch drive, Dwg. No. W16889/C Sh. 1 Ed. A	—	1 off		XSA121
702	Bearing, rotary transformer	2 off	—		XB90
703	Breather unit, Silica gel. WZ1156/B Sh. 1 Ed. A	—	1 off (loop)		XSA294
704	Brush, Loop	—	3 off		XB151
705	Brush, HT. rotary transformer	2 off	—		XB69
706	Brush, LT. rotary transformer	2 off	—		XB70
707	Brush Holder, Loop, Dwg. No. W17244/B Sh. 1 Ref. 1	—	1 off		XH28
708	Brush Holder, HT rotary transformer	2 off	—		XB96
709	Brush Holder, LT rotary transformer	2 off	—		XB97
710	Coil Assembly for controller switch drive, W16888 Sh. 1 Ed. A	—	1 off		XSA119
711	Cover, Loop, perspex, W17304/B Sh. 1 Ref. 1	—	2 off		XC240
712	Cover, Bakelite, for loop motor and transformer, W.17263/B Sh. 1 Ref. 1	—	1 off		XC275
713	Crystal Type 945, 110 kc/s ±100 cycles	X1	—		XC229
714	Desynn Transmitter potentiometer ED9/2664/C	—	1 off (Loop)		XRX242
715	Desynn Transmitter potentiometer	—	R1 (Loop cont.)		XT81
716	Fuse, 150 mA	F3	—		XF16
717	Fuse, 10 amp	F1	—		XF10
718	Fuse, 4 amp	F2	—		XF19
719	Fuseholder, miniature, panel mounting Type LS75	2 off	—		XF8
720	Fuseholder, panel mounting, WIS4154/C Sh. 1 Ref. 1	1 off	—		XF9
721	Handle, for Loop controller W18681/C Sh. 1 Ref. 1	—	1 Off		XH16
722	Handle Assembly for receiver tuning W15399/C Sh. 1 Ed. A	1 off	—		XSA95
723	Handle Assembly W15399/C Sh. 1 Ed. B	—	1 off (DF cont.)		XSA8
724	Inductance Unit (Range 1 and 2, mixer) W16808 Sh. 1 Ed. A	L9, 10	—		XSA312
725	Inductance Unit (Range 3 and 4 mixer) W16809 Sh. 1 Ed. A	L11, 12	—		XSA274
726	Inductance Unit (Range 1 and 2, loop) W16418 Sh. 1 Ed. A	L1, 2	—		XSA275
727	Inductance Unit (Range 3 and 4, loop) W16419 Sh. 1 Ed. A	L3, 4	—		XSA276
728	Inductance Unit (Range 1 and 2, R.F.) W16802 Sh. 1 Ed.A	L5, 6	—		XSA277
729	Inductance Unit (Range 3 and 4 R.F.) W16803 Sh. 1 Ed. A	L7, 8	—		XSA278

Item No.	Description	Location and Circuit Ref. or Quantity Required		Remarks	Spare Part Ref. No.
		Receiver	Other Units		
730	Inductance Unit (Range 1 and 2, Oscillator) W16814 Sh. 1 Ed. A	L13; 14	—		XSA279
731	Inductance Unit (Range 3 and 4 Oscillator) W16815, Sh. 1 Ed. A	L15, 16	—		XSA280
732	Inductance Unit (I.F. trap) W17553 Sh. 1 Ed. A	L17, 18	—		XSA281
733	Inductance Unit (1st I.F. crystal input) W17544 Sh. 1 Ed. A	L19, 20			XSA282
734	Inductance Unit (1st I.F. crystal output) W17545 Sh. 1 Ed. A	L21, 22	—		XSA283
735	Inductance Unit (2nd I.F.) W17546 Sh. 1 Ed. A	L23, 24	—		XSA284
736	Inductance Unit (3rd I.F.) W17547 Sh. 1 Ed. A	L25, 26	—		XSA285
737	Inductance Unit (Het.) W14641 Sh. 1 Ed. A	L27, 28	—		XSA403
738	Knob (E.K. Cole Dwg. C12482)	—	1 off (V/R Filter) 3 off (D.F. Cont.)		XK2
739	Knob Assembly, for selectivity, range and system switches W14367/C Sh. 1 Ed. A	3 off	—		XSA202
740	Knob ¾″ diameter, for het. and gain controls	3 off	3 off (DF Cont.)		XK4
741	Knob 15/16″ diameter for receiver tuning W16979/C, Sh. 1 Ref. 1	1 off	—	Replaces item 722 on remote con-controlled receivers.	XK14
742	Knob and gear Assembly W15253C Sh. 1 Ed. A	—	1 off (DF. Cont.)		XSA84
743	Knurled Nut, for securing loop to mounting W17574/C Sh. 1 Ref. 1	—	1 off (mounting plate).		XN42
744	Lamp, dial, 3 watt, 24 Volt Type A.MES.	Lp.1	Lpl (DF. Cont.)		XL10
745	Motor, 2-phase, for loop rotation WIS3974 Sh. 1	—	1 off		XM111
746	Mounting, anti-vibration	5 off	—	Rotary transformer suspension	XM14
747	Relay, Miniature, Type 4181 cm.	RL1, 2, 3, 4	—		XR125
748	Rotary Transformer, WIS3918/B Sh. 1 Ref. 1	1 off	—		XT2
749	Sealing Compound for loop streamlined housing	—	—	½ lb. tin	XC300
750	Shaft, flexible, for condenser drive W15322/C Sh. 1 Ref. 1	1 off	—		XS214
751	Spring, Tension, for Desynn transmitter arm W18585/C, Sh. 1 Ref. 1	—	1 off (Loop)		XS361
752	Spring, Tension, for loop corrector assembly W18586/C, Sh. 1 Ref. 1	—	1 off		XS361
753	Spring, Tension, for securing cover on loop winding, W18590/C Sh. 1 Ref. 1	—	2 off		XS362
754	Spring, Compression, for loop brushes W7451/C Sh. 1 Ref. 4A	—	3 off		XS363
755	Switch, miniature push button, locking type	S12, 13	S4, 5 (D/F Cont.)		XS202
756	Switch, midget wafer, No. WIS3770/C Sh. 13	—	S1 (V/R Filter)		XS301
757	Switch, wafer (selectivity) WIS3770/C Sh. 7	S9	—		XW63
758	Switch, wafer (selectivity) WIS3770/C Sh. 8	S8	—		XW64
759	Switch, wafer (selectivity) WIS3770/C Sh. 9	S7	—		XW65
760	Switch, wafer (selectivity, motor) WIS3770/C Sh. 10	S6	—		XW66
761	Switch wafer (RF) WIS3770/C Sh. 11	S2, 3, 4, 5	—		XW67
762	Switch wafer (RF, motor) WIS3770/C Sh. 12	S1	—		XW68
763	Switch, wafer (Function switch) WIS3770/C Sh. 6	S10, 11			XS302
764	Switch, midget wafer (Function switch) WIS3770/C Sh. 1	—	S1 (DF. Cont.)		XS286
765	Switch, midget wafer (Range) WIS3770/C Sh. 2	—	S2 (DF. Cont.)		XW29
766	Switch, midget wafer (Selectivity) WIS3770/C Sh. 3	—	S3 (DF. Cont.)		XS300
767	Switch, midget wafer (Ae matching cont.), WIS3770/C Sh. 14	—	S1 (DF. Ae Trans.)		XS238
768	Trimming Tool (Inductance)	—	—	For circuit alignment. Supplied with each receiver.	XT69
769	Trimming Tool (Capacity)	—	—	(as above)	XT64
770	Valve holder, B7G, ceramic with lower shield, Type 75/828	17 off	—		XV1
771	Valve holder, B7G, ceramic with lower shield, Type 75/841 or Type 75/842	1 off	—	For crystal valve (VI2)	XV16
772	Valve holder, top can for, with spring, for B7G	18 off	—		XC35
773	Vibrator Ericcsons Type AM14	Vbl	—		XV17

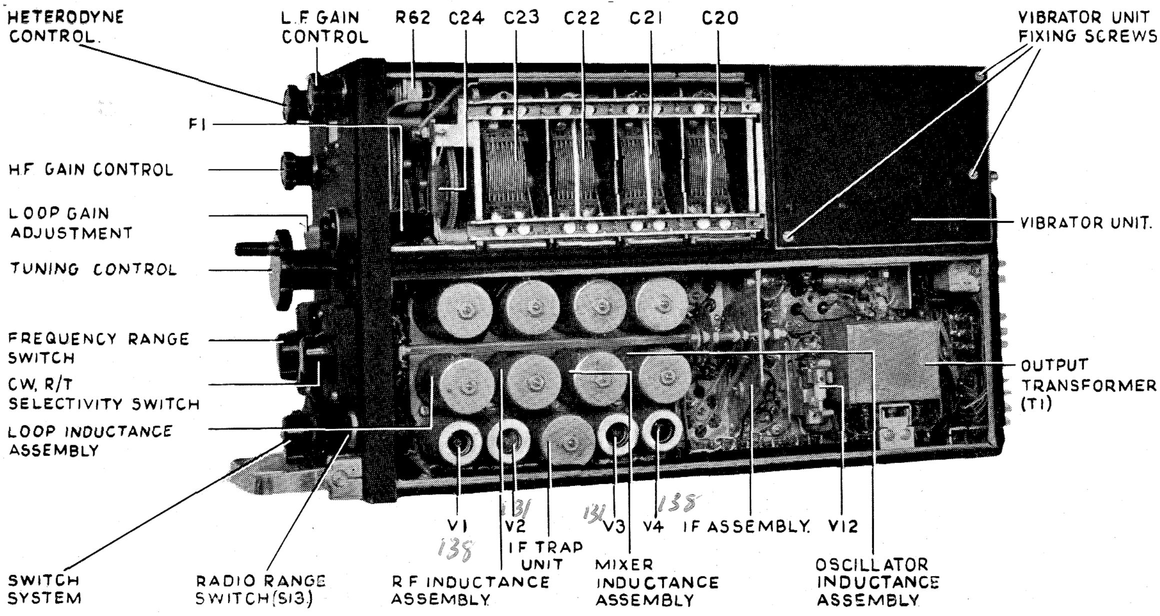


FIG. 7. RECEIVER TYPE AD.7092. COMPONENT LOCATION, RIGHT HAND SIDE. 5059

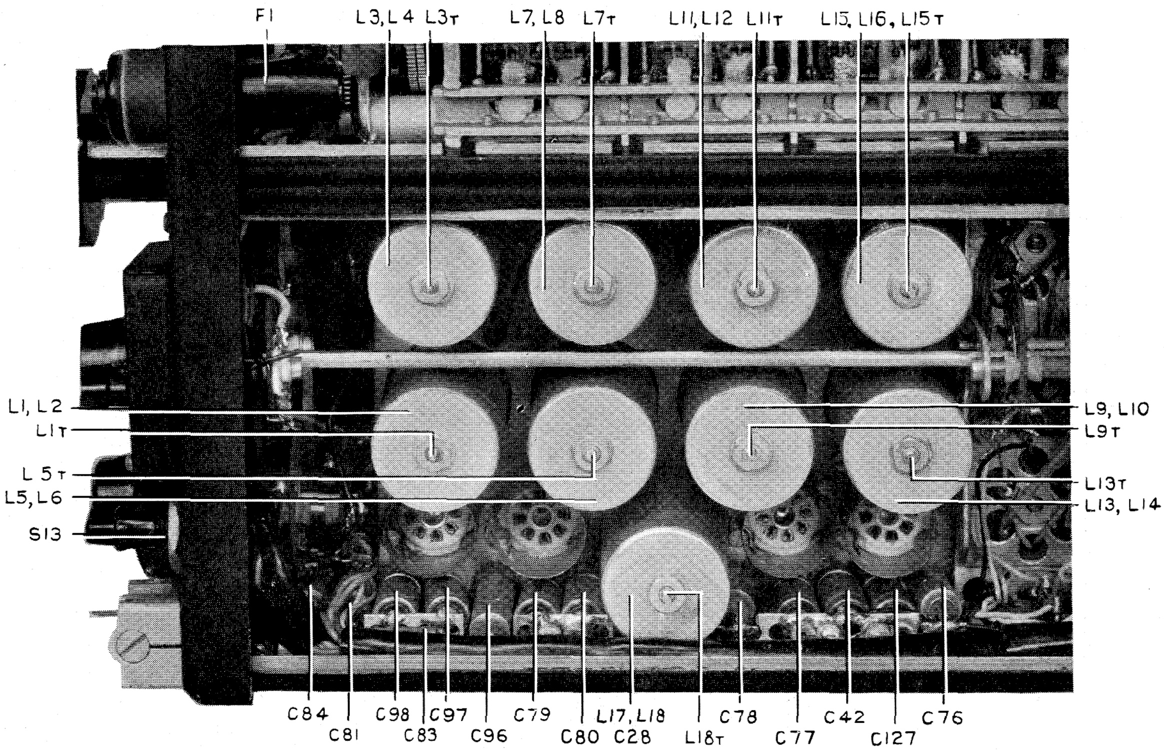


FIG. 8. RECEIVER TYPE AD.7092. COMPONENT LOCATION, RIGHT HAND SIDE, LOWER FRONT SECTION (V1—V4 REMOVED). 5060

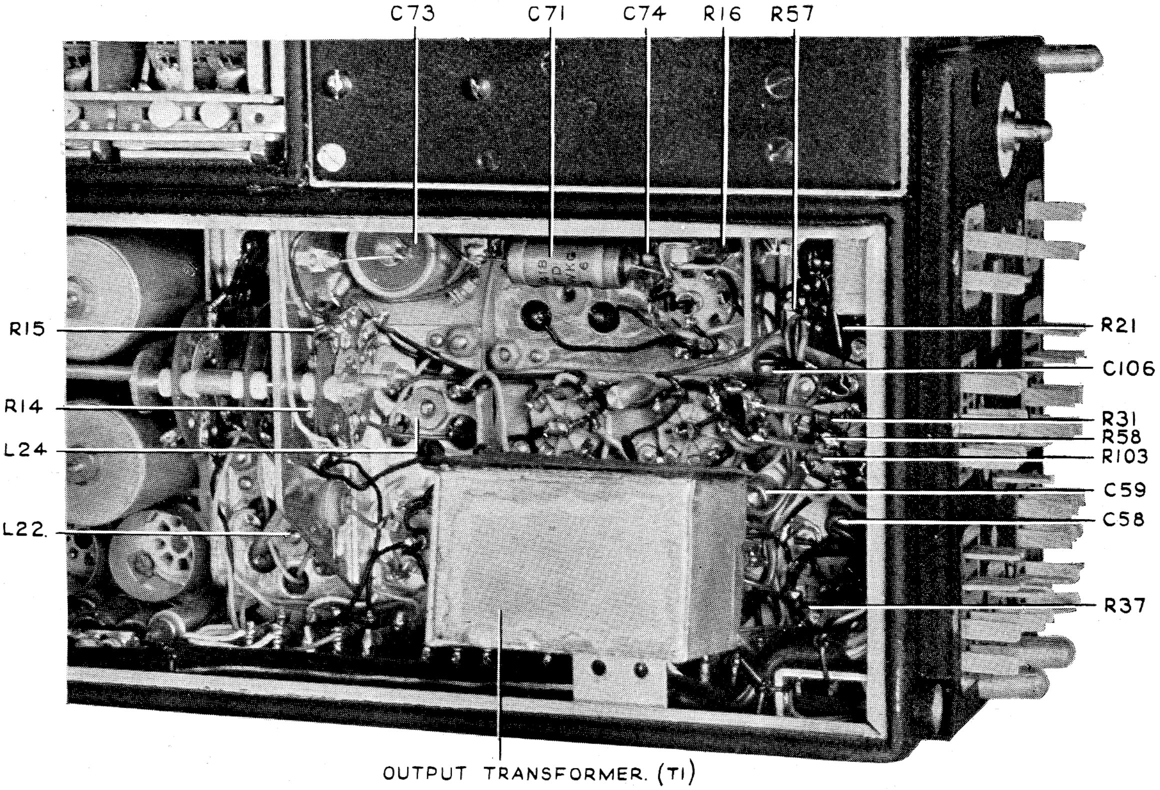


FIG. 9. RECEIVER TYPE AD.7092. COMPONENT LOCATION, RIGHT HAND SIDE. LOWER REAR SECTION (OUTPUT TRANSFORMER HINGED DOWN). 5061

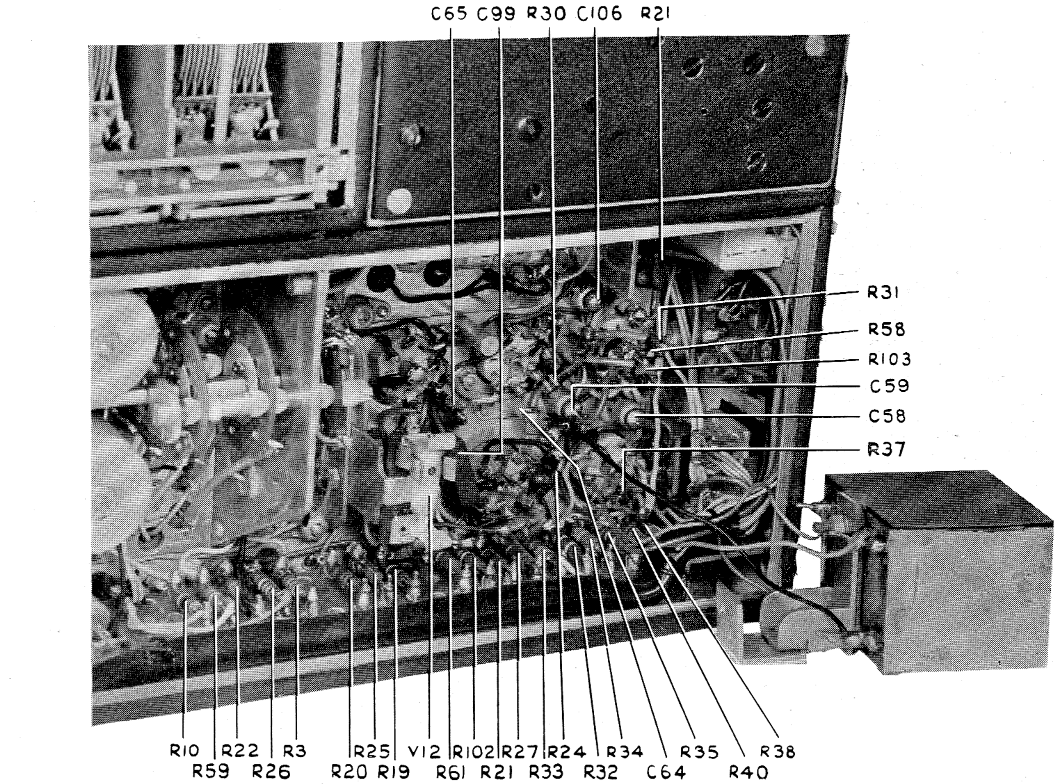


FIG. 10. RECEIVER TYPE AD.7092. COMPONENT LOCATION, RIGHT HAND SIDE. LOWER REAR SECTION (OUTPUT TRANSFORMER REMOVED). 5062

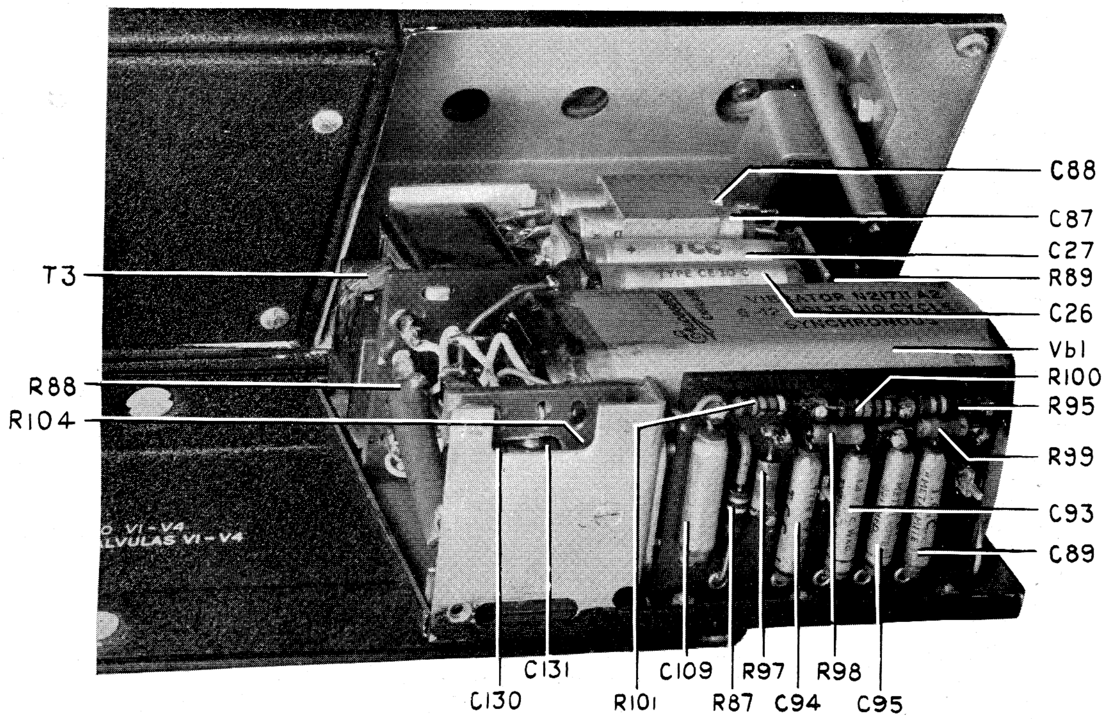


FIG. 11. RECEIVER TYPE AD.7092. COMPONENT LOCATION, VIBRATOR ASSEMBLY. 5063

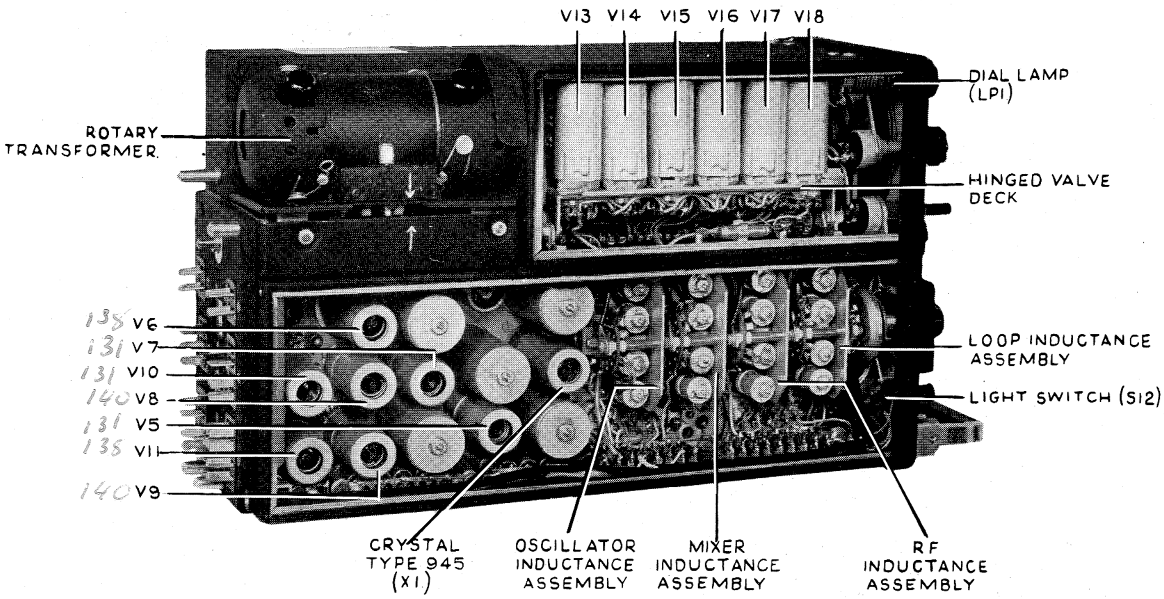


FIG. 12. RECEIVER TYPE AD.7092. COMPONENT LOCATION, LEFT HAND SIDE. 5064

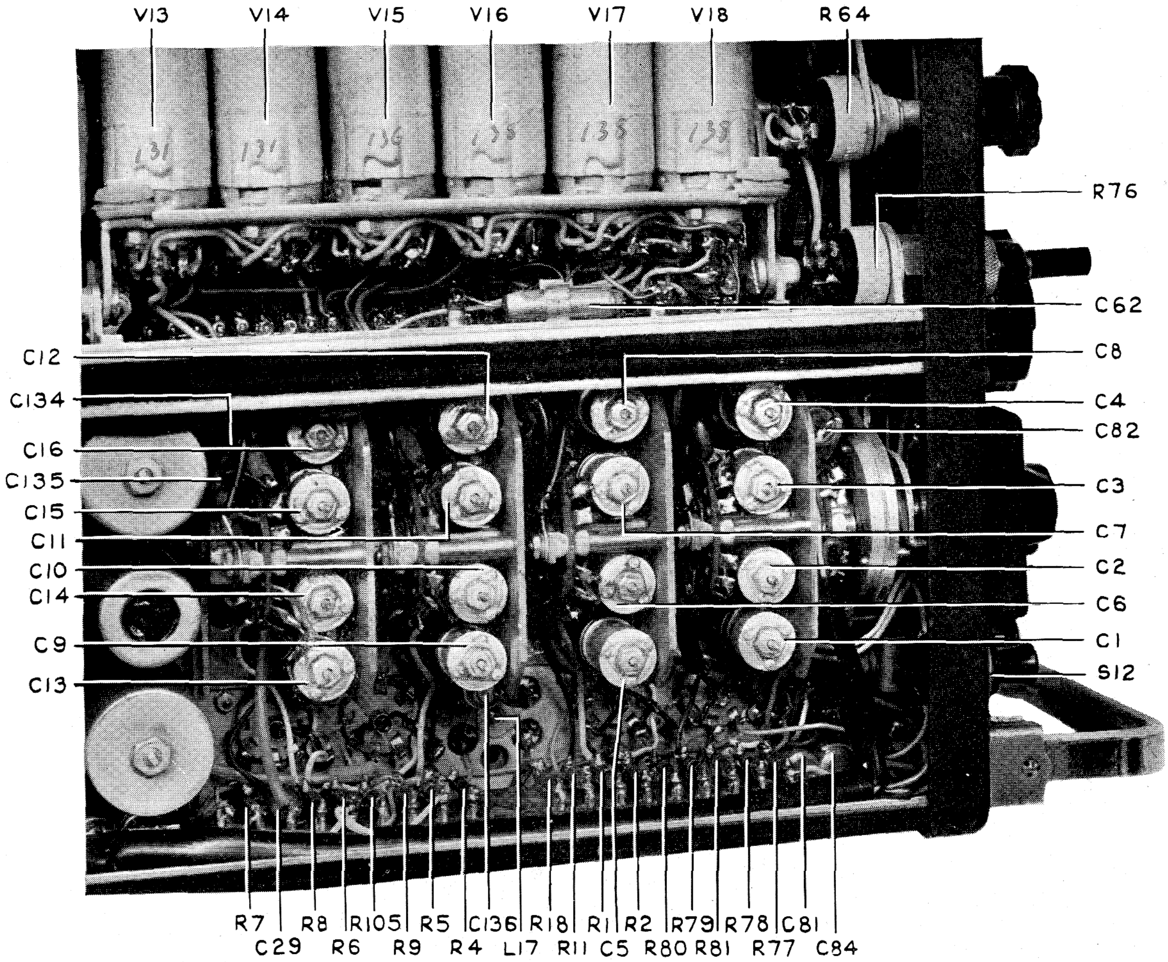


FIG. 13. RECEIVER TYPE AD.7092. COMPONENT LOCATION, LEFT HAND SIDE, LOWER FRONT SECTION. 5065

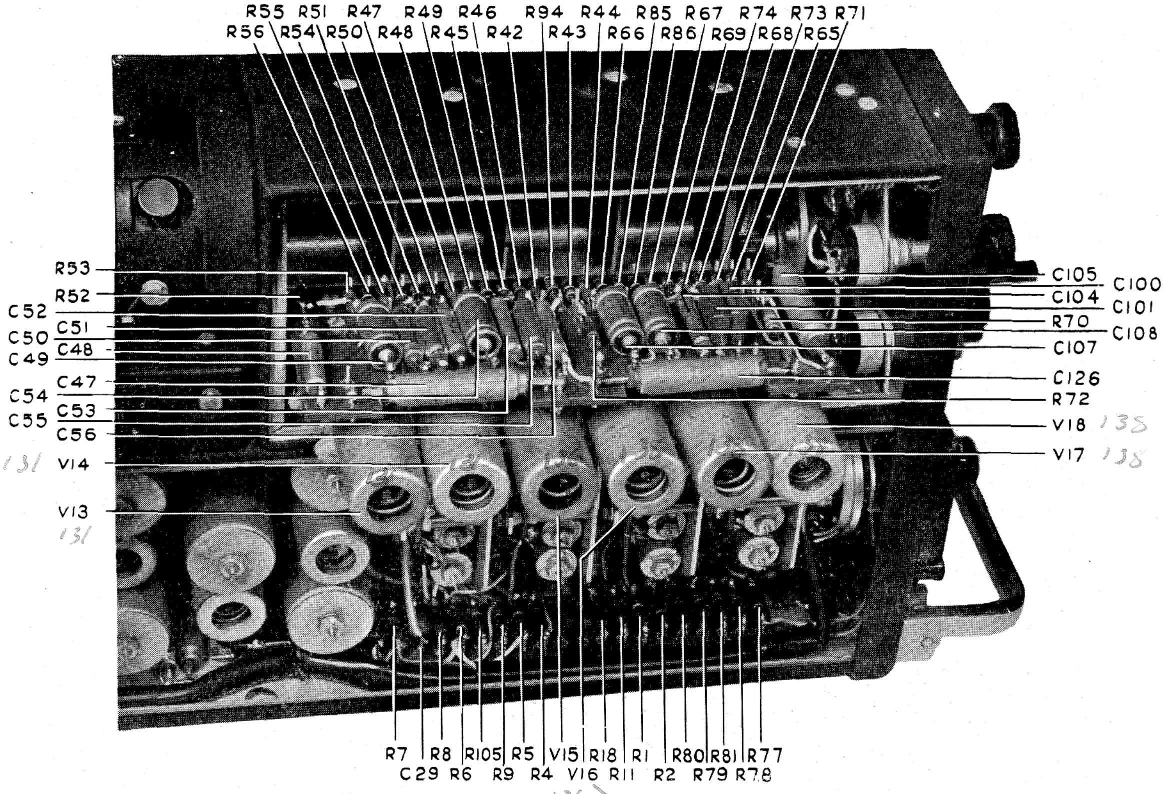


FIG. 14. RECEIVER TYPE AD.7092. COMPONENT LOCATION, LEFT HAND SIDE, UPPER FRONT COMPARTMENT, VALVE DECK HINGED FORWARD.

5066

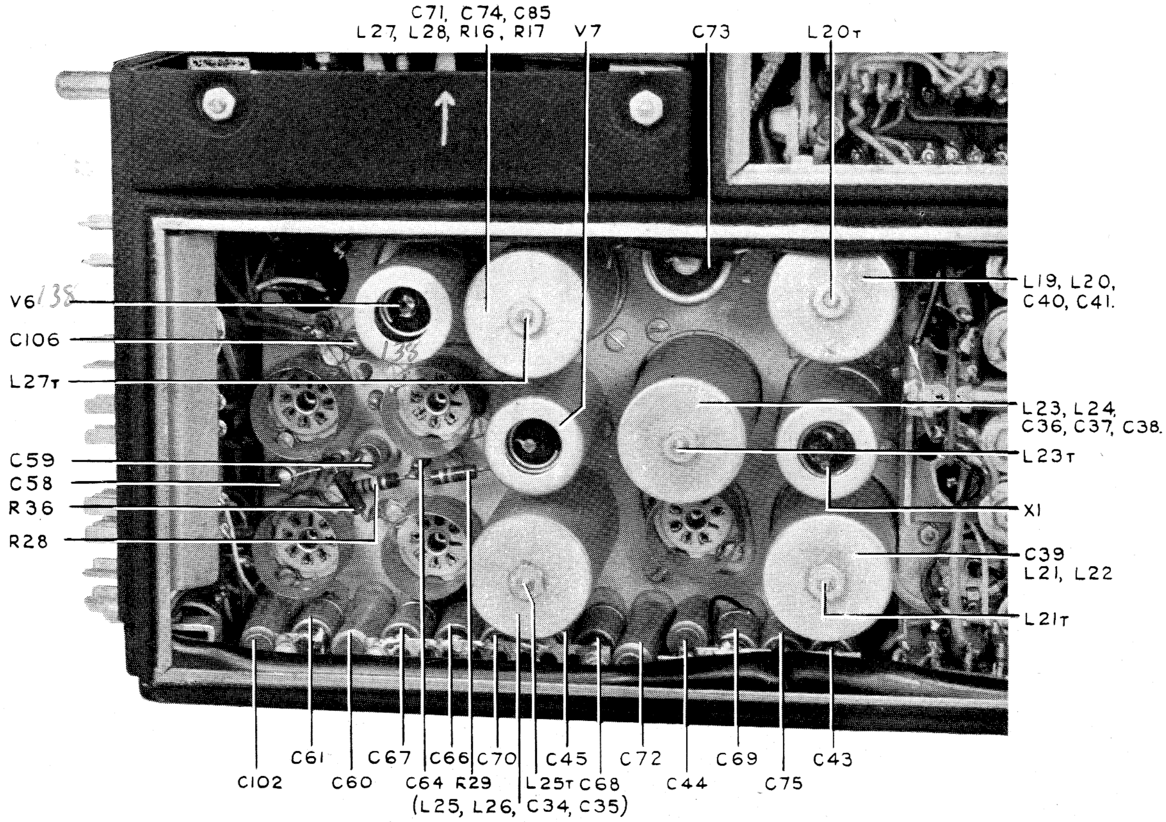


FIG. 15. RECEIVER TYPE AD.7092. COMPONENT LOCATION. LEFT HAND SIDE, LOWER REAR SECTION (V5, V8—V11 REMOVED.)

5067

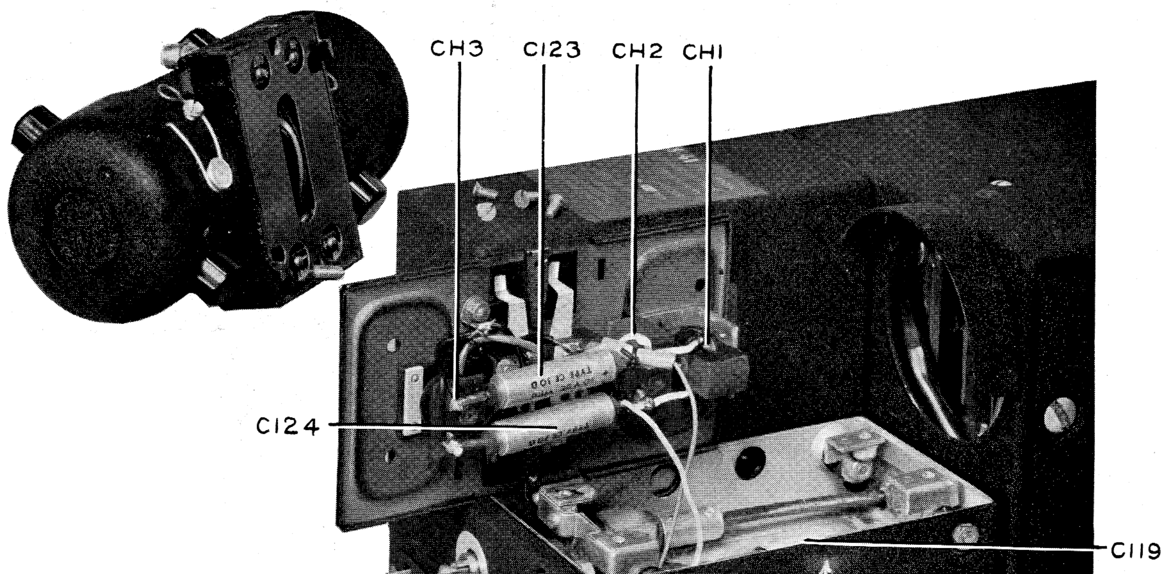


FIG. 16. RECEIVER TYPE AD.7092. EXPLODED VIEW SHOWING ROTARY TRANSFORMER AND FILTER UNIT.

5068

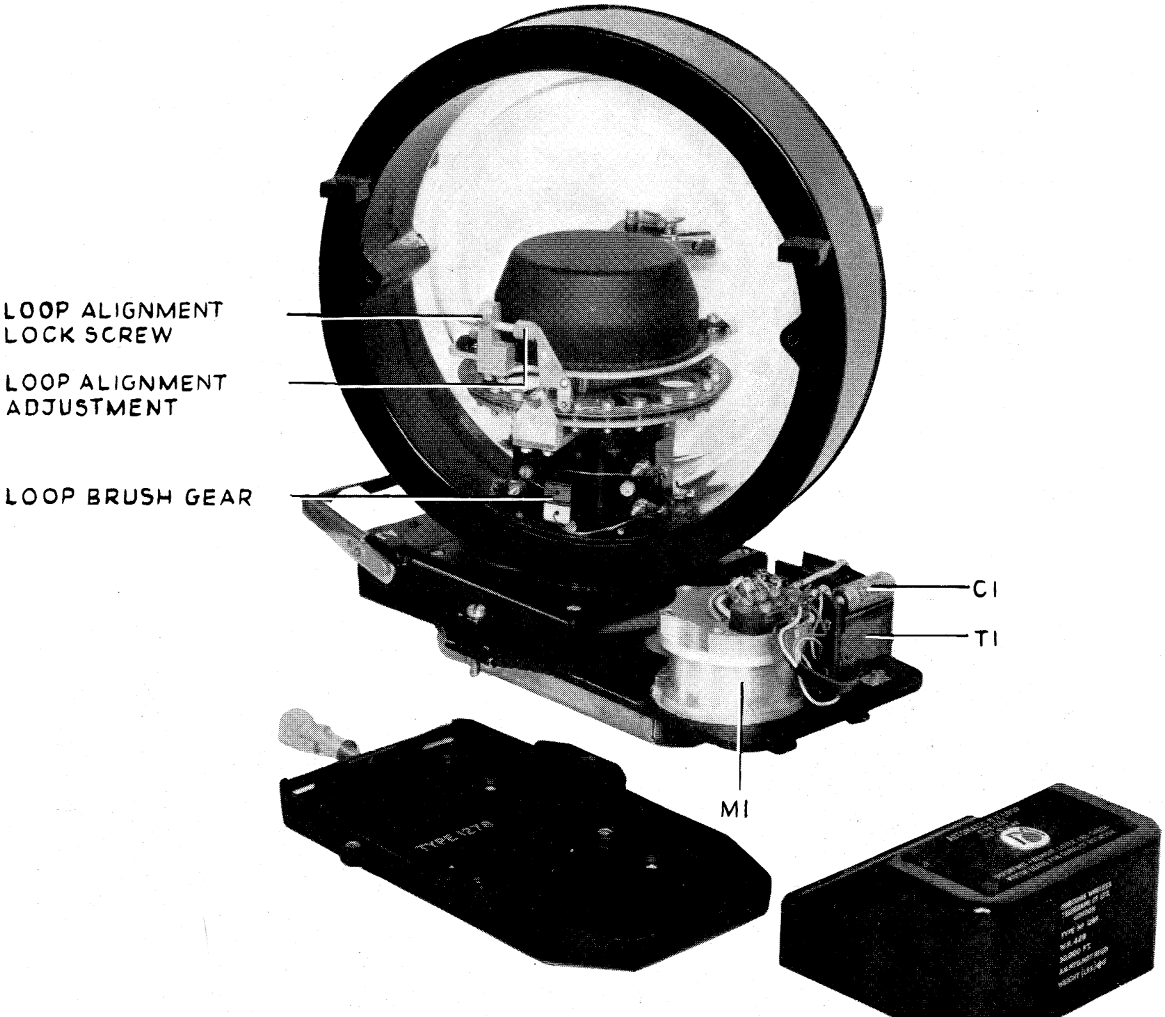


FIG. 17. ADF LOOP TYPE 1264 AND MOUNTING PLATE.
COMPONENT LOCATION.

5069

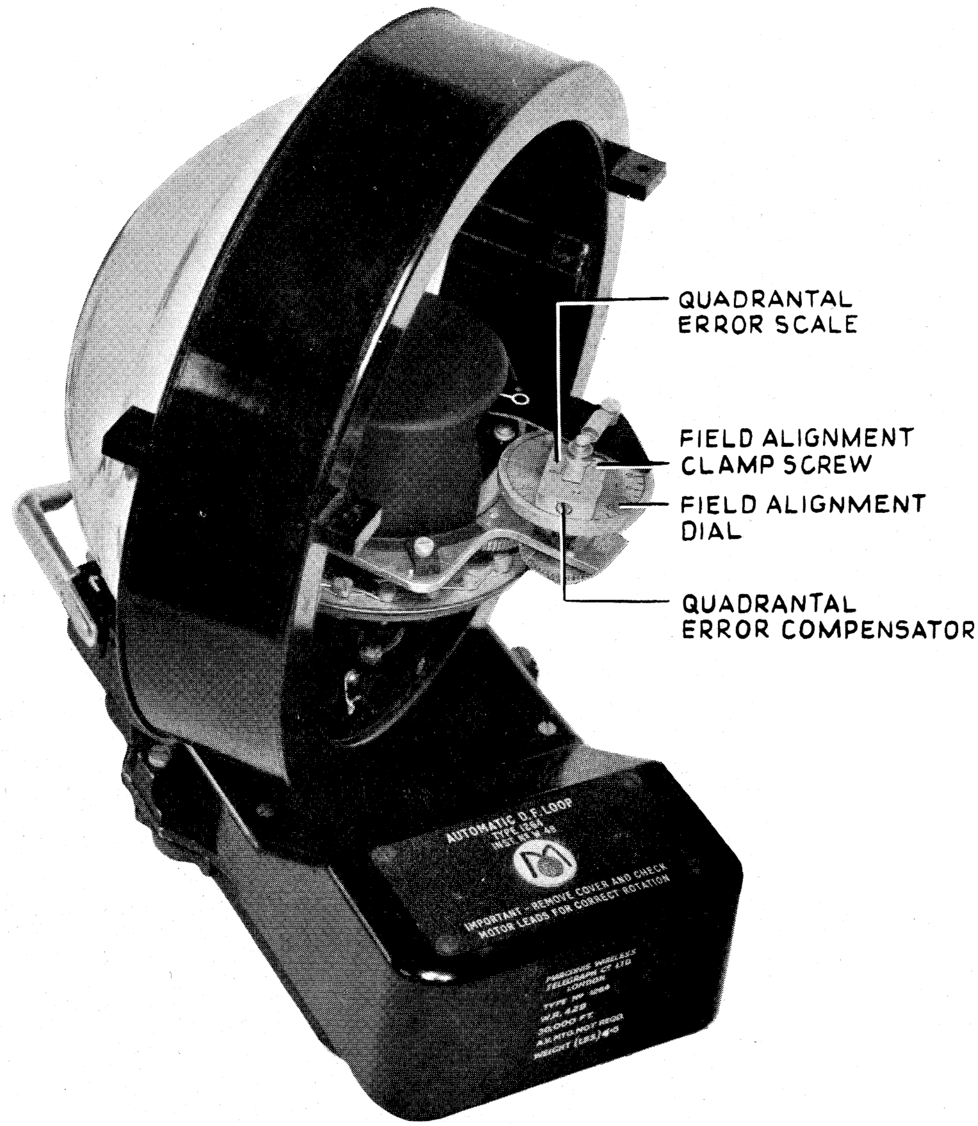


FIG. 18. ADF LOOP TYPE 1264. CORRECTOR MECHANISM. 5070

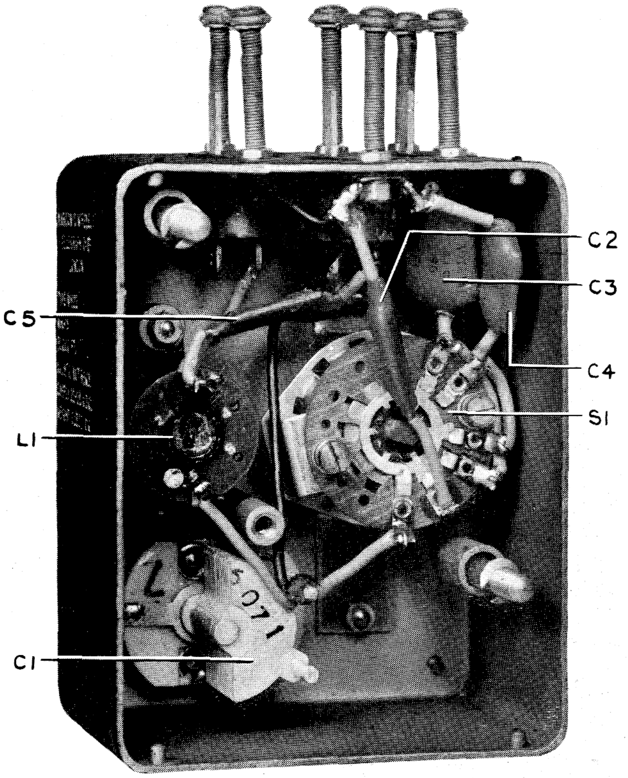


FIG. 19. DF AERIAL TRANSFORMER TYPE 922. COMPONENT LOCATION.

5071

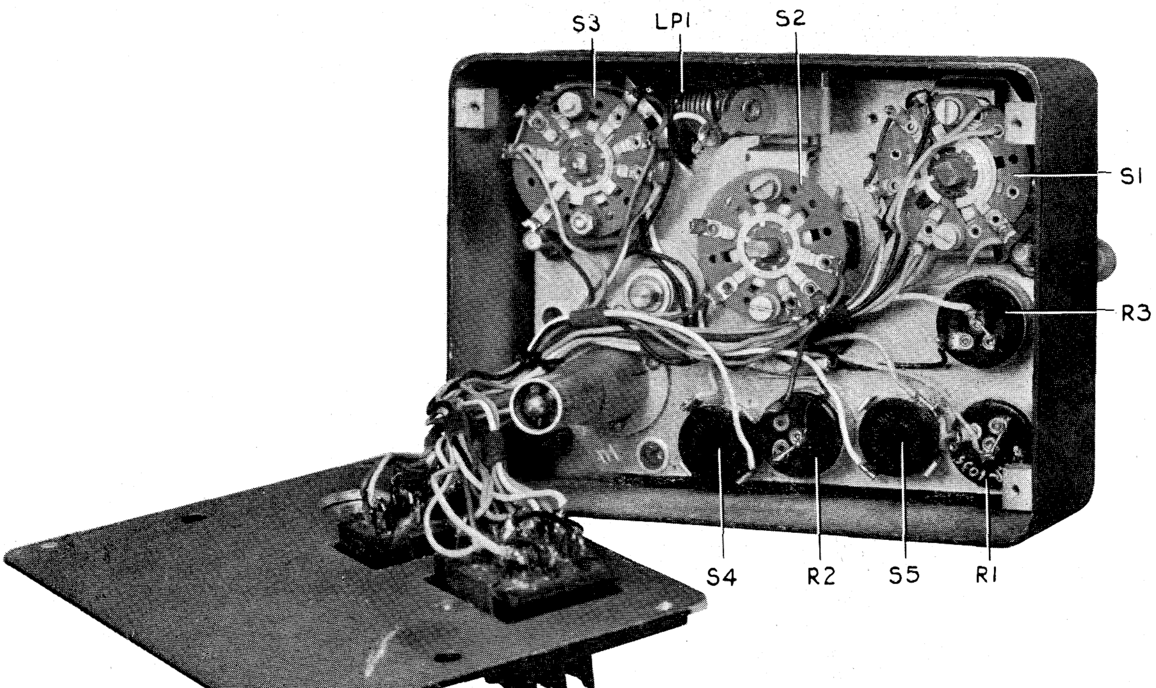


FIG. 20. REMOTE CONTROLLER TYPE 933. COMPONENT LOCATION.

5072

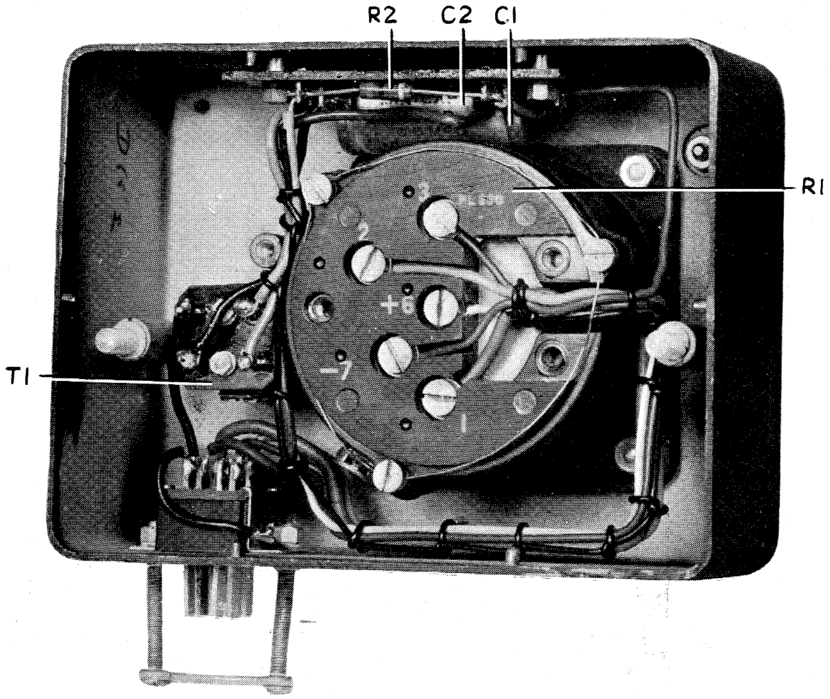


FIG. 21. LOOP CONTROLLER TYPE 1273. COMPONENT LOCATION. 5073

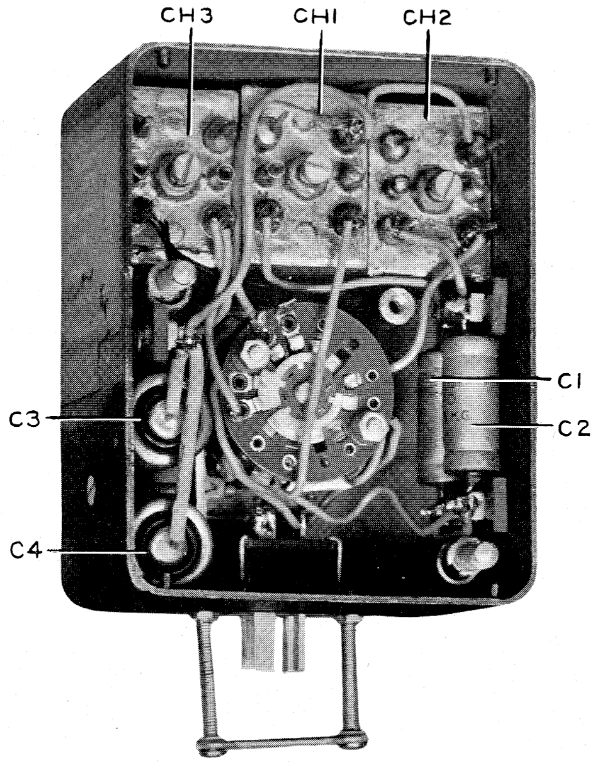


FIG. 22. VOICE/RANGE FILTER TYPE 949. COMPONENT LOCATION. 5074

Bearing indicator should have star connections

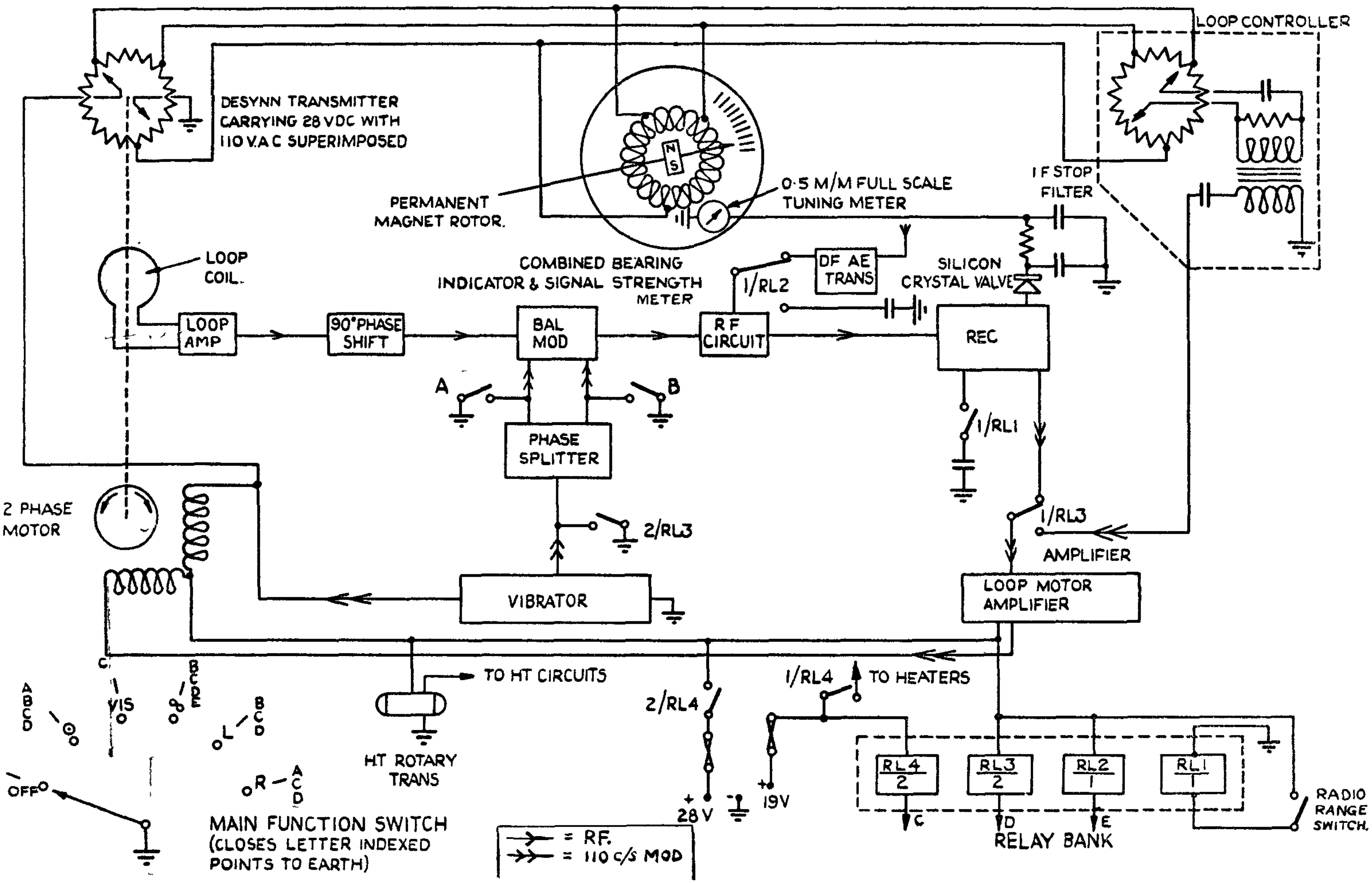


FIG. 24. RECEIVER TYPE AD.7092. SIMPLIFIED DIAGRAM SHOWING RELAY OPERATION AND "DESYNN" REPEATER SYSTEM.

5079

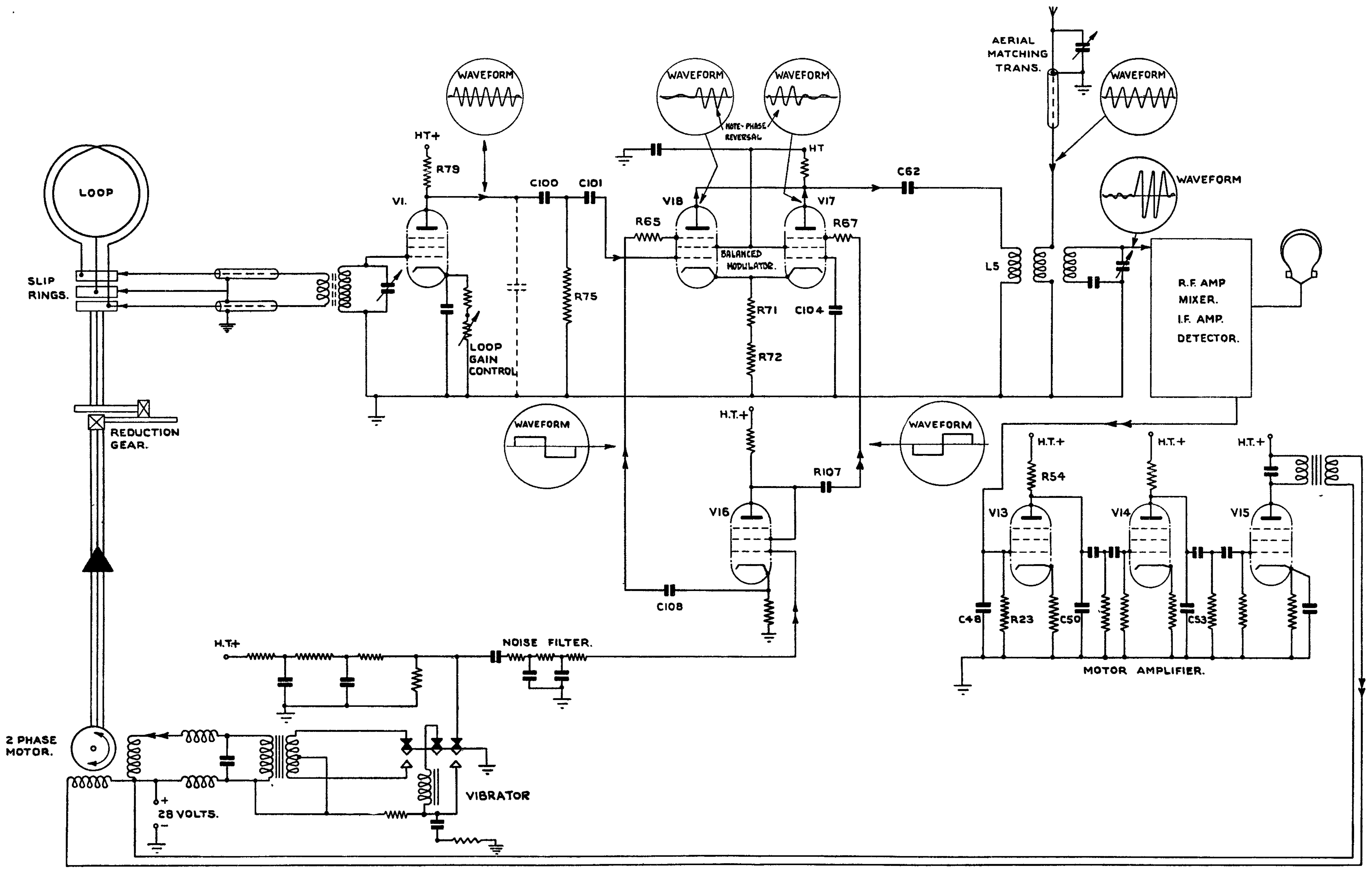


FIG. 23. RECEIVER TYPE AD.7092. SIMPLIFIED CIRCUIT DIAGRAM.

5078

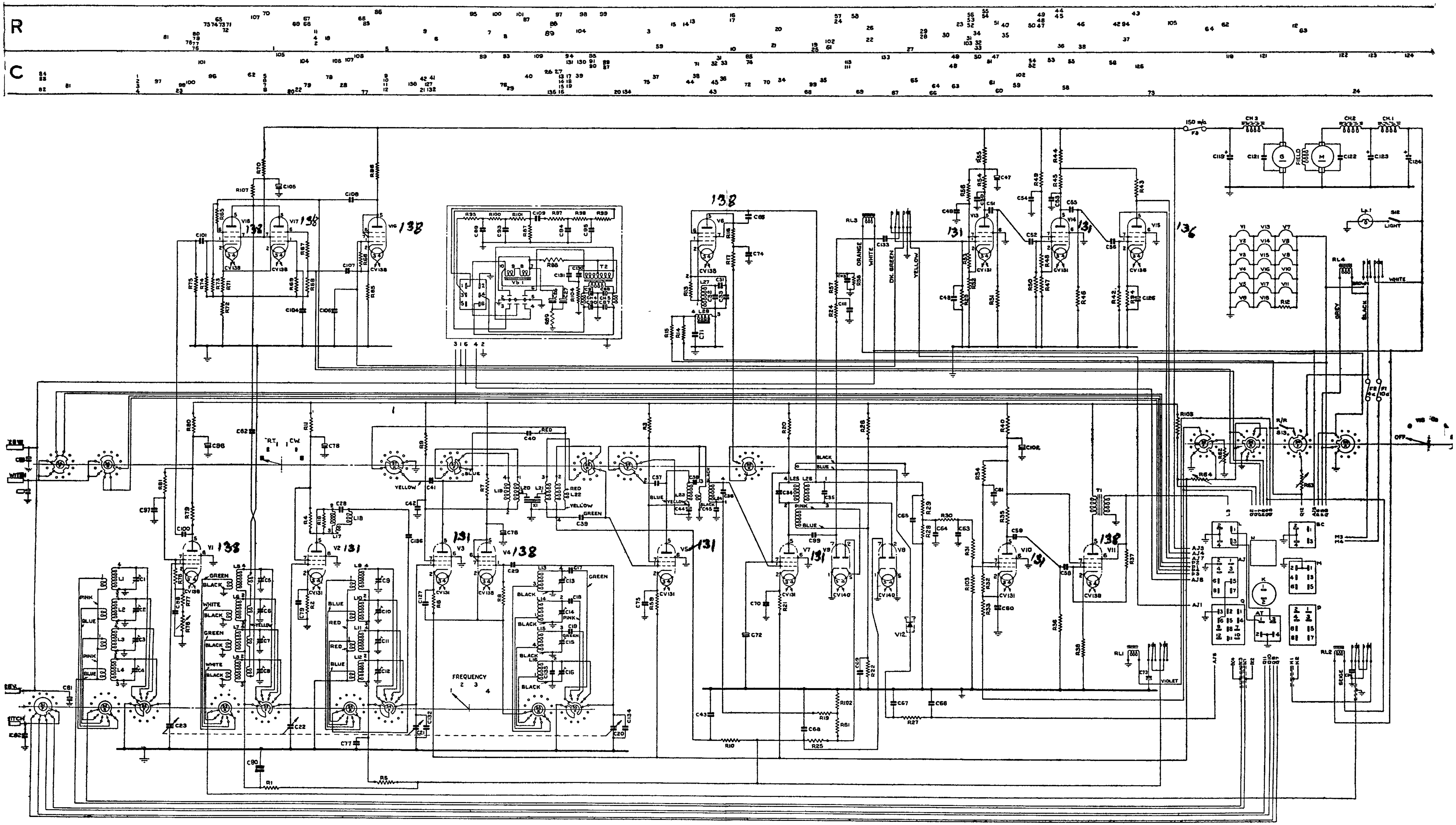


FIG. 25. RECEIVER TYPE AD.7092. CIRCUIT DIAGRAM.

5080

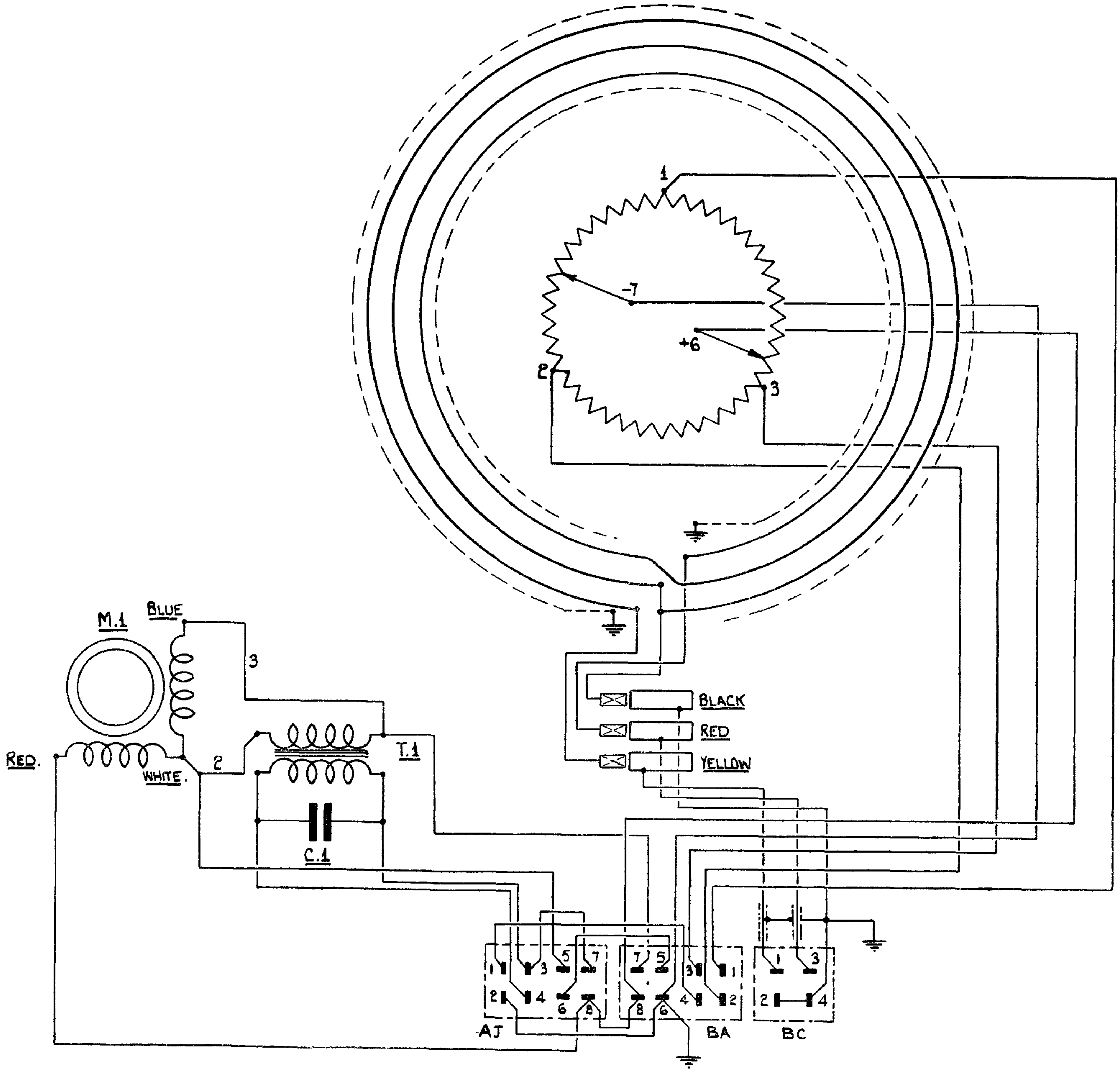


FIG. 26. LOOP TYPE 1264. CIRCUIT DIAGRAM.

5081

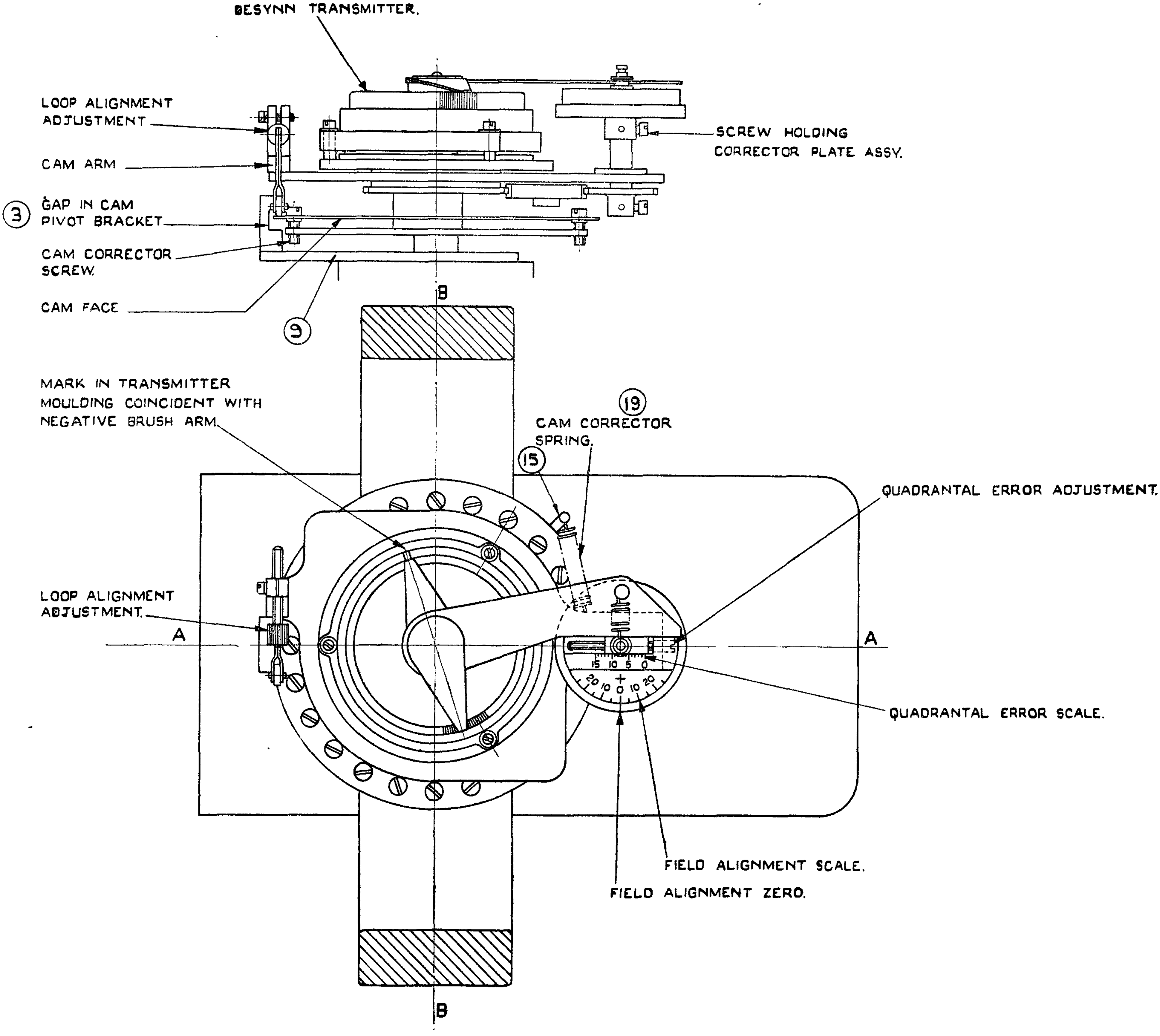


FIG. 27. LOOP TYPE 1264. ASSEMBLY DETAILS.

5082

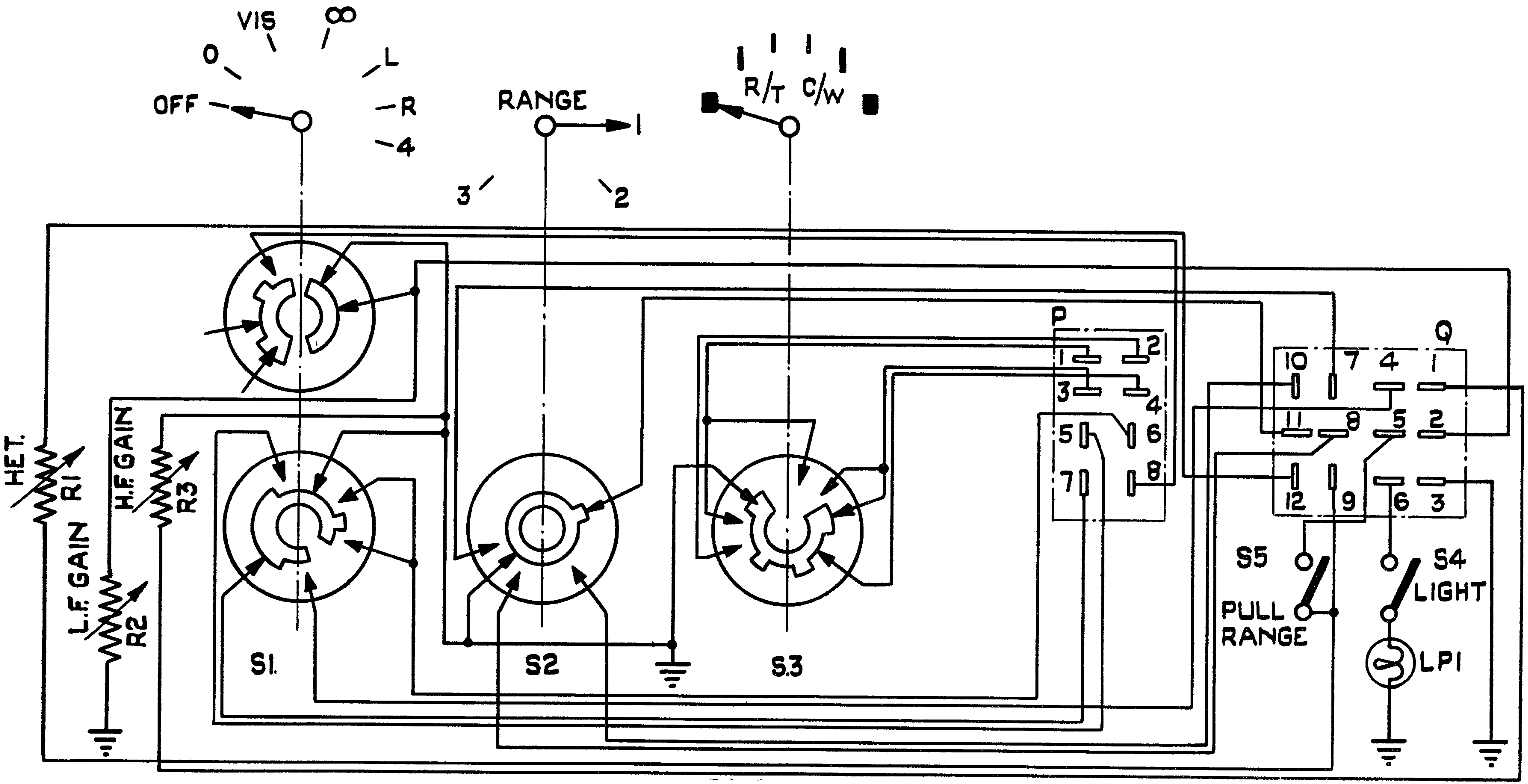


FIG. 28. REMOTE CONTROLLER TYPE 933. CIRCUIT DIAGRAM.
(Switches viewed from front in extreme anti-clock position).

5083

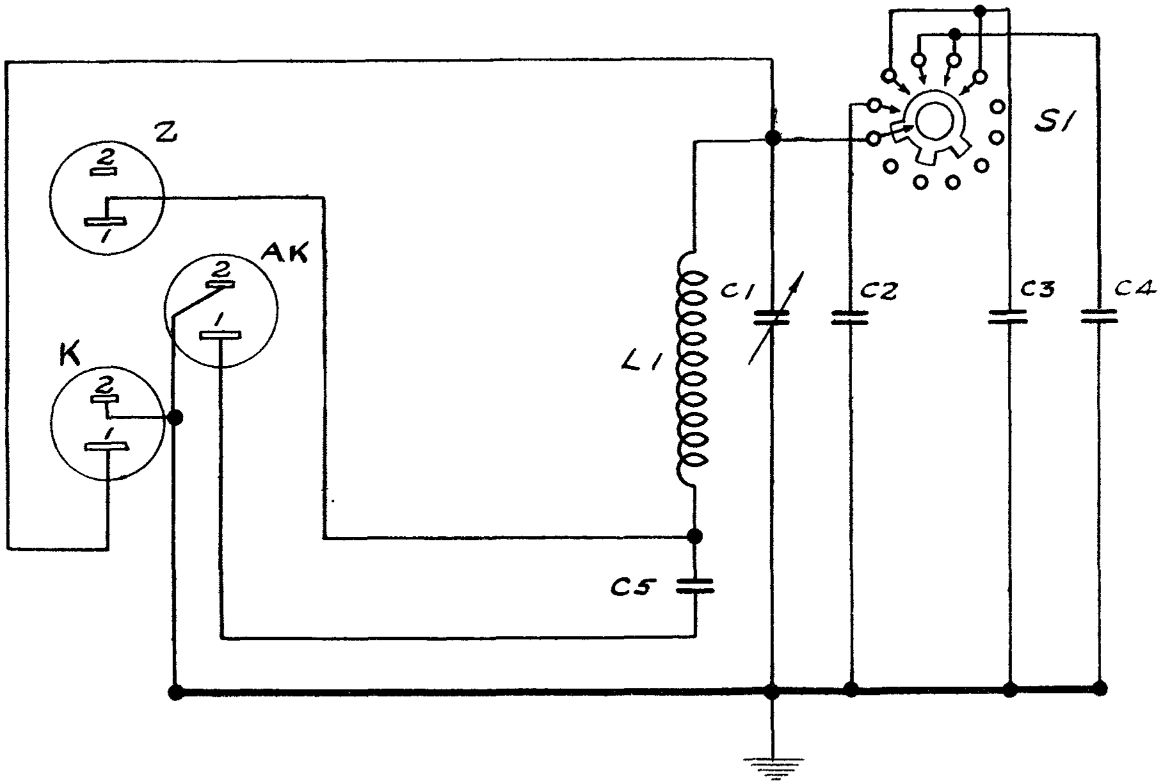


FIG. 29. DF AERIAL TRANSFORMER TYPE 922. CIRCUIT DIAGRAM. 5084

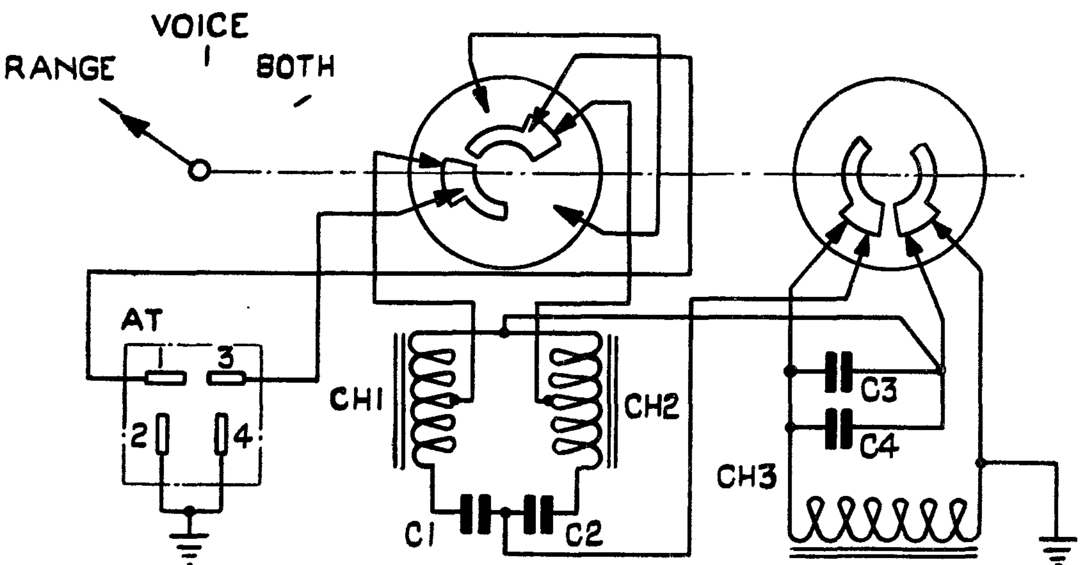


FIG. 30. VOICE/RANGE FILTER TYPE 949. CIRCUIT DIAGRAM. 5085

(All Switches viewed from front in extreme anti-clock position.

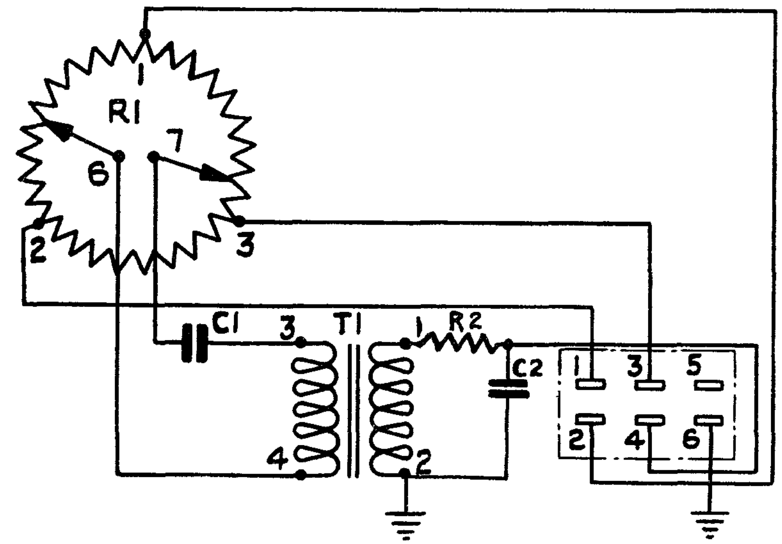


FIG. 31. LOOP CONTROLLER TYPE 1273. 5086

CIRCUIT DIAGRAM.

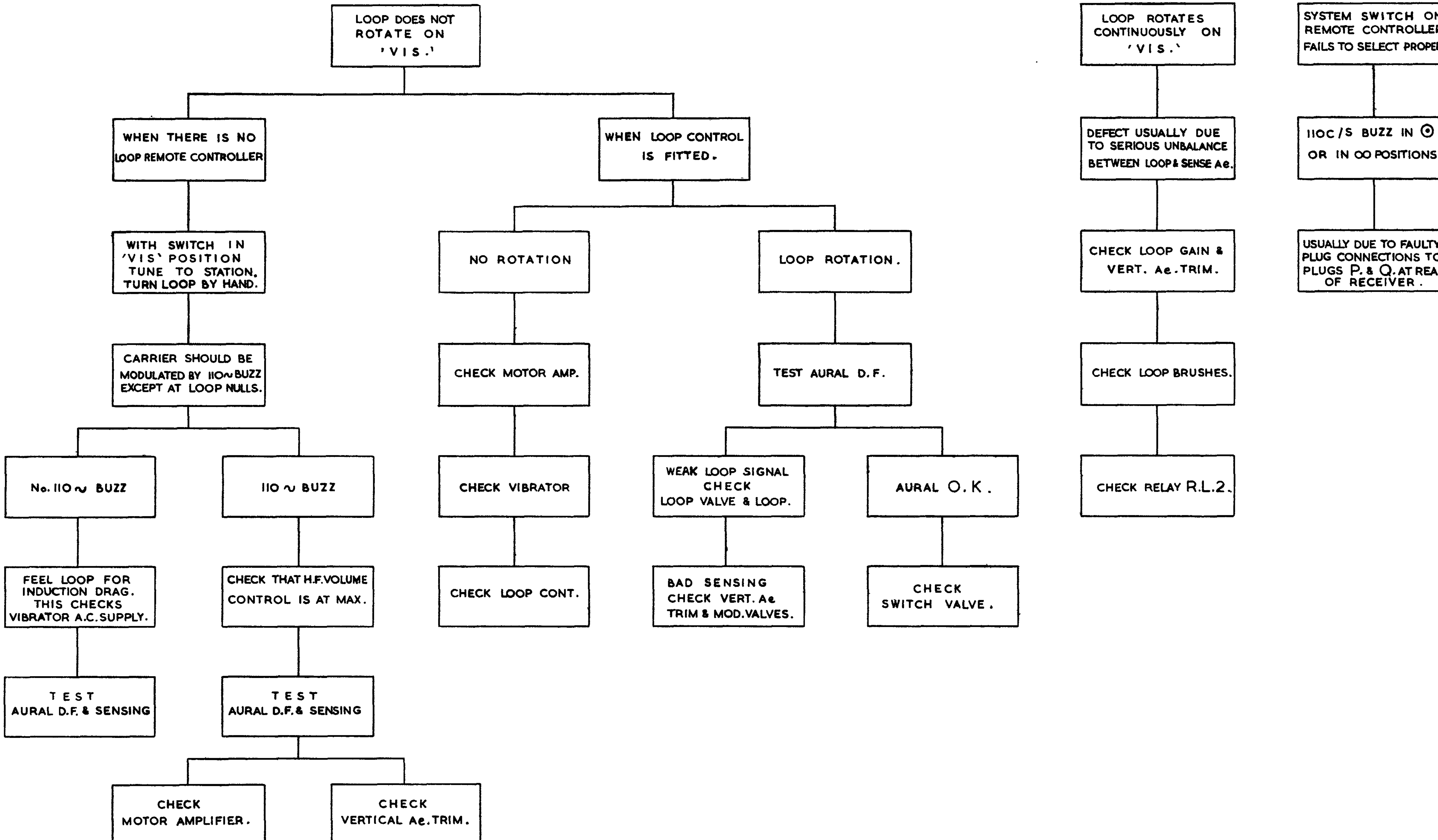


FIG. 33. FAULT LOCATION CHART.

5088

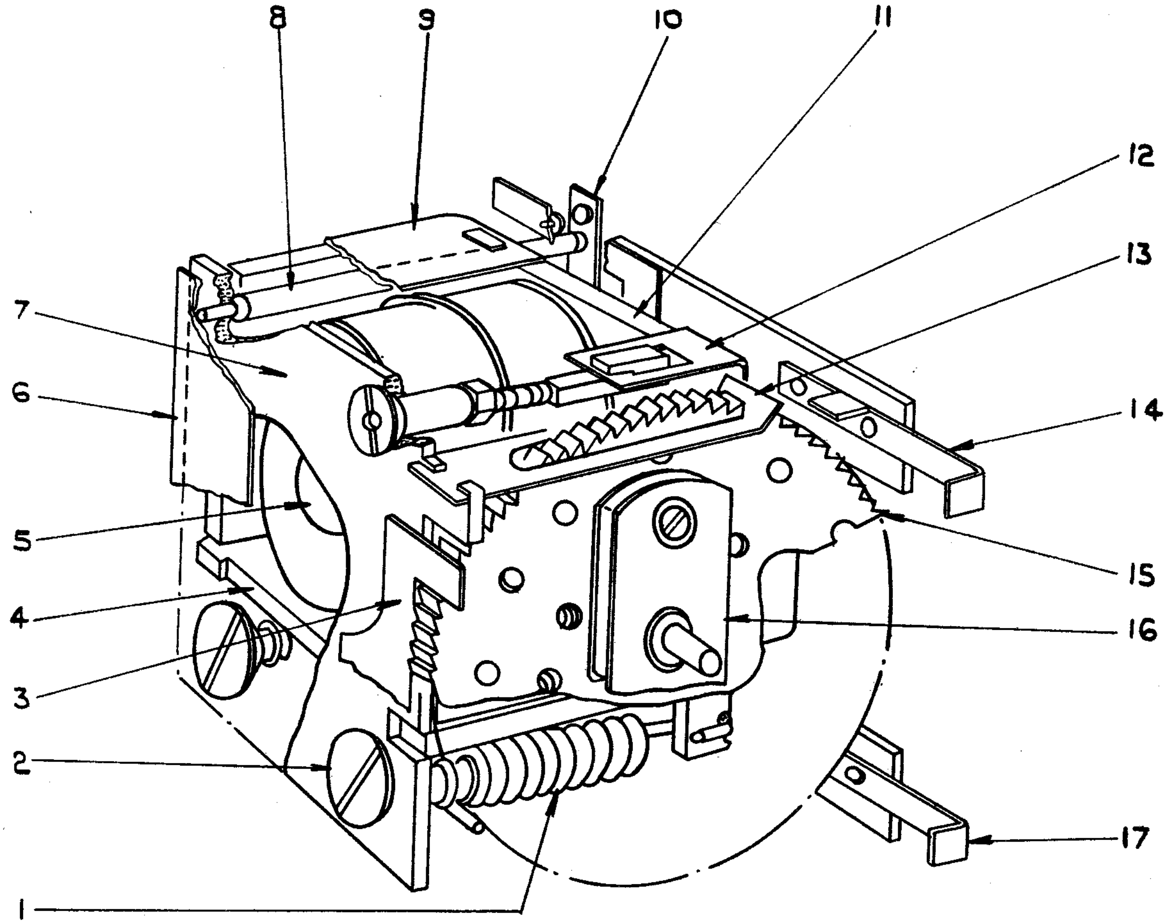


FIG. 32. TYPE 1263 CONTROLLER SWITCH DRIVE.

5087

INDEX

1. Retractor Spring
2. Retractor Spring Screw.
3. Non-return Spring.
4. Magnetic Joint.
5. Coil. Lowmoor Iron Core.
6. Cut-out Spring.
7. Vibrating Armature.
8. Push Rod.
9. Thermal Cut-out.
10. Interrupter Contacts.
11. Yoke.
12. Back Stop.
13. Main Pawl.
14. +28V Supply Plunger.
15. Ratchet Wheel.
16. Rubber Bonded Coupling.
17. Switch Line Plunger.

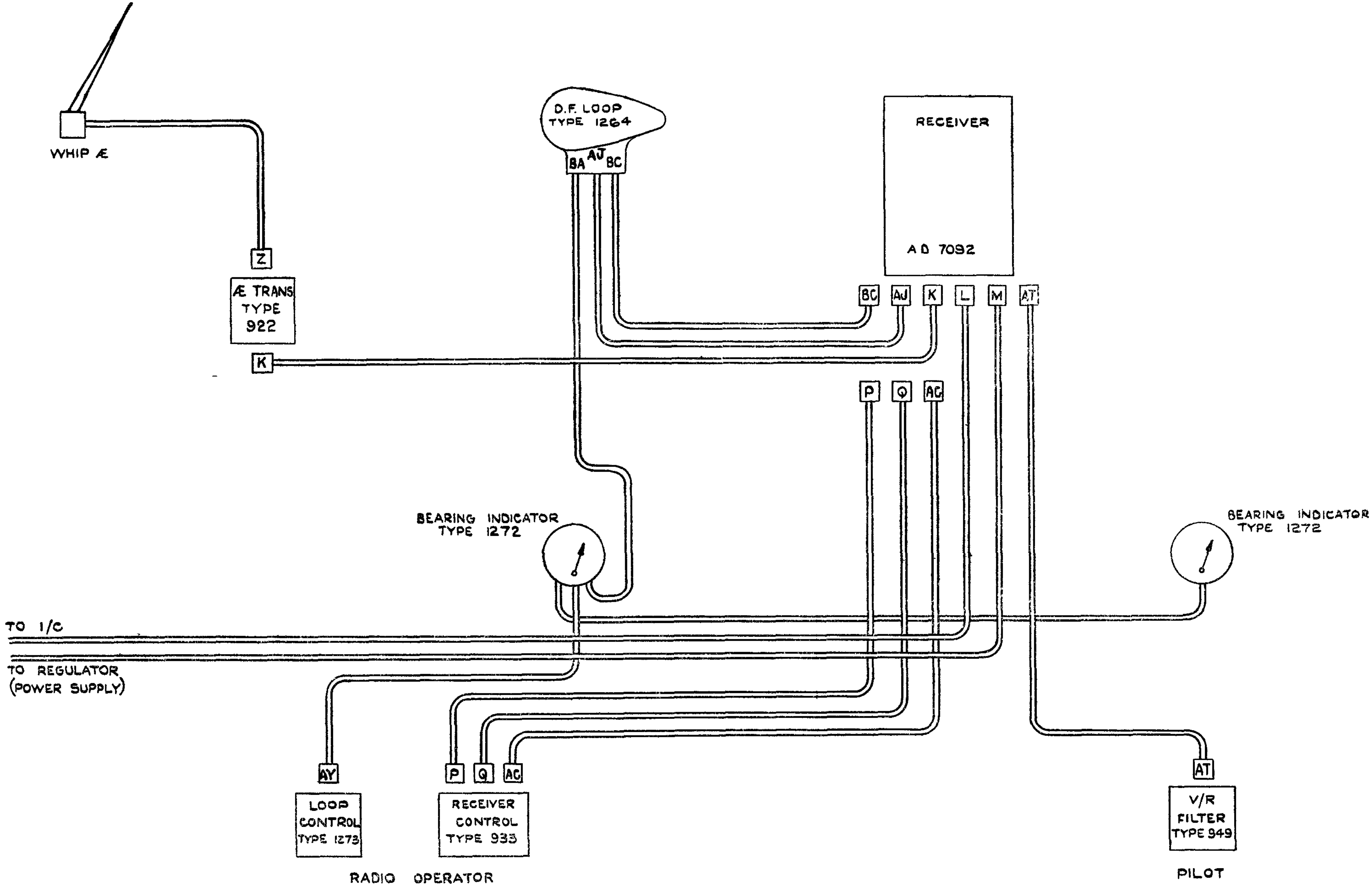


FIG. 34. INSTALLATION DIAGRAM. UNIT INTERCONNECTIONS.

5089

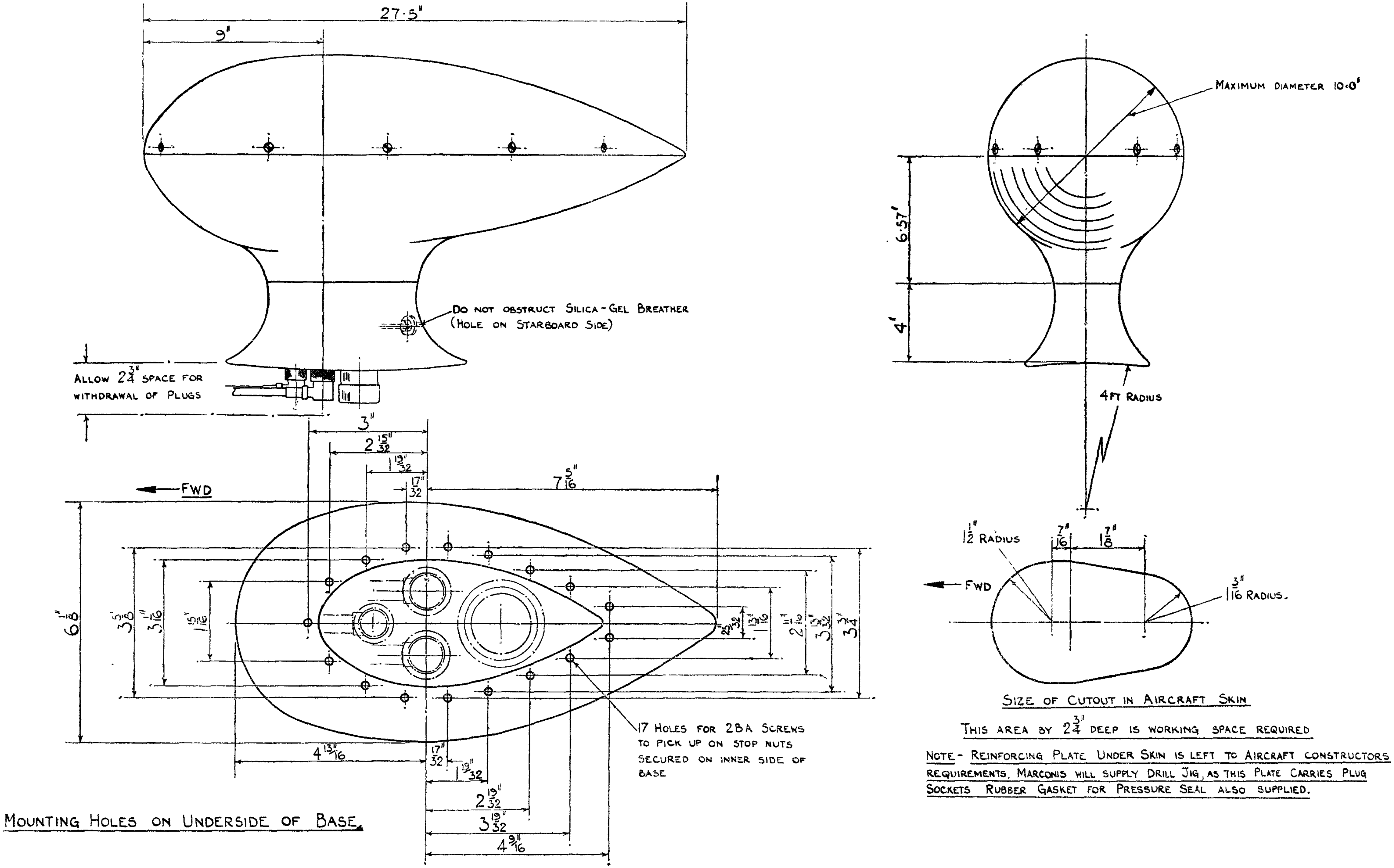


FIG. 35. LOOP STREAMLINED HOUSING. INSTALLATION DIAGRAM.

TEST UNIT TYPE 1322. Component Values			
CONDENSERS		RESISTANCES.	
C.1	30 pF (Max)	R.1	150 Ω
C.2	100 pF (Max)	R.2	390 Ω
C.3	100 pF	R.3	820 Ω
		R.4	3.3 kΩ
		R.5	6.8 kΩ

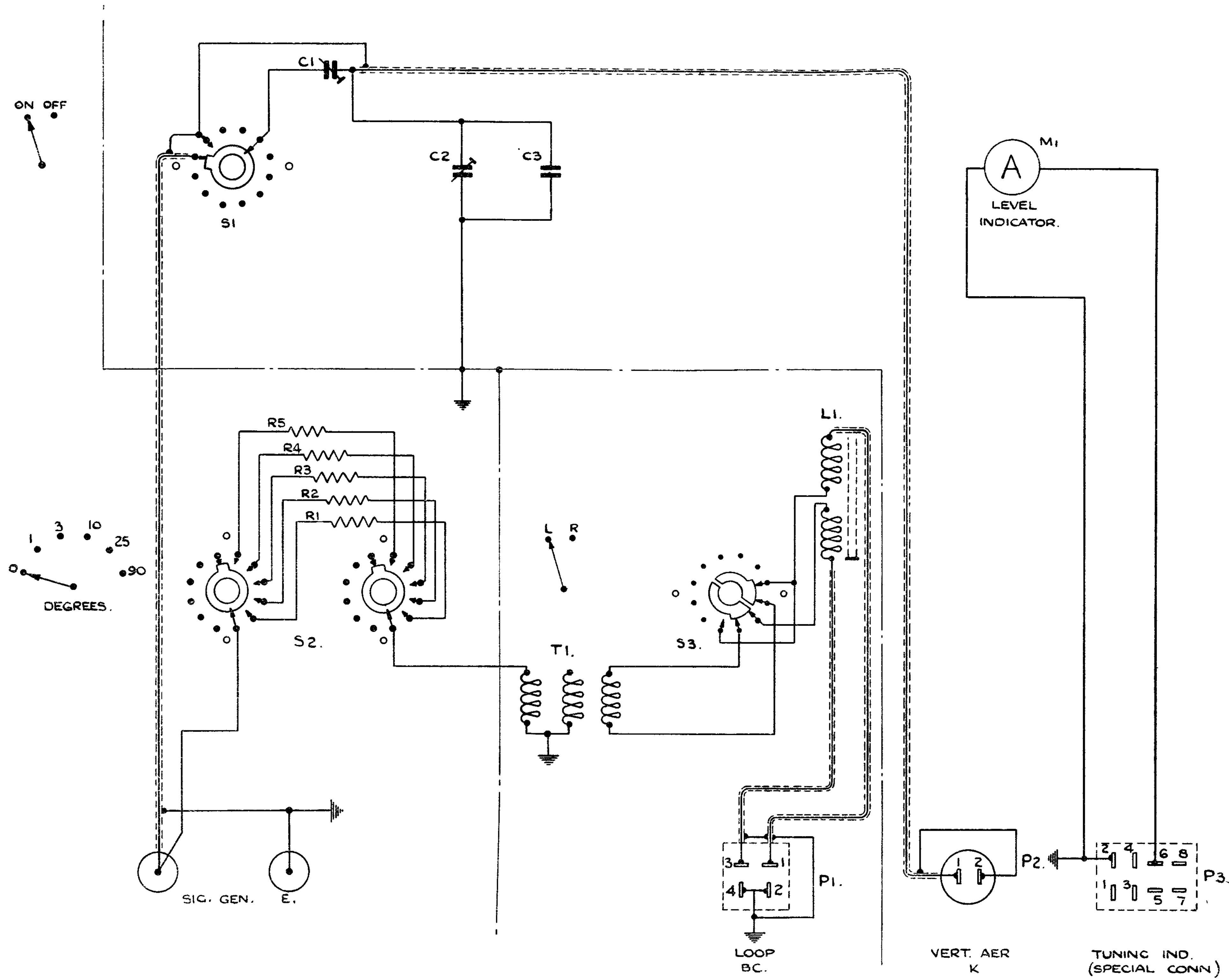


FIG. 36. SPECIAL TEST UNIT TYPE 1322. CIRCUIT DIAGRAM.

5091

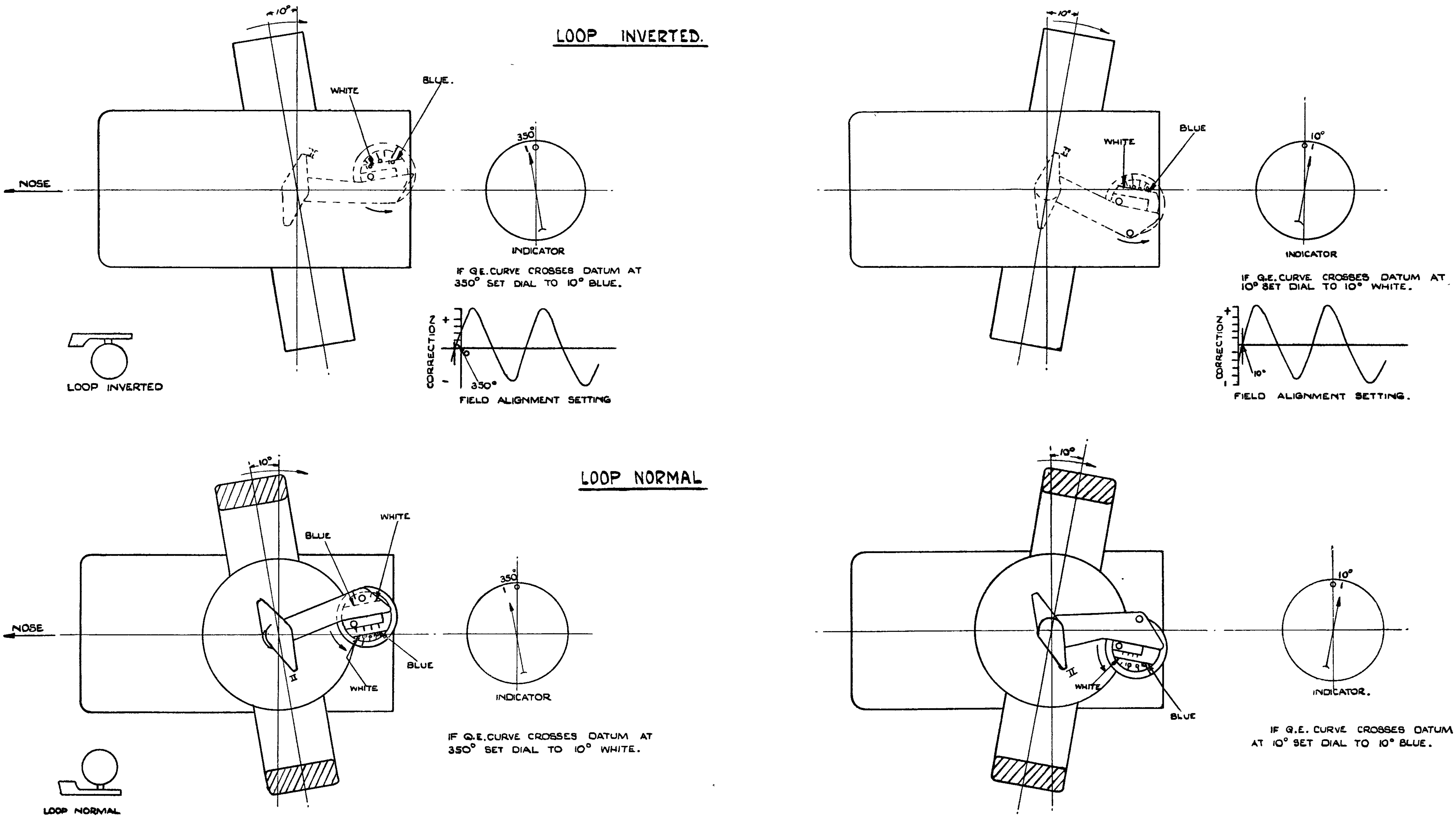
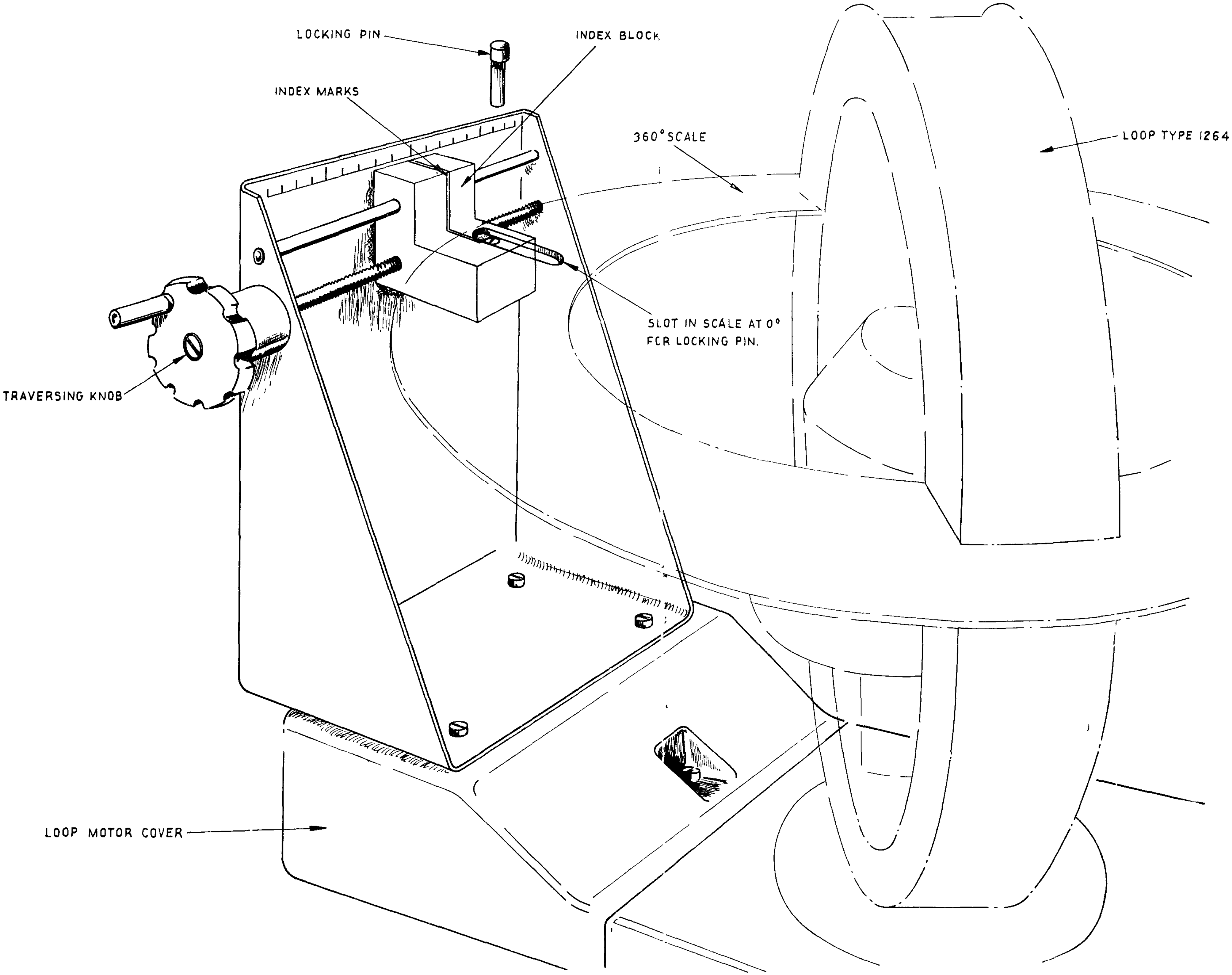


FIG. 37. LOOP FIELD ALIGNMENT DIAL. METHOD OF SETTING-UP CORRECTION FACTOR.

5092



5708

FIG 1. SCALE AND ADJUSTABLE CURSOR FITTED TO LOOP TYPE 1264B

12.5 Special Test Unit Type 1322.

In order to facilitate the testing and alignment of the receiver circuits, a special test unit has been designed. By the use of this instrument, conditions of operation on both the non-directional and the loop aerial may be effectively simulated.

(*a*) **Front Panel.** A tuning meter with a full scale deflection of 0.5mA is situated on the front panel of the unit. Three switches are provided for selecting the required test conditions, and at the base of the panel two connector plugs enable the unit to be connected to the receiver via the appropriate cables (*i.e.*, cables BC and K). A third connector plug is provided for a special test cable (BA/28) from the loop aerial to the test unit. This lead carries the current for the tuning meter, which is fed via cable AJ from the receiver to the loop. For certain simple tests, where the loop aerial is not required, cable AJ may be plugged straight into the test unit, thus supplying the meter directly. Terminals are also provided on the front panel for the signal generator connections.

(*b*) **Vertical Aerial Circuit.** A circuit diagram of the unit is shown in Fig. 36. The vertical aerial circuit consists of a 10 pF series condenser (C.1) to represent the effective aerial capacity, and a shunt adjustable capacity of approximately 200 pF maximum (C2 and C3), to simulate the capacities of the aerial rods and leads. This capacity is adjusted and pre-set at the factory to match the unit to a standard cable K. A switch is provided to enable the vertical aerial simulator to be switched in or out of circuit as required.

(*c*) **Loop Circuit.** The input from the signal generator is fed via an attenuating and phasing network to a small coupling coil in the centre of two equivalent loop windings. The total series inductance equals the loop inductance. A switch marked " L/R " permits the coupling coil connections to be reversed with respect to the loop windings, resulting in a 180° phase change of the input to the receiver, which is equivalent to reversing the loop direction. A further switch is provided which enables separate resistances in the attentuating network mentioned above to be selected as required. Resistances are provided which reduce signals to a level equivalent to " off course" positions of 1°, 3°, 10°, 25° and 90°. No provision is made in this unit to simulate the capacity and inductance of the loop lead. The receiver should therefore be connected to the test unit *via* the standard cable (BC).

When in use with this instrument the signal generator attenuator will read μV per metre.

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED
Head Office: Marconi House, Chelmsford · Telephone: Chelmsford 3221 · *Telegraphic Address: Expanse, Chelmsford*
01051/1,500

AIRCRAFT RADIO EQUIPMENT

AUTOMATIC DIRECTION FINDER

Type AD.7092

SUPPLEMENT No. 1
TO
TECHNICAL MANUAL
Ref. No. T.2067

Marconi

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED

Head Office: Marconi House, Chelmsford · Telephone: Chelmsford 3221 · Telegraphic Address: Expanse, Chelmsford

AUTOMATIC DIRECTION FINDER
TYPE AD.7092

ADJUSTMENT OF THE DESYNN BEARING TRANSMISSION SYSTEM

SUPPLEMENT No. 1
TO
TECHNICAL MANUAL
Ref. No. T.2067

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED

Head Office: Marconi House, Chelmsford · Telephone: Chelmsford 3221 · Telegraphic Address: Expanse, Chelmsford

AUTOMATIC DIRECTION FINDER TYPE AD.7092.

ADJUSTMENT OF THE DESYNN BEARING TRANSMISSION SYSTEM.

1. INTRODUCTION.

In the Type AD.7092 Automatic Direction Finder, the position taken up by the loop is transmitted to a remote bearing indicator, which may be installed in any position convenient for observation. The bearing information provided by the indicator is to a certain extent degraded by instrumental inaccuracy, and when precise bearings are required, as for determination of the quadrantal error (QE) value, or for navigation (not homing), it would be advantageous if the exact bearing of the incoming signal could be obtained by reading a large scale attached to the loop itself. Since in most cases this is inconvenient, the only alternative is to reduce the effect of instrumental inaccuracy to an absolute minimum, and the object of this supplement is to describe methods by which this can be achieved.

2. ADJUSTMENT OF BEARING TRANSMITTER.

Compensation for instrumental inaccuracy in the bearing indicator can be obtained by advancing or retarding the Desynn potentiometer sliders in the Type 1264 loop by adjustment of the circular cam fitted below the potentiometer. This cam is already adjusted at the factory so that errors due to the transmitter potentiometer are eliminated, and if it were used in conjunction with a perfect bearing indicator, there would be no errors in the system. The Type 1272 bearing indicator, however, may have a maximum instrumental inaccuracy of 2° and, as mentioned above, this may be too great for certain purposes. Further adjustment of the cam is required, therefore, if it is desired to match the loop potentiometer to a particular bearing indicator.

The adjustment may be performed under two conditions :—

(A) With QE compensator at 0°, the indicator reading is brought into coincidence with the reading on a scale attached to the loop. This case applies to prototype installations when it is desired to find the QE value.

(B) With the QE compensator set at the authorised figure, the indicator reading is brought into coincidence with the sum of the loop scale reading and the error correction figure (as obtained from the table of corrections on page 22 of the manual Ref. T.2067). For example, assuming a maximum QE correction of plus 10°, with the loop scale at 50°, the bearing indicator should read $50°+9.43°=59.5°$ approximately.

It should be understood that once the potentiometer cam screws have been disturbed the loop and bearing indicator are no longer directly replaceable items, and it will be necessary to readjust the cam screws if a bearing indicator is changed. In addition, where more than one bearing indicator is used on an aircraft, the accuracy of one instrument will be degraded when the loop is matched to the other. The loop potentiometer should be adjusted to match the indicator which will be used for taking navigational bearings.

It will generally be found most convenient to adjust the cam, before installing the indicator and loop in the aircraft.

The procedure is as follows :—

(i) Attach the scale and the cursor to the loop and baseplate respectively, as shown in the diagram Fig. 1. Centralise the loop scale to run true with the cursor. In this condition the loop is at right-angles to its baseplate, but not necessarily at right-angles to the centre line of the aircraft fuselage. The question of loop alignment should be ignored at this stage.

(ii) Check that the cam corrector is central in the gap in the cam pivot bracket (see Fig. 27, page 63, in technical manual Ref. T.2067).

(iii) With the bearing indicator scale vertical as mounted in the aircraft, the mean indicator reading should be 0° when the loop is rotated clockwise and then anti-clockwise up to the zero index on the loop scale (see para. 3.1 overleaf). If it is not, then the body of the transmitting potentiometer should be released by unscrewing the three clamping screws shown in the figure and rotated accordingly.

(iv) If the correction factor is known, set the QE compensator scale to the required figure. Otherwise set this scale at 0.

(v) Rotate the loop by 10° steps and plot a curve of the difference between the bearing indicator and loop scale readings, against the loop scale reading as a base line co-ordinate. If the QE correction has been applied, then plot, on the same base line, the theoretical QE curve as obtained from the table. To what extent cam correction is necessary will now be evident. With experience, drawing the curve can be dispensed with, since a direct comparison between the indicator and table can be made, but in any case the cam corrector should not be adjusted until a series of readings round the scale have been obtained, in order to decide whether cam correction is justified.

(vi) If it is decided to adjust the cam, rotate the loop clockwise to the 20° mark and check the indicator reading. Adjust the cam screw adjacent to the cam follower. Anti-clockwise rotation of the screw advances the reading and *vice versa.* (One complete turn = 1°).

Advance loop in 10° steps and where necessary adjust the screw nearest to the cam follower. Continue process for full 360° but do not adjust the screw nearest to the cam follower at the zero position.

Note:—Should the loop be intended for installation in an inverted position in the aircraft, and the matching procedure be performed before installation with the loop in the normal position, it will be necessary to rotate the loop in an anti-clockwise direction, and to use the small figures on the scale. This ensures that when the loop is mounted in the aircraft the appropriate corrections will be applied.

3. PRECAUTIONS TO BE TAKEN DURING ADJUSTMENT.

3.1 Allowance for hysteresis lag.

Owing to the effect of hysteresis the scale reading of the Type 1272 bearing indicator will lag $\frac{1}{2}$° behind the loop scale reading. This effect is not evident in flight as the indicator integrates the continual relative movement of aircraft and loop. When cam adjustment is performed, however, it will be necessary to create the service conditions artificially by advancing the loop scale $\frac{1}{2}$° more than the nominal value. Thus if the loop is turned clockwise and then anti-clockwise with an extra $\frac{1}{2}$° movement in each case, the same indicator reading will be obtained. Obviously overswinging and returning to the position required nullifies the setting.

3.2 Vibration.

Vibration is always present in flight and serves to overcome any friction in the bearing indicator pivots which might otherwise affect the readings. On the ground this effect should be simulated by lightly tapping the instrument case when readings are taken.

3.3 Effect of Additional Loading on Transmitting Potentiometer.

Adding additional load to the loop potentiometer, such as a duplicate indicator or loop controller, after adjustment, will slightly disturb the readings, and for this reason it is recommended that the cam correction be performed with all instruments and loop controller in circuit.

4. FINAL INSTALLATION IN AIRCRAFT.

Having adjusted the loop potentiometer cam to the indicator (either before or after installation) the loop should be prepared for use by adjusting the loop alignment screw until the indicator pointer is at zero when the loop is at right-angles to the axis of the aircraft fuselage. If the loop scale and cursor are left on, the loop alignment error will appear on the loop scale.

5. BEARING INDICATOR TYPE 1311.

The introduction of the 5″ bearing indicator Type 1311 provides greatly improved scale discrimination compared with the 3$\frac{1}{4}$″ instrument, the scale being graduated in 1° intervals. In addition the movement is more accurately made, and the instrumental error is reduced to a maximum of 1°. This includes the hysteresis error, which in this instrument is only $\frac{1}{4}$°.

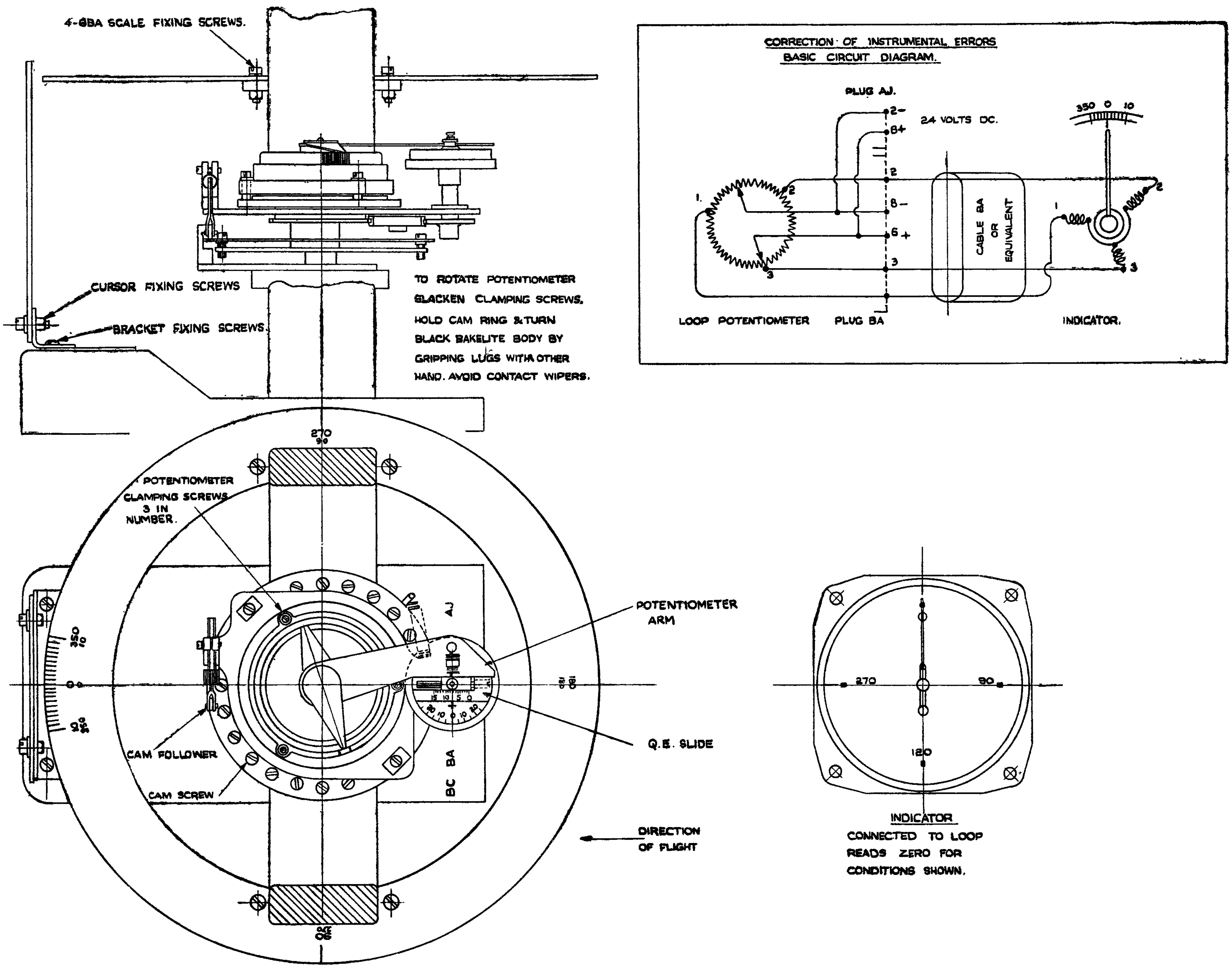


FIG. 1. BEARING INDICATOR ERROR CORRECTION FACILITIES.

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