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ARTIFICIAL HORIZONS
MK 1E AND MK 1F

GENERAL AND TECHNICAL INFORMATION

BY COMMAND OF THE DEFENCE COUNCIL

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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

WARNING

THE FOLLOWING SUBSTANCES, WHICH ARE HAZARDOUS TO HEALTH, ARE USED IN THE MAINTENANCE OF THIS EQUIPMENT:

(1) OIL, OX-14 (REF. NO. 34B/9100589).- FOR HANDLING PRECAUTIONS, SEE PUBLICATION AP100B-10, DATA SHEET S.2401

(2) VARNISH, SYNTHETIC (REF. NO. 33B/9433454) - FOR HANDLING PRECAUTIONS, SEE PUBLICATIONS JSP(F)395 AND AP100B-10, DATA SHEET S.2100.

(3) LACQUER, WHITE TINTALITE (REF. NO. 33C/2244718) - FOR HANDLING PRECAUTIONS, SEE PUBLICATION JSP(F)395

Chapter 1-1

ARTIFICIAL HORIZON, Mk.1E (SPERRY TYPE),

DESCRIPTION AND OPERATION

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Introduction

1 The artificial horizon, Mk.1E (Ref. No. 6A/4333462) is provided to give a continuous visual indication of the aircraft's attitude in roll and pitch relative to the vertical. This information is presented on the instrument dial (fig. 1), the aircraft being depicted as a tail-end view in miniature engraved centrally in the bezel glass and the horizon represented by a split bar. Thus, when the aircraft is in level flight the horizon bar will be in alignment with the miniature aircraft, whereas any departure from level flight will be shown by displacement or inclination of the horizon bar relative to the miniature aircraft.

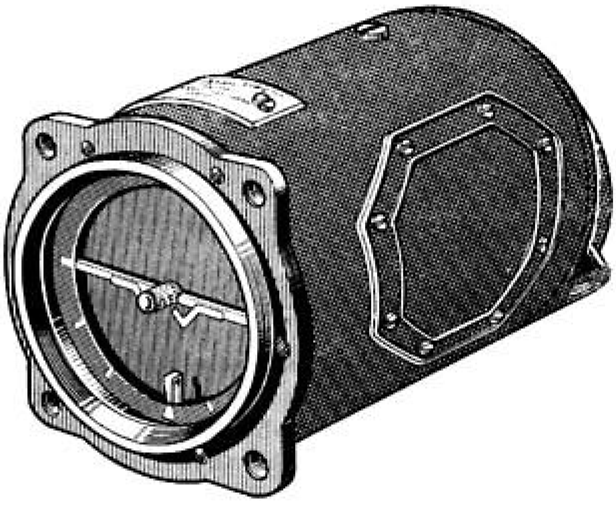

Fig. 1 Artificial horizon, Mk.1E (Sperry Type)

2 The mechanism has a pitch freedom of 85 deg in climb and 85 deg in dive, and complete freedom in roll. To enable accurate flight manoeuvres to be executed a bank angle pointer registers against a bank angle scale engraved around the lower half of the bezel glass in 30 deg, 60 deg and 90 deg graduations on each side of a central level flight datum.

3 The dial is finished in matt-black in contrast to the fluorized pointers and dial markings. Aluminium and aluminium alloy parts are anodized.

DESCRIPTION

Rotor assembly

4 The rotor of the gyro assembly (fig. 2) is a dynamically balanced wheel on a vertical shaft with toroidal pivots mounted in two 5-ball cageless bearing races. These races have self-aligning track surfaces, thereby making bearing alignment automatic. The races are lubricated by means of oil pads which ensure adequate lubrication throughout the instrument's life. The rotor bearings are shrouded by cylindrical skirts which prevent the ingress of any dust carried by the air circulation which operates the instrument. The lower bearing is fitted into a recess in the bottom of the rotor case, whereas the upper bearing is carried in a housing which is spring-loaded within the top cap to compensate for the differential expansion between the rotor shaft and rotor case. This ensures correct clearances on the rotor between -55 and +70 deg C.

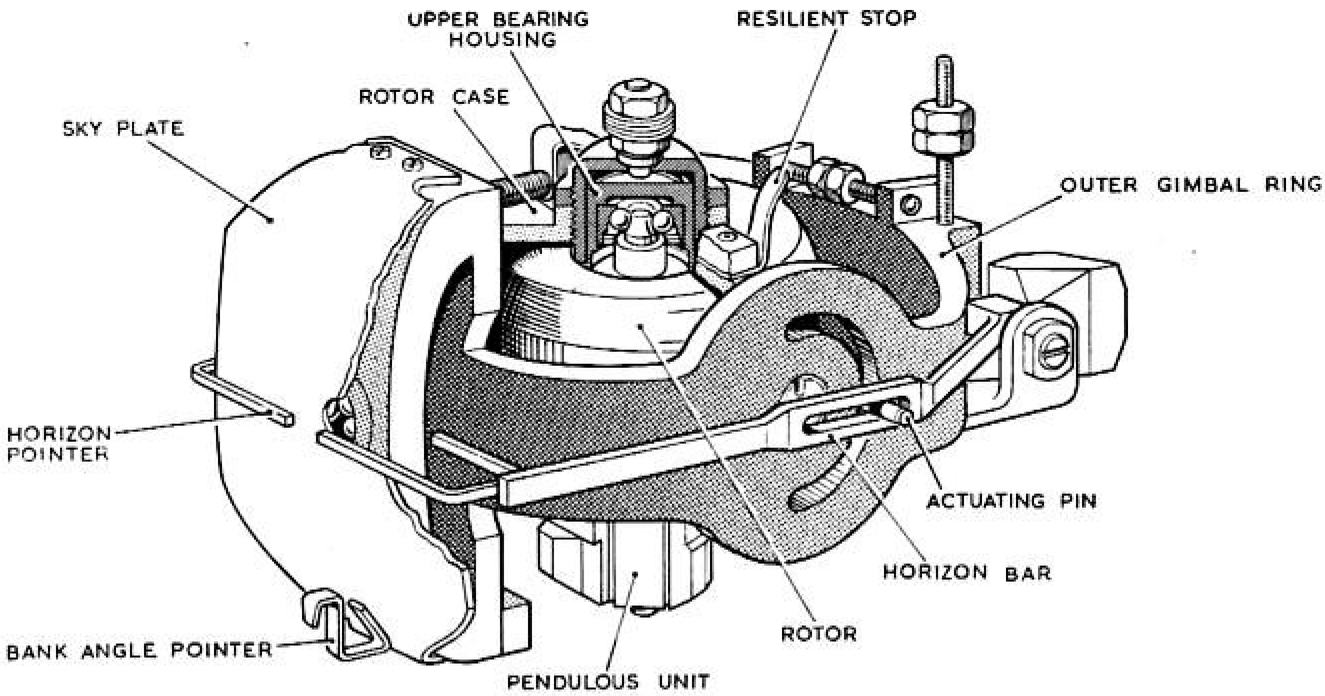

Fig. 2 General arrangement of mechanism

5 A window is incorporated in the rotor case so that marks on the top face of the rotor may be observed when checking the rotor speed during tests. The rotor spins in a counter-clockwise direction when viewed from above. The rotor case carries the resilient pitch stops and the adjustable horizontal balancing screw. The pendulous unit attached to the base of the rotor case inclines the rotor axis with the top 2.5 deg forward in the line of flight and 0.8 deg to the

left. This compensates for pendulous and erection turn acceleration errors at the roll erection rate of 8 deg/min during a rate 1 turn (180 deg/min) at 260 knots and partially compensates in other conditions. The pendulous unit onsists of a body with a slot aperture in each side which is controlled by a vertical vane so that the vanes bisect the slots at correct rotor axis inclination.

6 Diametrically opposite vanes (fig. 6) are clamped to opposite ends of a common spindle carried in plain bearing bushes within the walls of the pendulous body with the end thrust taken on ball bearings.

Gimbal assembly

7 The rotor assembly is mounted transversely within the gimbal ring by oil-lubricated toroidal pivots and bearings which are fitted with oil reservoir pads and air retainer washers. The pivots and bearings are arranged so that on one side the bearing race is accommodated in the rotor case and engages a pivot screwed into the gimbal ring, whereas on the other side (fig. 3) the pivot is attached to the rotor case and engages a bearing race carried in an adjustable housing within the gimbal ring. This latter arrangement provides for the air passages to the rotor through an air-pivot. On the other side clearance is provided for the horizon bar actuating pin which projects from the rotor case.

8 The gimbal ring is of rectangular shape and allows the rotor assembly freedom in pitch from 85 deg climb to 85 deg.dive. At these limits, adjustable stop screws contact a horn type resilient stop on top of the rotor case. The gimbal ring is pivoted fore and aft in the instrument and has total freedom in roll. The air-pivot adjacent to the rear cover forms the connection between the air inlet on the rear cover and the air passage in the gimbal ring. The front pivot is carried in a sleeve fixed in the bezel glass and engages a bearing race carried in a bridge casting (fig. 2) attached to the end of the gimbal ring. Adjustable balance weights are fitted for balancing and calibration.

Pointers and bezel

9 The background or skyplate of the dial is a plate attached to the bridge casting on the gimbal ring, and has a centre hole through which passes the front pivot of the gimbal ring. The skyplate is finished in matt-black and carries the fluorized bank angle indicator. The horizon bar assembly is an accurately balanced assembly pivoted in ball bearing races on the side of the gimbal ring and is slotted to engage the actuating pin projecting from the rotor case.

10 The pointer portion of the bar is formed by two D-section arms (fig. 2), one of which is set at right-angles to the bar and passes across the dial terminating near the front pivot, whereas the other arm, also at right-angles to the bar, passes between the bridge casting and the gimbal ring and aligns across the dial with the opposite arm. Thus the fluorized portions of the pointer arms across the dial appear on the front presentation as a single bar with a cut-away centre giving clearance to the front pivot.

11 The front pivot is fitted through the centre of the bezel glass which is made from a transparent synthetic material capable of withstanding an external pressure in excess of 399 mbar (10 in Hg). The bezel glass is engraved with the tail end view of a miniature aircraft and a bank angle scale, both of which are treated with fluorescent compound. A retainer ring held by screws secures the bezel glass, fitted from the rear of the bezel casting, against the sealing ring.

12 Four integral corner lugs on the bezel fitted with 2 B.A. anchor nuts form the instrument mounting to the flight instrument panel.

Case and rear cover

13 Attached to the bezel is the cylindrical case of the instrument which is enclosed at the other end by the rear cover. A sealed access panel and plug on the side and top of the case respectively (fig. 1) are provided for assembling and calibrating. The rear cover has three alternative connections for the vacuum supply and carries the rear bearing of the gimbal mounting. The bearing race is accommodated within an adjustable housing for end-float adjustment of the gimbal ring pivots.

14 Holes around the bearing housing connect with the air inlet filter assembly attached to the rear cover. The filter assembly consists of a gauze and felt filter, fully climatically-proofed and impregnated with a saturated vapour phase inhibitor powder to protect the bearings against corrosion.

PRINCIPLE OF OPERATION

15 Referring to fig. 3, 4 and 5, the function of the artificial horizon is to determine the roll and pitch attitudes of the aircraft and present this information on the instrument dial. Therefore the attitude of the aircraft must be measured against a reference uninfluenced by the aircraft but controlled to maintain a fixed attitude relative to the surface of the earth. For this purpose the gravity controlled gyroscope is employed in the form of a rotor spinning around a vertical axis and carried in gimbal rings so that it has freedom in roll and pitch (fig. 4). The gimbal rings are arranged so that the inner ring carrying the rotor is pivoted laterally on the axis Y-Y in an outer ring which is itself pivoted parallel to the fore-and-aft axis X-X of the aircraft. Thus a change in pitch attitude of the aircraft turns the instrument case and hence the outer gimbal ring which is held by the rigidity of the gyroscope.

16 The pointer bar, representing the horizon, is pivoted on the side of the outer gimbal ring and engages an actuating pin on the inner gimbal ring. Pointer movement magnification is such that as the outer gimbal ring turns about the axis Y-Y the pointer bar is displaced above or below the miniature aircraft on the bezel glass. As an example, the presentation of climb is shown in fig. 5 as compared with level flight represented in fig. 4.

17 Rolling the aircraft turns the instrument case about the fore and aft axis X-X, the outer gimbal ring being stabilized as the gyroscope maintains its plane of spin. Hence the aircraft's lateral attitude is shown by the turning of the instrument case and the miniature aircraft relative to the horizon bar. The actual angle of bank is shown by the bank angle pointer registering against the bank angle scale.

18 To operate the air driven rotor, an engine-driven vacuum pump extracts the air from the instrument case at an operating suction of 119 ± 17 mbar ($3\ 1/2 \pm 1/2$ in Hg) This causes air to enter the instrument through the filter on the rear cover and then, via the passages in the outer gimbal ring pivot, into the inner gimbal ring (i.e., rotor case) where it issues from a jet orifice in the inner wall. The jet stream impinges on buckets on the periphery of the rotor and spins the rotor at high speed (15000 r/min). The air passes out through slots in the pendulous unit at the bottom of the rotor assembly and circulates in the instrument case where it is drawn off by the vacuum pump.

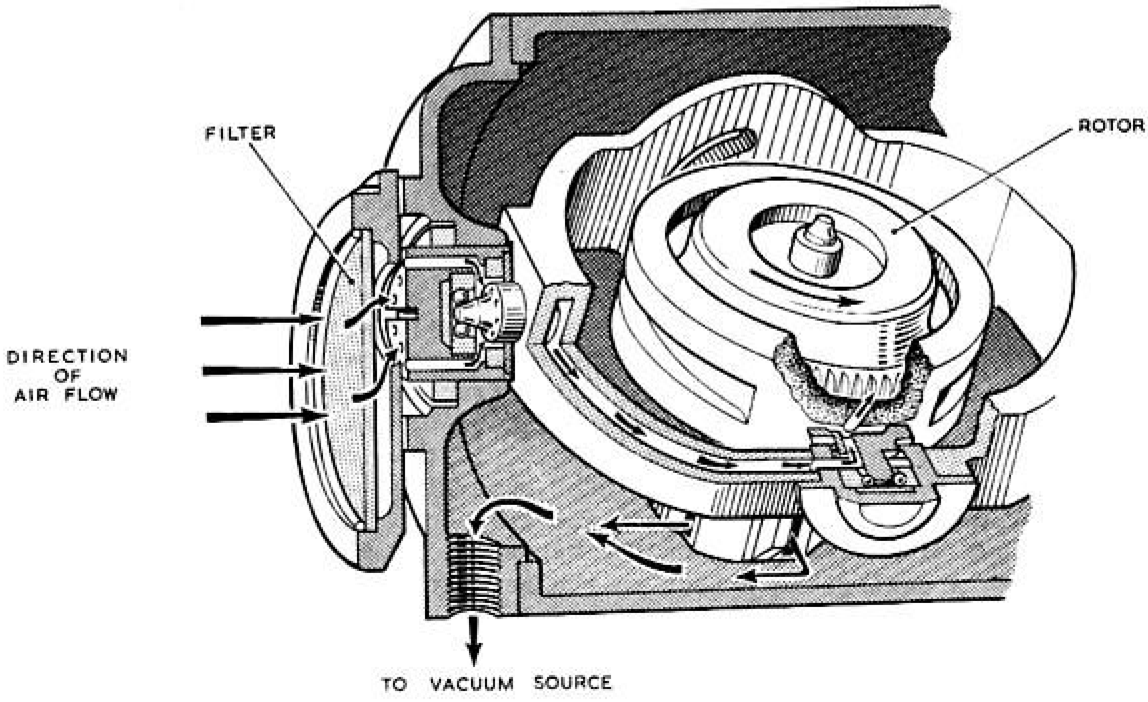

Fig. 3 Diagram showing airflow

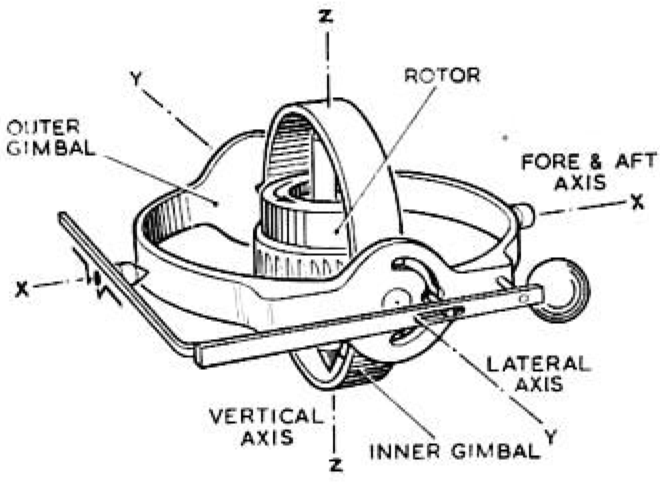

Fig. 4 Level flight presentation

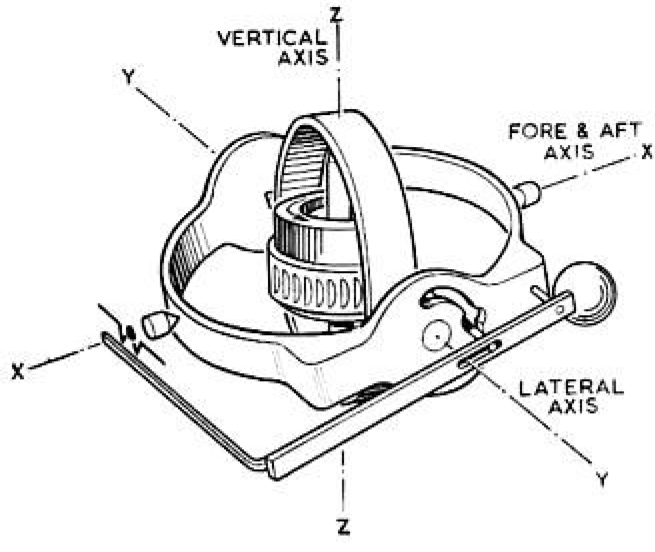

Fig. 5 Climb presentation

19 The rotor unit is made slightly pendulous so that when the rotor is stationary, the rotor axis will be within 30 deg of the vertical. To cater for turn acceleration errors the rotor axis is inclined with the top 2.5 deg forward and 0.8 deg to the left, which provides complete compensation during a rate 1 turn at 260 knots.

20 Erection and maintenance of the rotor axis at the correct inclination is performed by the pendulous unit at the base of the rotor assembly. The pendulous unit consists of a body with a slot aperture in each side through which emerges the air exhausted from the rotor case. The slot apertures are controlled by two pairs of pendulous vanes arranged so that diametrically opposite vanes are mounted on the opposite ends of a common spindle. The vanes hang vertically and are adjusted so that at the correct inclination the vanes bisect the slots, thereby producing four equal jet reactions, namely fore, aft, left and right. Should the rotor axis depart from the correct inclination, for example, to the left, the correction would be as follows.

21 The gravity controlled vanes (fig. 6) remain vertical, thus vane A increases the slot aperture B, whereas the opposite vane will close its slot aperture, and the reaction of the air from slot B will produce a force in the opposite direction to its jet stream. This force produces a moment on the rotor equivalent to an upward force at C which transferred to the top plane of the rotor would correspond to a downwards force at D. As gyroscopic precession takes place at 90 deg in the direction of spin, in this case counter-clockwise when viewed from above, the gimbal and rotor assemblies will turn to the right until the rotor axis regains its correct inclination. The erection rate is 8 deg/min and thus slight swinging of the vanes due to aircraft movement is only transient and has a negligible effect on the pendulous control.

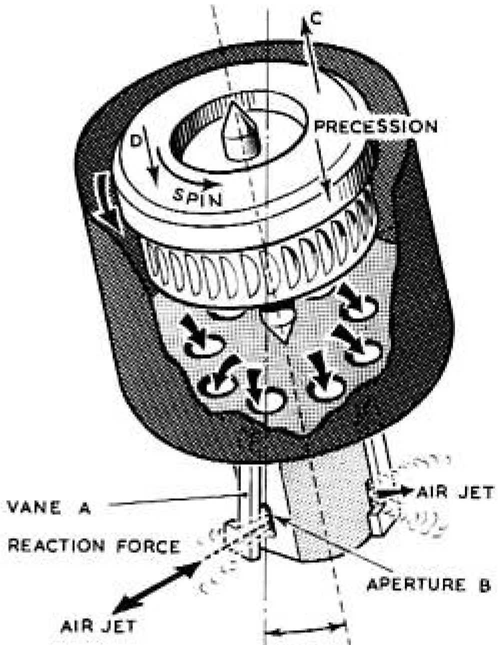

Fig. 6 Direction of airflow and operation of pendulous vanes

Chapter 1-2

ARTIFICIAL HORIZON, Mk.1F (SMITH TYPE)

DESCRIPTION AND OPERATION

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13 Gyro erection

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Introduction

1 In Chapter 1-1, the general remarks applicable to the artificial horizon, Mk.1E (Sperry Type) also apply to the Mk.1F (Smith Type) (Ref. No. 6C/22108) which is described in this chapter. Presentation on the two instruments is identical but there are mechanical differences and the erection of the gyro is achieved by a slightly different method. The two types are interchangeable.

Fig. 1 Dial presentation

DESCRIPTION

Rotor assembly

2 The rotor assembly consists of a rotor contained in a case, an erection assembly and a pendulous ball assembly. The rotor is pivoted on its lateral axis and is carried by the gimbal ring. The rotor consists of a wheel with a duralumin centre and a rim of heavy tungsten alloy material, the rim being serrated on its periphery to provide a means of rotation by air issuing tangentially from multiple slots. Since the rotor centre has a co-efficient of expansion equal to that of the aluminium case, variations in temperature do not affect bearing adjustment. The rotor spindle is carried in ball bearings, the upper bearing being spring-loaded and the lower one adjustable.

3 Lubrication pads are provided, and oil retaining washers, retained by circlips are fitted on both the upper and lower rotor bearings.

4 Air for driving the rotor, passes from the annulus through holes in the ring which surrounds the rotor and impinges upon the serrations on the rim of the wheel. The air passages and air flow through the artificial horizon to the rotor assembly are illustrated in fig. 2.

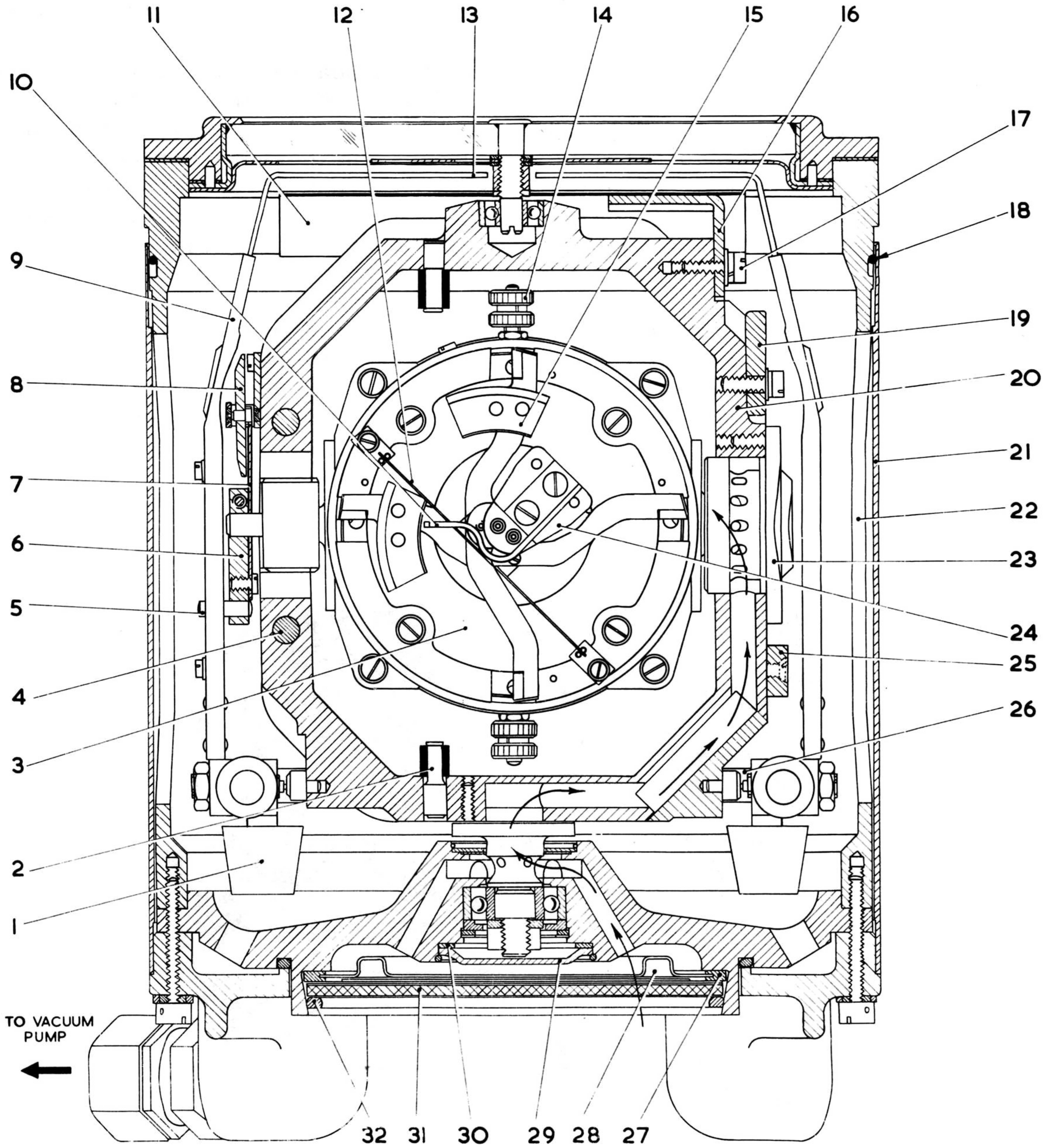
5 The erection assembly comprises four jets which are inclined towards the centre of an erector plate and operate in conjunction with movable vanes controlled by pendulous weights. Jewelled bearings are employed for the vane pivots to minimize friction and to render the vanes sensitive to very small deviations in the attitude of the rotor assembly. The bearing plate (24, fig. 2) carries the spring stop (10) as well as the two bearings for the upper ends of the vane pivots. The bearing plate and spring stop are retained in position by two cheese-headed screws.

6 The pendulous ball assembly screws on to the bottom of the rotor case. It consists of two concentric dished plates between which a ball of heavy tungsten alloy is free to move. The upper plate is retained by a ring held in place by three countersunk head screws. At the front and rear ends of the rotor assembly are two adjustable weights (14, fig. 2), each consisting of two milled nuts with an interposed spring washer.

Gimbal assembly

7 The gimbal ring (20, fig. 2) is supported, front and rear, in ball bearings. The front bearing is mounted in the gimbal ring and engages a pivot fixed in the centre of the bezel glass. The rear bearing assembly is housed in the rear of the instrument frame over which fits the rear cover incorporating the inlet connection and the filter.

8 A sky plate is fixed to the gimbal ring by a screw (17, fig. 2) which passes through the sky plate bracket. A roll pointer which registers against a fixed annular scale is attached to the lower end of the sky plate. Two rubber covered stops (3) are located at the front and rear ends of the gimbal ring and limit the gyro movement in pitch to 85 deg in climb or dive. Vertical and horizontal adjustable balance weights are positioned at the front and rear ends of the gimbal ring respectively.



1	Balance weight	17	Sky plate screw
2	Rubber-covered stop	18	O-ring
3	Erector plate	19	Balance weight
4	Dowel screw	20	Gimbal ring
5	Crankpin	21	Outer case
6	Crank	22	Main frame
7	Sector gear	23	Rotor assembly bearing housing
8	Damping wheel	24	Vane bearing plate
9	Horizon bar arm	25	Balance weight
10	Spring stop	26	Tie bar
11	Sky plate	27	Rubber washer
12	Centralizing spring	28	Metal gauze
13	Horizon bar	29	Cover plate
14	Adjustable weight	30	Rubber seal
15	Pendulous weight	31	V.P.I. filter disc
16	Sky plate bracket	32	Circlip

Fig. 2 Sectional view of the Mk.1F (Smith Type) artificial horizon

9 The sides of the gimbal ring carry the two ball bearings which support the gyro assembly, one of the bearings being fixed and the other adjustable. The rotor assembly shaft is extended through one bearing and carries on its outer end, a crank (6) and a crankpin (5) which engages the horizon bar (9) between two needle guides. Attached to the gyro assembly crank is a sector gear (7) which meshes with a small pinion carried by a damping wheel (8). This geared up flywheel has the effect of reducing the period of oscillation of the horizon bar when the gyro is started from rest.

10 The horizon bar is in two parts which are supported by two light-alloy arms pivoted at the rear of the gimbal ring and connected by a tie-bar (fig. 3) so that they move together. The arms are actuated by a crank and a crankpin which engages a slot in one of the arms. The movement of the rotor assembly is in this way transmitted to the horizon bar.

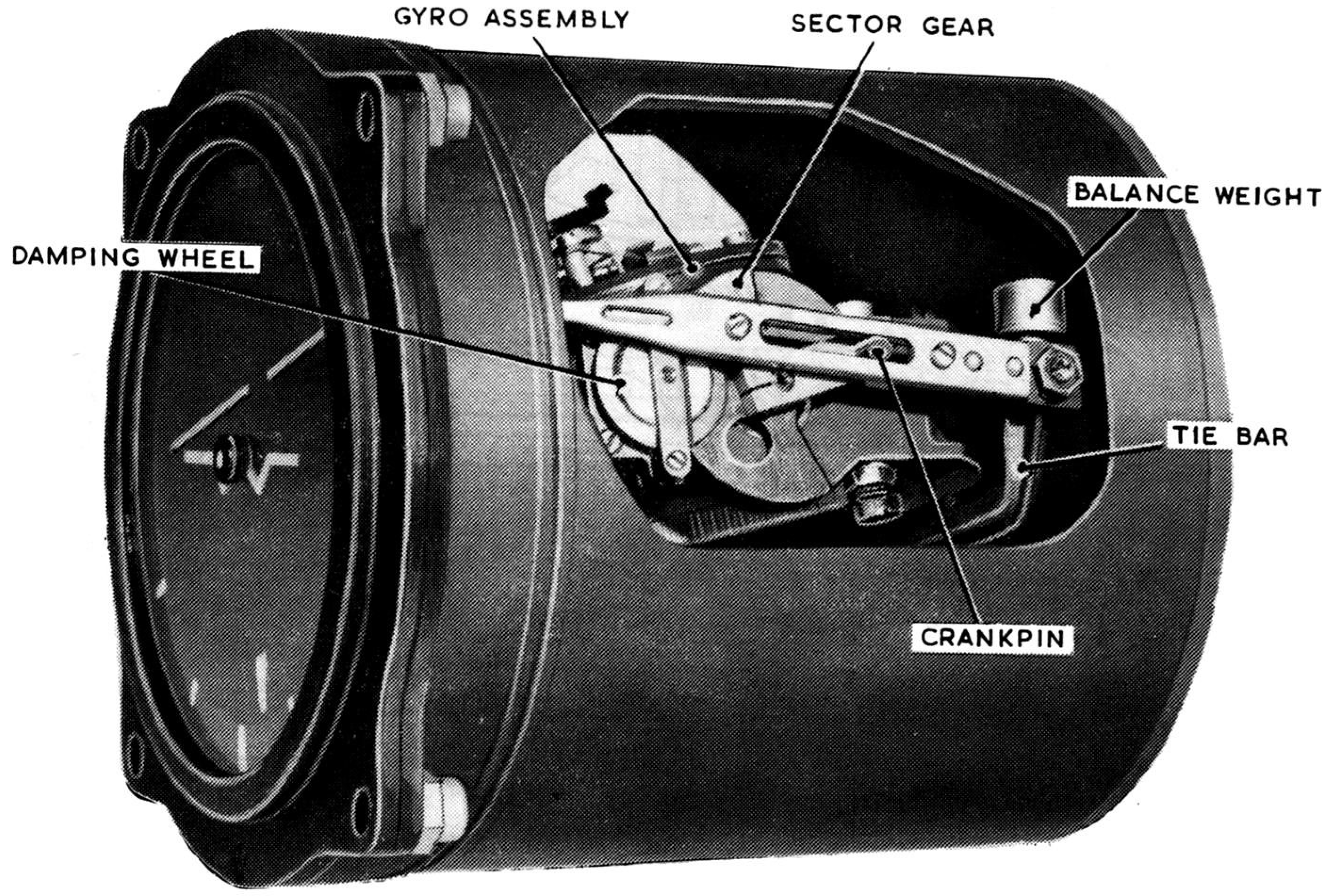


Fig. 3 Instrument with damping mechanism exposed

11 The cast light-alloy main frame carries the front bezel and glass, the gimbal ring and the rear plate. On each side of the cylindrical frame is a large cut-away, enabling adjustments to be carried out without complete dismantling as was necessary on earlier types. The rear plate carries the rear bearing for the gimbal ring and incorporates air passages for the rotor vacuum supply. The filter is also situated in the rear plate. A thin outer cover slides over the main frame, the joint at the front being sealed by an O-ring. At the rear, the cover can is located by a ring into which the suction supply union is screwed, two alternative positions being provided. The ring is retained by 6 cheese-headed 2 B.A. screws, the joint against the rear plate being sealed by an O-ring.

OPERATION

12 The principle of operation of the artificial horizon is described in Chapter 1-1. The Mk.1F (Smith Type) instrument differs from that described in Chapter 1-1 in the method used to erect the gyro, also in the construction of the case, and the method of mounting the outer gimbal.

Gyro erection

13 The rotor assembly must be erected to the desired vertical before the instrument can function correctly and this condition must be maintained during flight. It is desirable to make the gyro non-pendulous under normal flight conditions, so that it is unaffected by centrifugal force during turns, but a pendulous system is desirable when the instrument is not running. This conditions is achieved by the use of a ball of heavy tungsten alloy in the base of the rotor assembly, moving between two curved surfaces whose centres of curvature coincide with the intersection of the gimbal axes. If the gyro axis is inclined from the vertical the ball will roll to the lowest point, but the balance will be unaffected until at about 40 deg inclination the ball will reach the limit of its travel and act as a fixed counterweight making the whole unit pendulous. During turns the ball will take up a position on the curved surface where gravitational force is balanced by centrifugal force and there is no resultant to unbalance the gyro unit. This arrangement ensures that before starting the gyro, the spin axis is within 40 deg of the desired position.

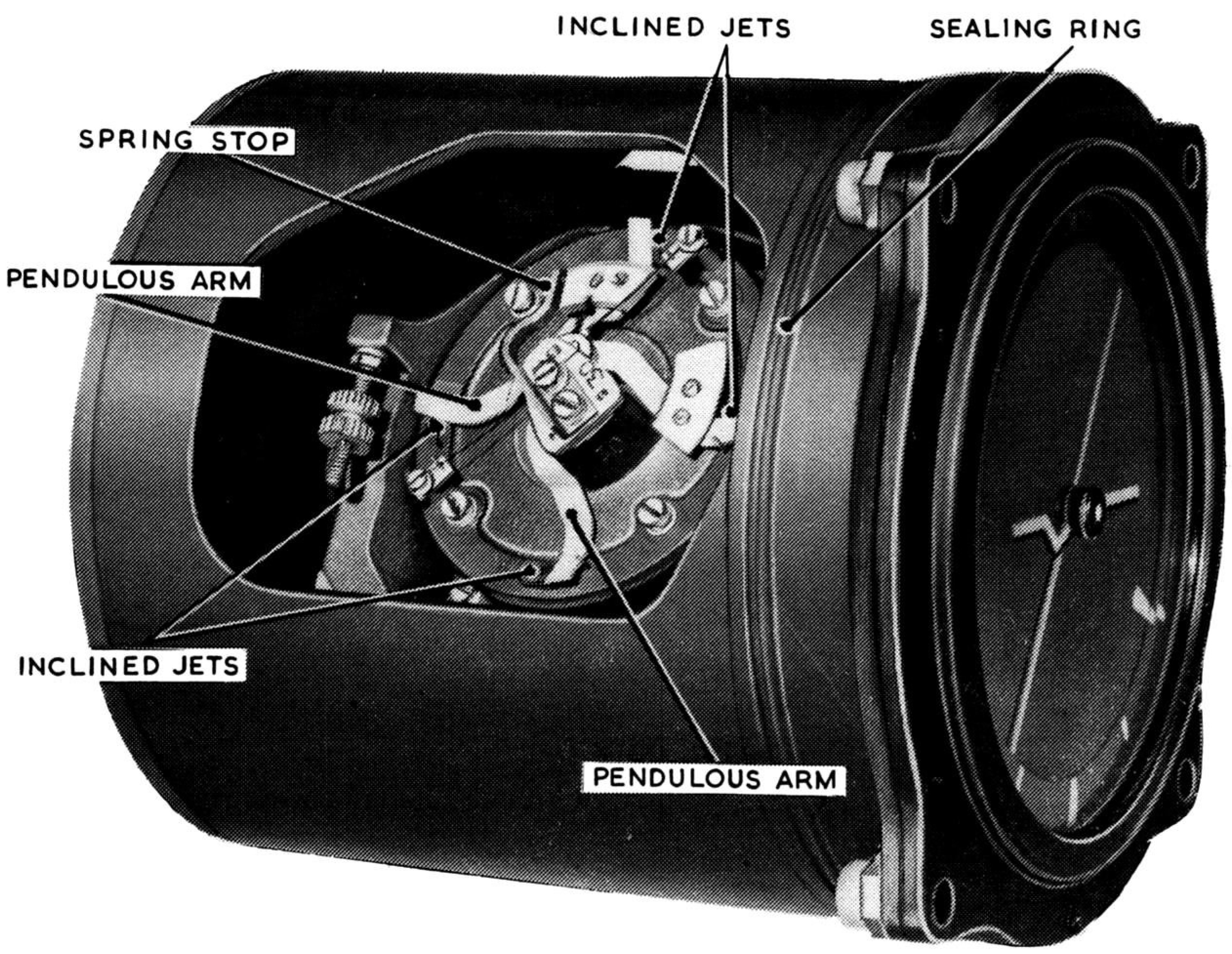


Fig. 4 Instrument with erection assembly exposed

14 Accurate positioning of the gyro spin axis from the 40 deg position is effected by utilizing the reaction from four inclined jets, through which the air is exhausted from the gyro compartment, to precess the gyro in the desired direction. The four air jets at the top of the rotor assembly are equally spaced on the fore-and-aft and transverse axes of the gyro system. The reactions due to the air issuing from the jets are equal and balance each other. If one jet is restricted, however, and the opposite jet opened, unbalance will occur, tending to precess the gyro at right-angles to the axis on which the jets are situated. The opposing pairs of jets are controlled by two pendulous vanes pivoted about their vertical axes. Each vane is centralized by a very light leaf spring. The incorporation of these springs

and the inclination of the air jets are the main mechanical differences between the instrument described in this chapter and the artificial horizon Mk.1E described in Chapter 1-1.

15 Since the vanes are pendulous and, consequently affected by centrifugal force, any turn executed by the aircraft will cause displacement of the bank erecting vane with the resulting precession of the gyro. This precession will cause the horizon bar to move in the same direction as the aircraft is banked, thus tending to diminish the indicated bank angle. There will also be a slight pitch error, showing an apparent climb, due to the effect of the turn on the tilted gyro. This condition is compensated for by inclining the gyro axis in pitch which has the effect of exaggerating the indication of bank and dive. This is exactly opposite to the effect produced by the action of centrifugal force on the erecting vane. It will, therefore, be apparent that for a given rate of turn of the aircraft, a suitable angle of inclination of the gyro axis can be chosen to create an apparent precession whose rate is exactly equal and opposite to the precession rate due to the displaced erecting vane. On the instrument dealt with in this chapter, complete compensation is provided for a 180 deg/min rate of turn of the aircraft.

Chapter 2-1

STANDARD SERVICEABILITY TEST

for

ARTIFICIAL HORIZON MK.1E (SPERRY TYPE)

Introduction

1 This chapter describes the tests to be applied to the artificial horizon, Mk.1E (Sperry Type) immediately prior to installation in an aircraft and at any time that serviceability is suspect.

Test equipment

▶ 2 A gyro test table Mk. 4M (Ref. No. 6C/7530926) or suitable equivalent is required. ◀

Preparation for test

3 Examine the filter for cleanliness and renew as necessary.

4 The instrument is to be mounted on the test table in the normal position: that is, with the plane of the mounting face of the fixing flange vertical, and with the centre line passing through the top two fixing holes horizontal to within 1/4 degree.

5 Except where otherwise stated, the suction in the instrument case is to be maintained at 119 ± 4 mbar (3 1/2 ± 1/8 in Hg).

Exercising

6 Before any tests are applied, the instrument is to be exercised as follows:

6.1 Set the test table to produce roll, pitch and yaw over a total arc of 15 degrees at 6-10 oscillations per minute, with the direction of rotation reversing at one minute intervals.

6.2 With the gyro running, start the table motor and exercise the instrument under these conditions for 15 minutes.

6.3 At the conclusion of the 15 minute period, re-level the table. Lock the table in the horizontal plane and switch on the motor so that the table vibrates slightly.

TESTING

7 Remove the plug screw in the side of the instrument case and fit the special toppling screw.

Rotor starting test

8 Proceed as follows:

8.1 Reduce the suction to 51 mbar (1 1/2 in Hg) by means of the suction regulator.

8.2 Without altering the setting of the suction regulator, cut off the suction to the instrument and allow the rotor to come to rest

8.3 Re-apply suction at 51 mbar (1 1/2 in Hg) for 30 seconds. Rotate the instrument about the roll axis until the toppling step is reached. Check that without further movement about the roll axis the gyro precesses about the pitch axis, indicating that the rotor is running.

8.4 Re-apply suction and adjust the suction to 119 mbar (3 1/2 in Hg). Cut-off the suction and allow the rotor to come to rest.

Settling test

9 Proceed as follows:

9.1 With the rotor stationary, quickly apply full suction of 119 mbar 3 1/2 in Hg). Check that the horizon bar and bank pointer settle to within 2.38 mm (3/32 in) of their datums within 2 minutes.

9.2 If the instrument fails this test, two further attempts are to be made. Provided that it is within tolerance on both these further tests, the instrument is serviceable.

Erection tests

10 Proceed as follows:

10.1 With the gyro running at normal speed, roll the instrument counter-clockwise until the horizon bar is displaced to approximately 25 mm (1 in) above the datum and then return the instrument to its normal position.

10.2 Check that the time taken for the horizon bar to return from 22 mm (7/8 in) to 7.9 mm (5/16 in) above the datum is between 1.3/4 and 4 minutes. The horizon bar must not deviate more than 5 degrees in roll during this test.

10.3 Repeat this test, rolling the instrument clockwise to lower the horizon bar. The erection times must be within the tolerances stated in para. 10.2 and must differ from those obtained in para. 10.2 by more than 80 seconds.

10.4 Turn the gyro test table through 90 degrees counter-clockwise (viewed from above) and then roll the instrument clockwise until the horizon bar is displaced approximately 25 mm (1 in) below the datum. Return the instrument and the test table to their normal positions, thus displacing the bank pointer in roll.

10.5 Check that the time taken for the bank pointer to return from 30 degrees to 10 degrees roll is between 1.3/4 and 4 minutes. During this test the horizon bar must not deviate vertically more than 4.8 mm (3/16 in).

10.6 Repeat this test turning the test table counter-clockwise and rolling the instrument counter-clockwise until the horizon bar is approximately 25 mm (1 in) above the datum. Return the instrument and test table to the normal positions, thus displacing the bank pointer in roll in the opposite direction to the previous test. The erection times must be within the tolerance stated in para. 10.5 and must not differ from these obtained in para. 10.5 by more than 80 seconds.

11 At the conclusion of the tests, cut off the suction supply and allow the rotor to come to rest before removing the instrument from the test table. Remove the toppling screw and refit the plug screw.

Chapter 2-2

STANDARD SERVICEABILITY TEST

for

ARTIFICIAL HORIZON MK.1F (SMITH TYPE)

Introduction

1 This chapter details the tests to be applied to the artificial horizon, Mk.1F (Smith Type) immediately prior to installation in an aircraft and at any time that serviceability is suspect. The tolerances specified must not be exceeded.

Test equipment

▶ 2 A gyro test table Mk. 4M (Ref. No. 6C/7530926) or suitable equivalent is required. ◀

Preparation for test

3 Before commencing the tests, the plug screw situated between the top of the filter and the top suction inlet blanking screw on the rear of the instrument is to be removed and replaced by the toppling screw. Examine the filters for cleanliness and renew as necessary.

4 The instrument is to be mounted in the normal position on the gyro test table and tested at room temperature (10 to 20 °C), maintaining a suction, as measured by the suction gauge on the test table, of 119 ± 4 mbar (3 1/2 ± 1/8 in Hg) during the tests.

Exercising

Exercise the instrument by running it for 15 minutes under roll, pitch and yaw conditions, using the automatic switch on the test table.

Note ...

> When an instrument has been in storage at a Depot or Maintenance Unit and is required to be tested prior to issue, exercising under roll, pitch and yaw conditions is permitted for 30 minutes, before commencement of the tests.

TESTING

Rotor starting test

6 Apply a suction of 34 mbar (1 in Hg). Chech that the gyro commences to rotate.

Settling test

7 With the gyro stationary, quickly apply a suction of 119 mbar (3 1/2 in Hg). Check that the horizon bar and roll pointer settle to within 1.6 mm (1/16 in) of datum position, within 1 1/2 minutes.

Erection test

8 In the tests detailed in para. 9 and 10, the horizon bar is to be level at the 30 degree displacement position at the commencement of the erection period; this can be effected by suitably rotating the table.

9 Proceed as follows:

9.1 Commencing with the instrument running, in the normal position, remove the instrument from the test table and displace the gyro by rolling the instrument case counter-clockwise about the fore-and-aft axis until the horizon bar is raised approximately 7.9 mm (5/16 in).

9.2 Rotate the case back to the normal position and restore it to the test table.

9.3 Check that the time taken for the horizon bar to move from a displacement of 20.6 mm (13/16 in) (30 deg) to within 7.9 mm (5/16 in) (10 deg) of the datum position is between 1 3/4 and 4 minutes. Check that during the erection the horizon bar does not incline more than 2 deg from the horizontal.

10 Proceed as follows:

10.1 Remove the instrument from the test table and displace the gyro by rolling the instrument case clockwise about the fore-and-aft axis until the horizon bar is depressed approximately 23.8 mm (15/16 in).

10.2 Rotate the case back to the normal position and restore it to the test table.

10.3 Check that the time taken for the horizon bar to move from a displacement of 20.6 mm (13/16 in) (30 deg) to within 7.9 mm (5/16 in) (10 deg) of the datum position is between 1.3/4 and 4 minutes. Check that during the erection the horizon bar does not incline more than 2 deg from the horizontal in a counter-clockwise direction, or 4 deg in a clockwise direction.

Note ...

The erection rates in para. 9 and 10 are to be within 1.1/4 minutes of each other.

11 In the tests detailed in para. 12 and 13, the horizon bar is to be central at the commencement of the roll erection period.

12 Proceed as follows:

12.1 Commencing with the instrument running in the normal position, remove the instrument from the test table.

12.2 Displace the gyro by turning the instrument case 90 deg counter-clockwise about the vertical axis and then rolling it clockwise about the fore-and-aft axis until the horizon bar is depressed approximately 23.8 mm (15/16 in).

12.3 Rotate the case back to the normal position and turn it back to the starting position and restore it to the test table. Check that horizon bar is inclined 30 deg to the horizontal with the right end uppermost.

12.4 Check that the time taken for the roll pointer to erect from 30 deg to within 10 deg of the datum position is between 1 3/4 and 4 minutes. Check that during erection of the roll pointer, the horizon bar does not deviate from the datum position by more than 1.6 mm (1/16 in).

13 Proceed as follows:

13.1 Remove the instrument from the test table.

13.2 Displace the gyro by turning the instrument case 90 deg. counter-clockwise about the vertical axis and then rolling it counter-clockwise about the fore-and-aft axis until the horizon bar is raised approximately 23.8 mm (15/16 in).

13.3 Rotate the case back to the normal position and turn it back to the starting position and restore it to the test table. Check that the bar is inclined 30 deg. to the horizontal with the left end uppermost.

13.4 Check that the time taken for the roll pointer to erect from 30 deg. to within 10 deg. of the datum position is between 1 3/4 and 4 minutes. Check that during erection of the roll pointer, the horizon bar does not deviate from the datum position by more than 1.6 mm (1/16 in).

Coasting test

14 Turn off the suction supply. Check that the gyro does not stop in less than 12 minutes.

15 Disconnect the instrument from the test table, remove the toppling screw and fit the blanking screw. Lock the blanking screw with synthetic varnish.

Chapter 3-1

SERVICING

for

ARTIFICIAL HORIZON Mk.1E (SPERRY TYPE)

Introduction

1 This chapter details the procedure for servicing the artificial horizon Mk.1E manufactured by Sperry Limited.

2 The lubrication of these instruments is to be performed only if the date is more than nine months from the repair date which is shown, prefixed by the letters PIL, on the instrument case.

Tools and materials

▶ WARNING

TAKE PRECAUTIONS WHEN HANDLING THE OIL, VARNISH AND LACQUER LISTED BELOW. REFER TO THE WARNING IN THE PRELIMINARY PAGES OF THIS PUBLICATION. ◀

3 The following tools and equipment are required:

3.1 Hypodermic syringe (Ref.No. 1J/219) complete with No. 14 needle.

3.2 Oil, OX-14 (Ref. No. 34B/9100589)

3.3 Varnish, synthetic (Ref. No. 33B/9433454)

3.4 Lacquer, white tintalite (Ref. No. 33C/2244718)

SERVICING

CAUTION

It is important that, when steadying the gimbal assembly and removing the pendulous unit, the vane assemblies are not touched.

4 Remove and retain the access panel and sealing ring.

5 Rotate the gimbal assembly by hand until the pendulous unit is in view. Carefully remove the pendulous unit.

6 Using the hypodermic syringe and the No. 14 needle, carefully insert oil OX-14 into the central hole of the rotor housing, pausing after each drop to allow the oil to be fully absorbed. This will only take a few seconds. The reservoir pad adjacent to the bearing is considered to be saturated when no more oil can be absorbed. On no account should more than six drops of oil be applied.

7 On completion of the lubrication, allow the unit to stand with the bottom bearing uppermost for a period of 30 minutes to ensure that as much lubricant as possible reaches the bearing assembly.

8 Refit the pendulous unit, ensuring that the letter 'F' inscribed on the flange is facing towards the rear of the instrument. Lock the fixing screws with synthetic varnish.

9 Refit the access panel and sealing ring.

▶ 10 Mark the instrument case with the letters RL and the month and the year (eg, RL/11/94) using lacquer, white tintalite. ◀

11 Perform the standard serviceability test as detailed in Chap.2-1.