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(formerly A.P.1275A, Vol.1, Sect.13 chap. 31).

DIRECTIONAL GYRO, Mk.1 SERIES

GENERAL AND TECHNICAL INFORMATION

BY COMMAND OF THE DEFENCE COUNCIL

J. T. Durrett

Ministry of Defence

FOR USE IN THE
ROYAL NAVY
ROYAL AIR FORCE

Prepared by Procurement Executive, Ministry of Defence.

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WARNINGS

CONTROL OF SUBSTANCES HAZARDOUS TO HEALTH

MAKE SURE YOU KNOW THE SAFETY PRECAUTIONS AND FIRST AID INSTRUCTIONS BEFORE YOU USE A HAZARDOUS SUBSTANCE

READ THE LABEL ON THE CONTAINER IN WHICH THE SUBSTANCE IS SUPPLIED

READ THE DATA SHEET APPLICABLE TO THE SUBSTANCE

OBEY THE LOCAL ORDERS AND REGULATIONS

Chapter 1

DESCRIPTION

Introduction

1. The directional gyro is an air-driven gyroscopic flight instrument which provides a reference in azimuth. Its purpose is similar to the magnetic compass, with the advantage that turning and acceleration errors and lag are entirely absent, and the instrument is unaffected by magnetic disturbances. It must be noted, however, that the directional gyro has no magnetic detector and therefore does not replace the compass, but is used as an associated instrument, in conjunction with the compass.

2. The instrument operates up to 55^{o} in bank, climb and drive. Should the aircraft exceed the instrument freedom, the gyro mechanism should be caged by operating the caging knob before the manoeuvre, and then uncaged when normal flight has been resumed.

Types available

3. The following instruments are available:-

▶ Directional gyro, Mk. 1A, fluorescent ... ... Ref. No. 6A/4332811 ◀

4. The Mk. 1 version of the instrument (fig.1) is of Sperry manufacture, and is similar to the directional gyro, Type D.L.2 except that the Mk. 1 instrument has the earlier type unshrouded rotor. A full description of the type D.L.2 is given in A.P.112G-0339-1.

Fig.1 Directional gyro, Mk. 1

5. The Mk. 1A versions of the instrument (fig.2) are manufactured by Reid and Sigrist and are described in the following paragraphs. Mk.1 and Mk. 1A instruments serve an exactly similar purpose and are completely interchangeable.

DESCRIPTION

Rotor assembly

6. The rotor consists of a dynamically balanced wheel with a heavy rim, fitted on a shaft which is carried in two-ball-bearing assemblies screwed into the inner gimbal ring. Buckets are cut into the periphery of the rotor so that the rotor may be spun at high speed by means of an air jet.

Fig.2 Directional gyro, Mk.1A

Gimbal ring assembly

7. The inner gimbal ring (fig.3 (5)) is a die casting, approximately rectangular in shape and pivoted horizontally on the fore-and-aft axis within the outer gimbal ring by means of pivots and ball-bearing assemblies. The outer gimbal assembly is in the form of a sealed cylindrical case carried vertically in the instrument case and consisting of a cylindrical gimbal ring (4), a top cover plate (3) and a bottom cover plate. The outer gimbal ring incorporates two erection ports (fig.4 (17)) controlled by a semi-circular plate attached to the inner gimbal ring so that when the rotor tilts, one port is almost closed and the other opened. The reaction from the jet of air issuing from the open port provides the erecting torque. The top cover plate (3) incorporates a hollow spindle which provides an entry for the operating air. The air passage is continued in the form of a nozzle and jet which is directed at the centre of the buckets cut in the periphery of the rotor wheel. The bottom cover plate carries a bevel gear (16) which engages a bevel pinion when the caging control is operated. The top and bottom cover plate are secured to the outer gimbal ring by csk screws and an extended flange on the top cover plate carries the compass card.

Caging mechanism

8. A caging knob (13) is fitted to a shaft which carries a bevel plunger (14) and a bevel pinion (15). When the knob is pushed in, the bevel pinion engages the bevel gear (16) and the bevel plunger becomes disengaged from the centralizing bracket plate (11) which allows the centralizing bracket (9) to turn on its pivots (12) under the tension of two springs (8) which are anchored to the bottom of the instrument case. This action raises the centralizing ring (6), which operates two levers (10). This in turn, raises the inner gimbal centralizing bracket (7) which centralizes the inner gimbal ring thus setting the rotor axis horizontal.

Instrument case

9. The instrument mechanism is housed in a cast light-alloy case, on the rear of which is incorporated a filter housing. The filter element is of wire gauze and felt, climatically proofed and V.P.I. impregnated, and is retained in its housing by a sealing ring and a wire circlip. An air passage connects the filter chamber to the hollow spingle of the outer gimbal. On the rear of the case a threaded boss provides the vacuum supply connection.

Note; "VPI" means a saturated "Vapour Phase Indicator" powder impregnated filter.

1 TUBULAR SPINDLE
2 NOZZLE AND JET
3 TOP COVER PLATE
4 CYLINDRICAL GIMBAL RING
5 INNER GIMBAL RING
6 CENTRALIZING RING
7 INNER GIMBAL CENTRALIZING BRACKET
8 SPRINGS
9 CENTRALIZING BRACKET
10 LEVERS
11 CENTRALIZING BRACKET PLATE
12 PIVOTS

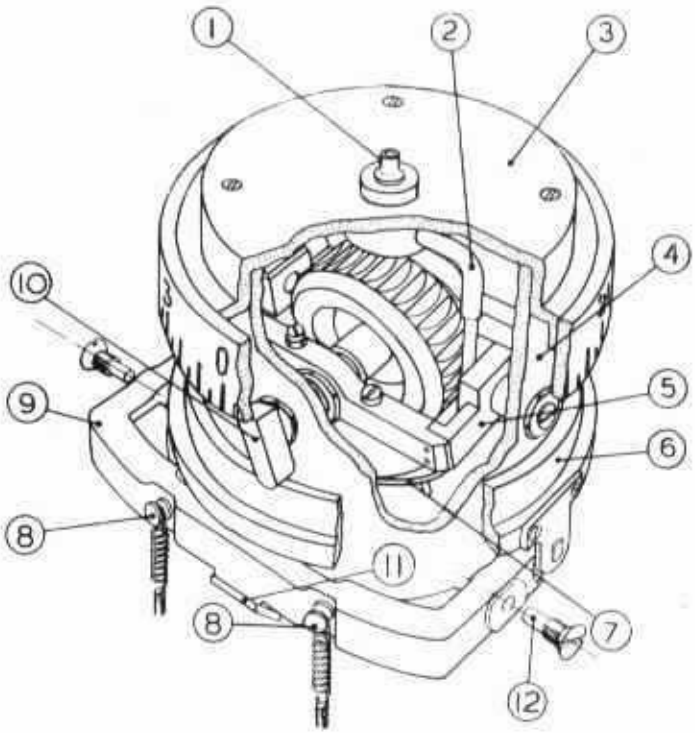


Fig.3 Mechanism of directional gyro, Mk. 1A

10. The bezel is secured to the case casting by csk screws and accommodates the dial and bezel glass. The compass card is observed through an aperture in the dial which carries the fluorescent or luminous lubber line. The instrument is mounted on the flight instrument panel by four corner lugs, which incorporate self-locking anchor nuts.

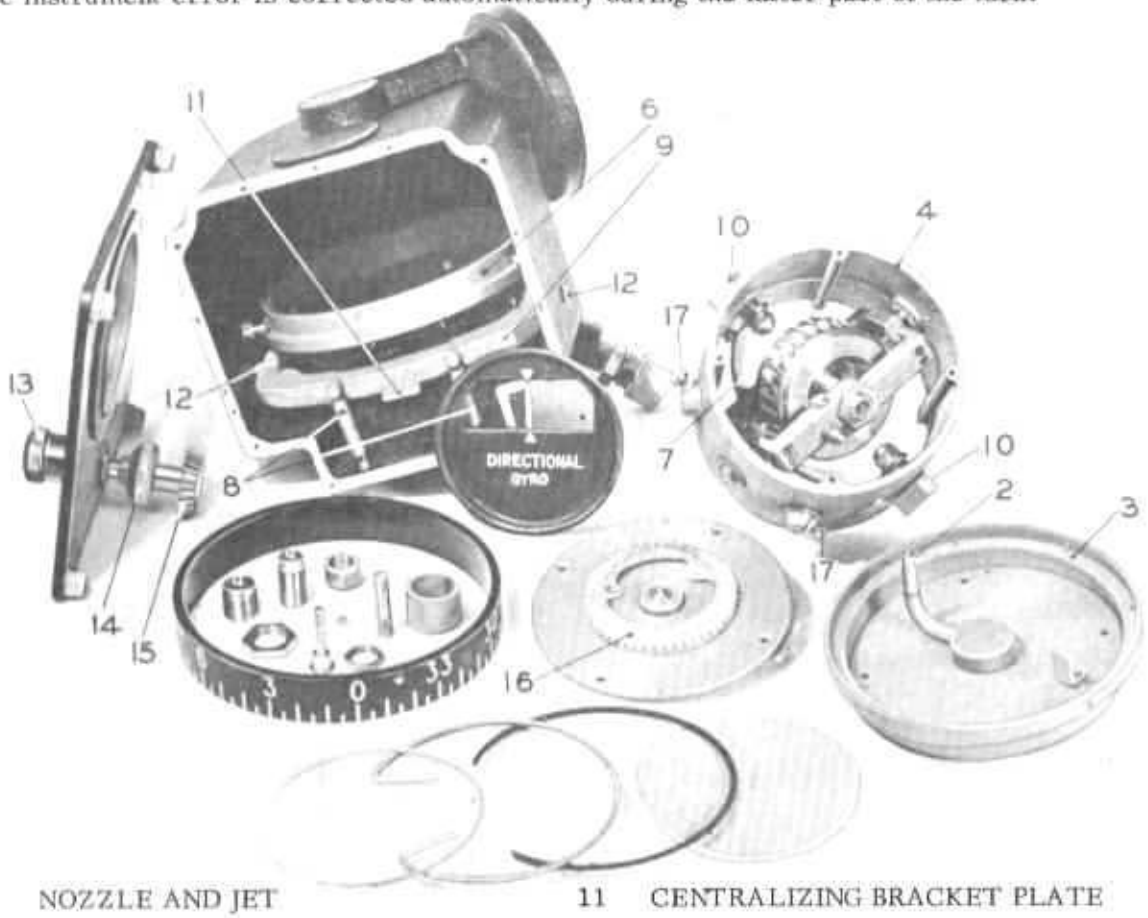
OPERATION

11. The gyroscope will start as soon as vacuum is applied, but it should be remembered that it will not reach its full rotational speed until $3\frac{1}{2}$ to 4 minutes after starting. While it is attaining full speed the reading may be somewhat inaccurate, but the errors will not be serious once the vacuum has been applied for about $1\frac{1}{2}$ minutes.

12. After this initial period the setting should be adjusted by pushing the knob to the forward position and turning it until the reading of the indicator coincides with that of the magnetic compass. The knob should then immediately be pulled out, while the scale is watched to see that the setting is not disturbed while doing so. The instrument will now indicate at any moment, the reading of the aircraft in azimuth, and may be used in making accurate changes in course. The gyroscope may, however, drift slowly and at least every 15 minutes or immediately before accurate readings are required, the indication should be checked against that of the compass and the scale reset is necessary.

13. The instrument will function, though not indicate without error during climbs, dives and banks up to 55°. When these angles are exceeded the gyro is disturbed and topples, and the indicator must be reset after normal flight has been resumed. Fig.5 shows graphically the effects of banking in turns for ranges of bank angles and instrument readings, and it may be observed that the correction for a particular angle of bank varies with the instrument reading. Thus, for comparatively flat turns as when gaining a track in a bombing run the

errors may be considered as small; even with a banked turn the error is not serious, as it disappears when level flight is resumed. Also as the bank angle is usually reduced gradually, the instrument error is corrected automatically during the latter part of the turn.



2	NOZZLE AND JET	11	CENTRALIZING BRACKET PLATE
3	TOP COVER PLATE	12	PIVOTS
4	CYLINDRICAL GIMBAL RING	13	CAGING KNOB
6	CENTRALIZING RING	14	BEVEL PLUNGER
7	INNER GIMBAL CENTRALIZING BRACKET	15	BEVEL PINION
8	SPRINGS	16	BEVEL GEAR
9	CENTRALIZING BRACKET	17	ERECTING PORTS
10	LEVERS		

Fig.4 Directional gyro, Mk.1A, dismantled

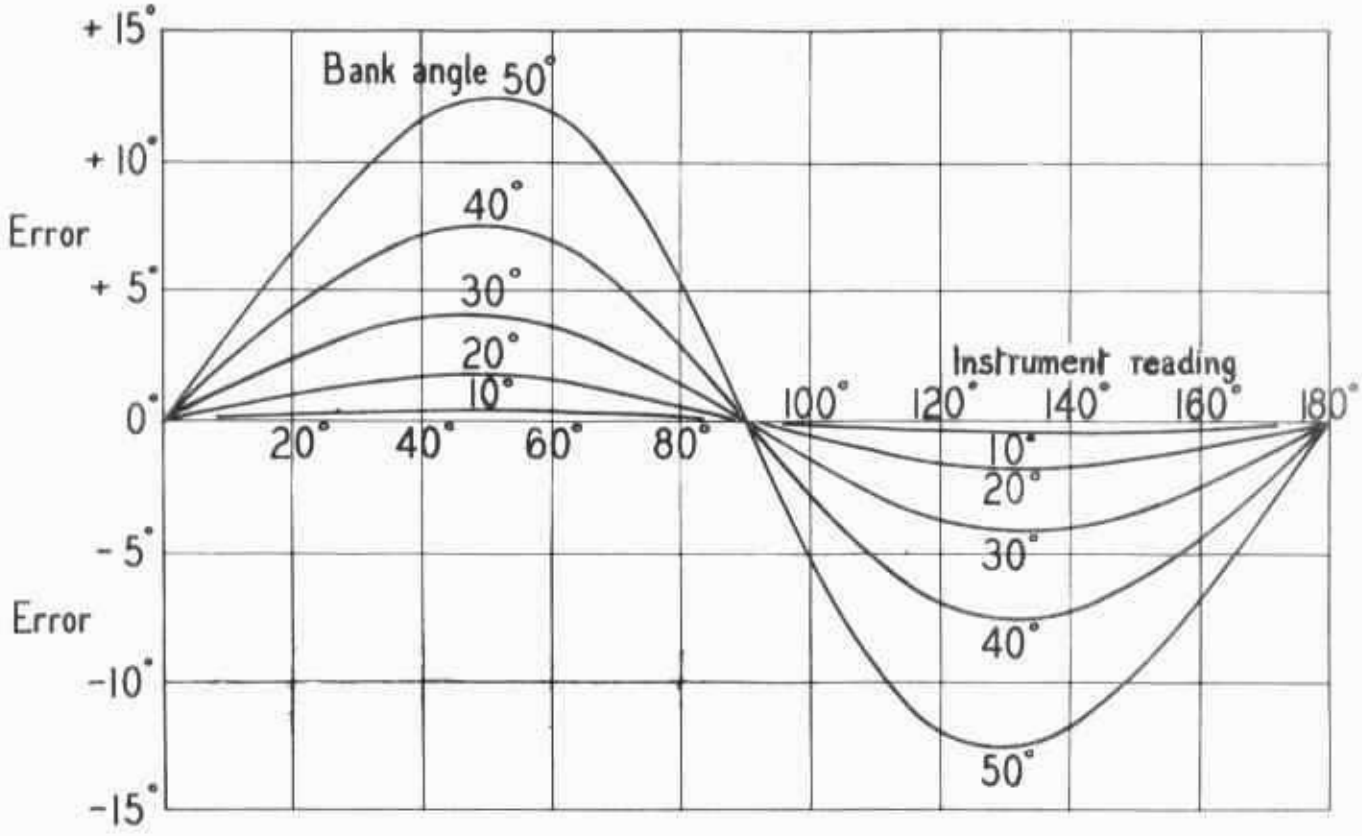


Fig.5 Errors of directional gyro due to banking

Chapter 2

STANDARD SERVICEABILITY TEST

Introduction

1. The tests laid down in this Chapter are to be applied on receipt, when serviceability is suspect, on completion of servicing or repair, and during inspections made at Equipment Depots. The tolerances given must not be exceeded.

METHOD OF TESTS

2. Unless otherwise specified, the instruments are to be tested in the normal position, i.e. with the dial upright and in a vertical plane. Vacuum at $3\frac{1}{2} \pm \frac{1}{2}$ in. Hg measured adjacent to the outlet connection on the instrument case is to be applied throughout the tests unless otherwise stated.

TEST EQUIPMENT

3. The equipment required for the test is a gyro instrument test table, Mk. 4M (Ref. No. 6C/7530926) or suitable equivalent.

EXERCISING

4. Prior to applying the tests, exercise the instrument by running it for 15 minutes under roll, pitch and yaw conditions with reversal at one minute intervals, using the automatic reversing switch.

TESTS

5. Before commencing the tests, examine the filter of the instrument for cleanliness and change it if necessary.

Starting test

6. Set the test table level and turn the vacuum supply ON, slowly increasing to 1in Hg. The rotor should commence to run. Increase the vacuum to $3\frac{1}{2}$ in Hg and allow 10 minutes for the rotor to reach full speed.

Drift test

7. (1) Set the gyro unit at ZERO and uncage.

(2) Set the test table to produce $\pm 7\frac{1}{2}^{o}$ roll, pitch and yaw conditions at a frequency of 7 to 10 cycles/min. Using the automatic reversing switch, operate for 10 minutes at minimum speed.

(3) Level the test table and check ZERO heading. Maximum permissible drift is $4\frac{1}{2}^{o}$.

Rotation test

8. (1) Set the test table for rotation in azimuth and adjust the motor speed so that the table completes one revolution in 1 min. 40 sec. to 2 min.

(2) Note the reading of the azimuth pointer on the periphery of the table.

(3) Set the gyro unit to ZERO and uncage.

(4) Rotate the test table through 360^{o}.

(5) Check the card against its former heading. Maximum permissible is $\pm 3^{o}$.

(6) Cage the gyro and disconnect the vacuum source.

Chapter 3

SERVICING

SERVICING

1. The vacuum supply of the aircraft should be checked to ensure that a vacuum supply of $3\frac{1}{2} \pm \frac{1}{2}$ in Hg is available at the instrument when the engine is running at normal revolutions. If the vacuum supply relief valve has been correctly set and the required vacuum is not obtained, the installation must be checked for leaky connections, kinks in flexible hoses or choked filters.

2. Check the instrument and its installation for security and signs of damage and ensure that the caging control moves smoothly over its range. Push the caging control to the caged position and then rotate it, ensuring that the card turns freely and smoothly through the whole 360^{o}.

3. The filter element must be changed at periods detailed in the relevant Servicing Schedule.

Standard serviceability test

4. Prior to installation and at any time when the serviceability of the instrument is suspect, the tests detailed in Chapter 2 should be applied.

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