Nov. 5, 1940. D. G. K. MOSS 2,220,457

GYROSCOPIC NAVIGATIONAL INSTRUMENT

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Fig. 1.

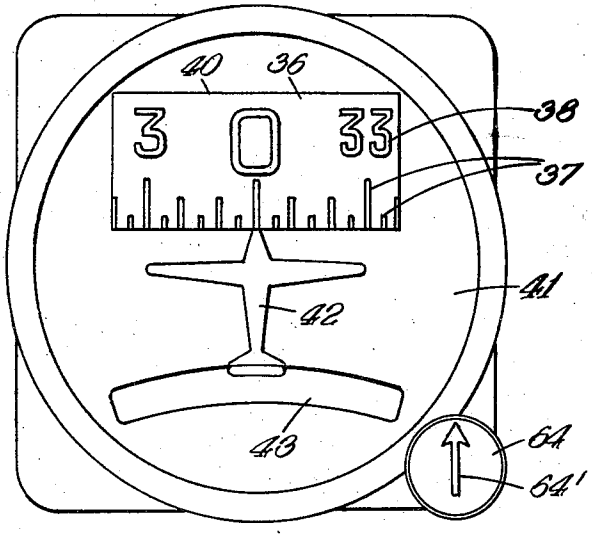
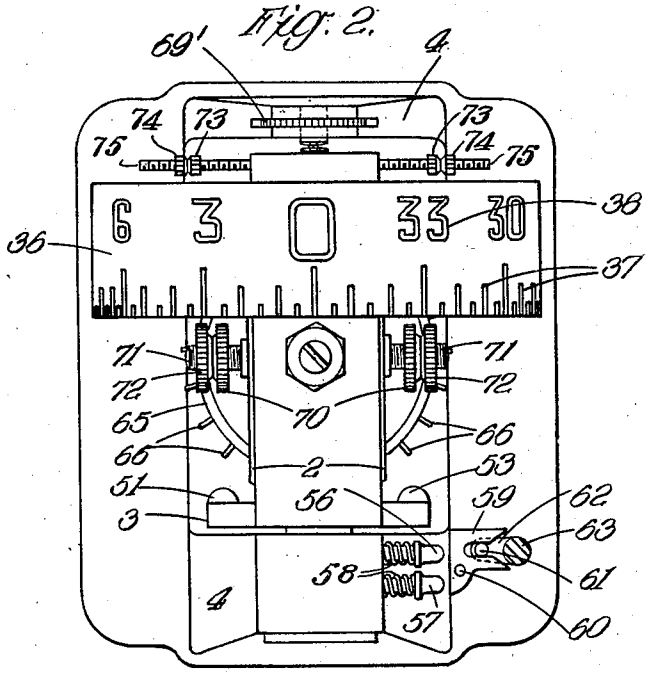


Fig. 2.



Douglas George King Moss
INVENTOR
By
his ATT'Y.

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GYROSCOPIC NAVIGATIONAL INSTRUMENT

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Fig. 3.

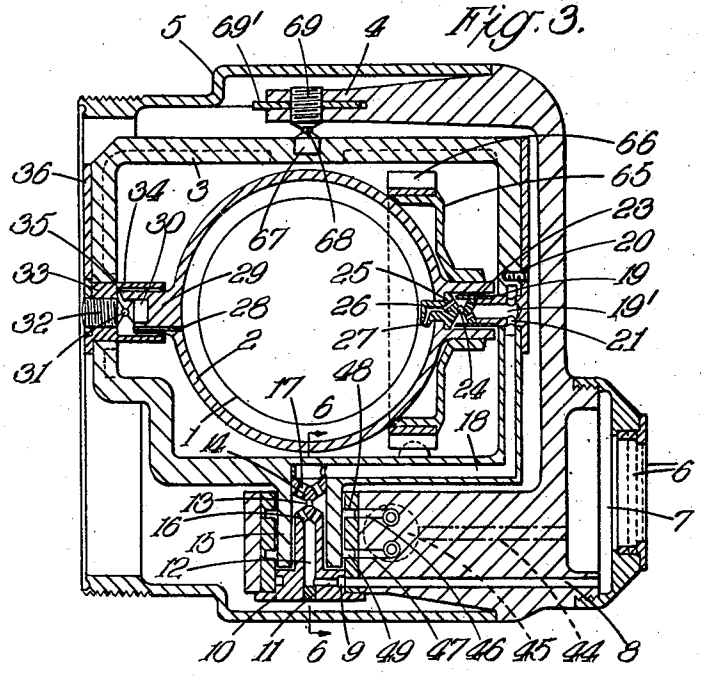
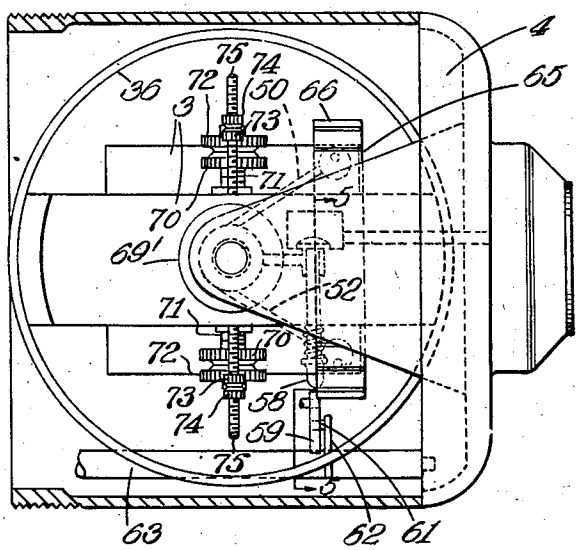


Fig. 4.



Douglas George King Moss
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By Otto Munn
his ATT'Y

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GYROSCOPIC NAVIGATIONAL INSTRUMENT

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Fig. 5.

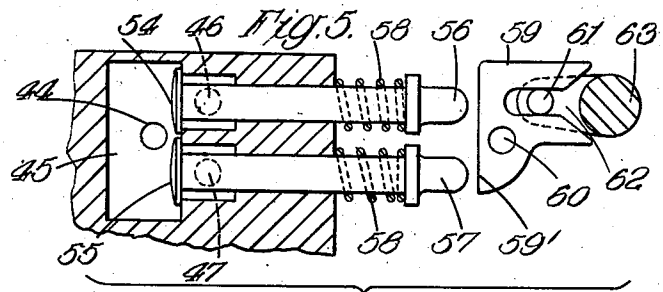


Fig. 6.

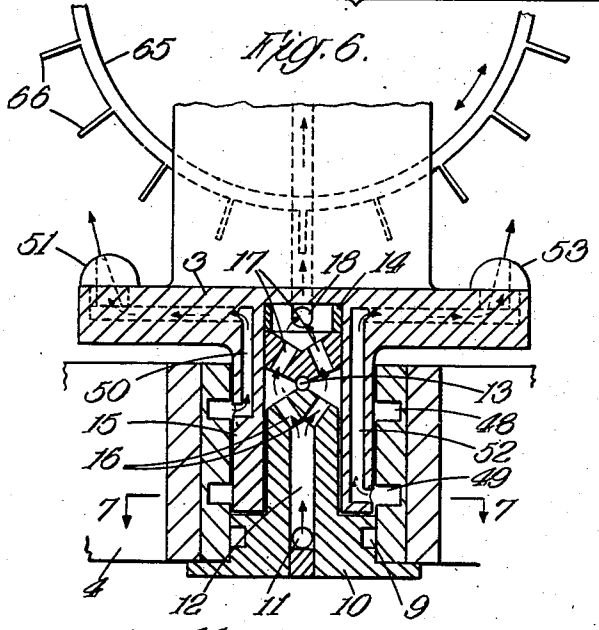
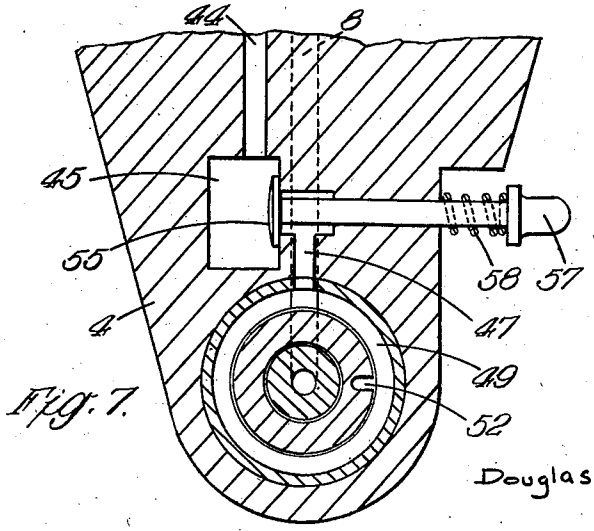


Fig. 7.



Douglas George King Moss
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By [signature]
his Atty.

Nov. 5, 1940. D. G. K. MOSS 2,220,457

GYROSCOPIC NAVIGATIONAL INSTRUMENT

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Fig. 8.

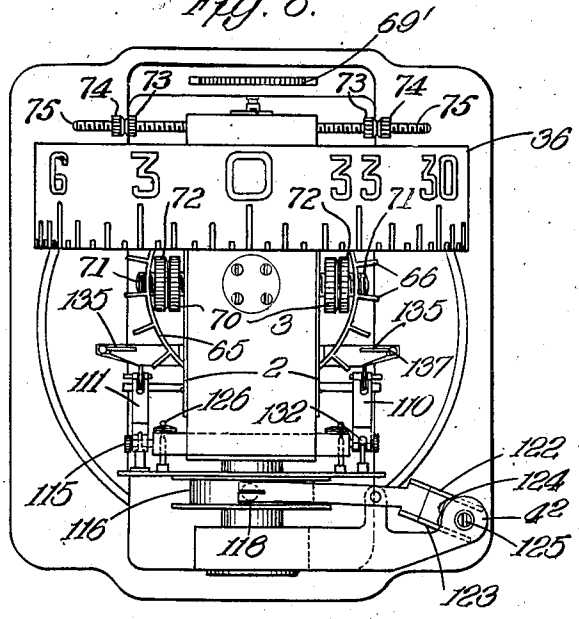
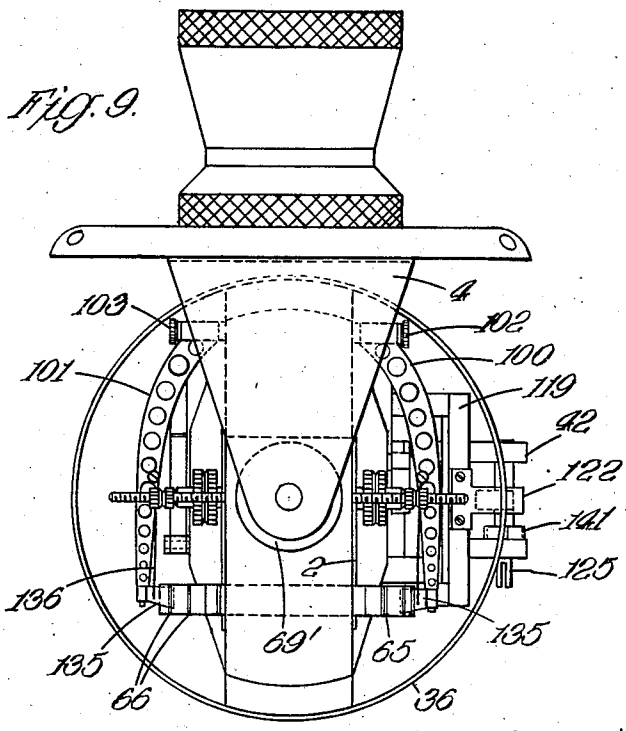


Fig. 9.



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Nov. 5, 1940. D. G. K. MOSS 2,220,457

GYROSCOPIC NAVIGATIONAL INSTRUMENT

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Fig. 10.

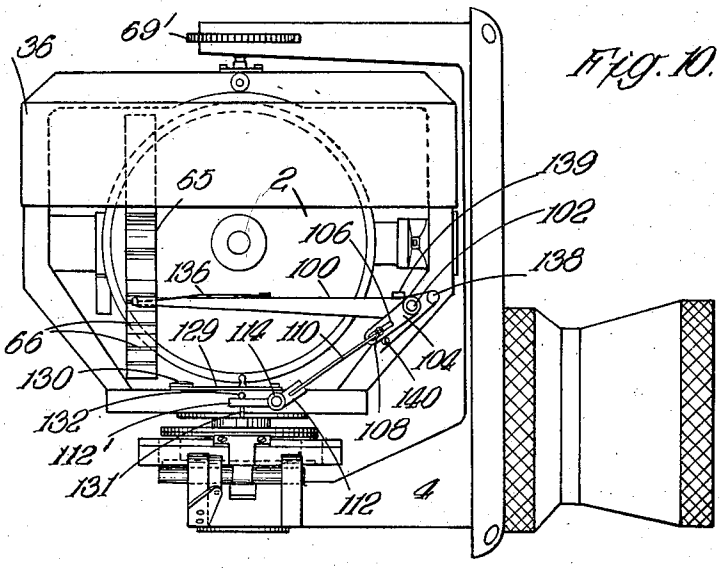
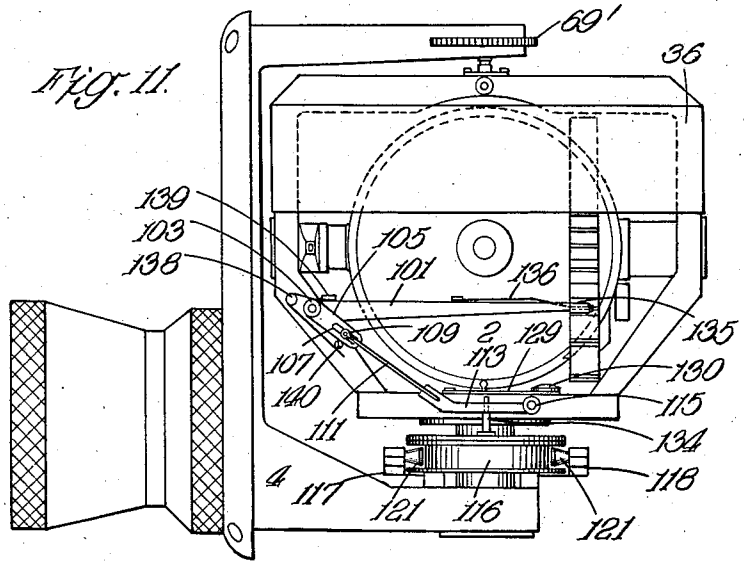


Fig. 11.



Douglas George King Moss
INVENTOR

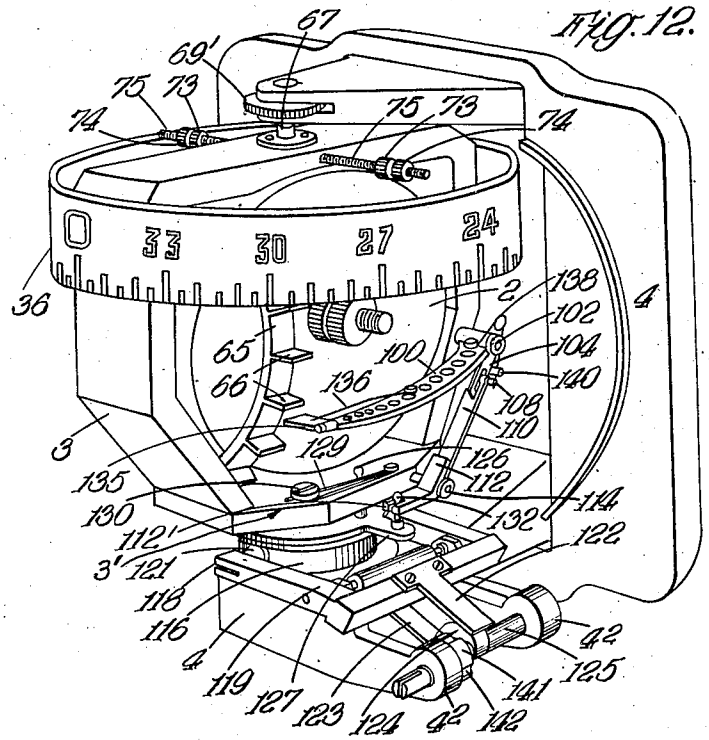
By Otto Munk
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Nov. 5, 1940. D. G. K. MOSS 2,220,457

GYROSCOPIC NAVIGATIONAL INSTRUMENT

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Fig. 12.



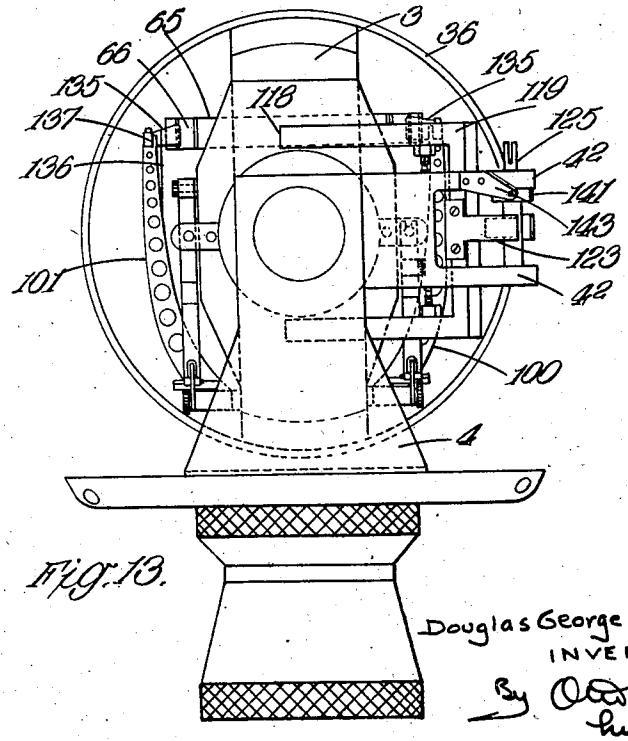


Fig. 13.

Douglas George King Moss
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Nov. 5, 1940. D. G. K. MOSS 2,220,457

GYROSCOPIC NAVIGATIONAL INSTRUMENT

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Fig. 14.

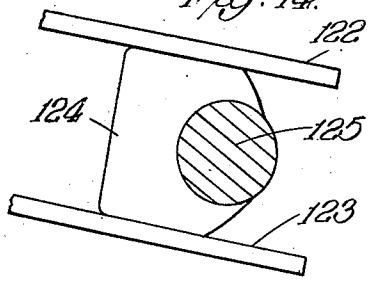


Fig. 15.

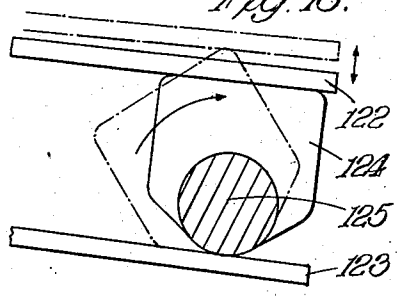
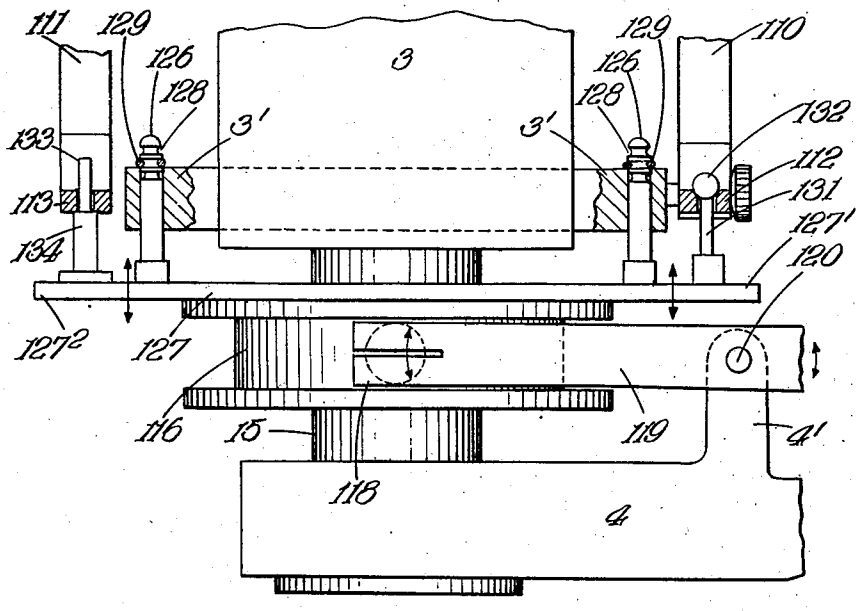


Fig. 16.



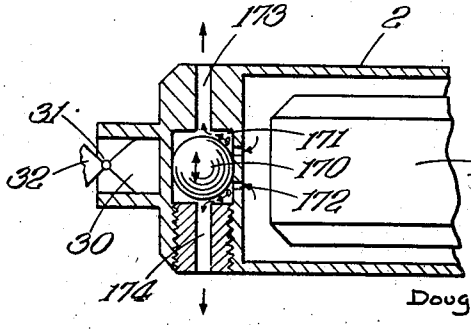


Fig. 20.

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Nov. 5, 1940. D. G. K. MOSS 2,220,457

GYROSCOPIC NAVIGATIONAL INSTRUMENT

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Fig. 17.

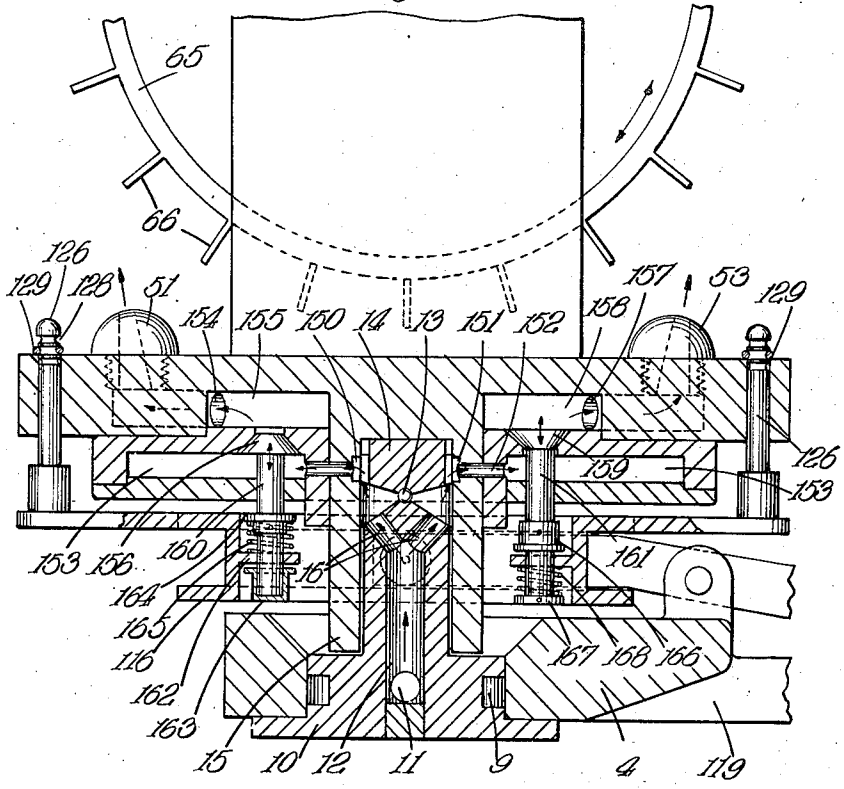


Fig. 18.

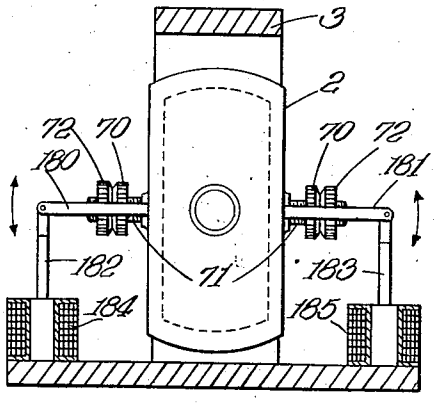
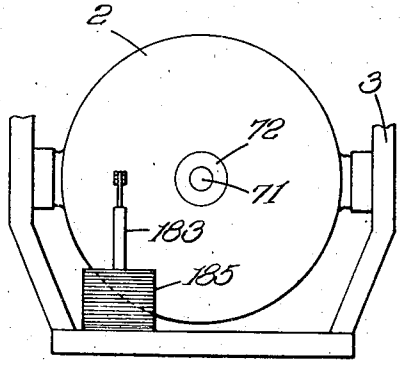


Fig. 19.



Douglas George King Moss
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Patented Nov. 5, 1940 2,220,457

UNITED STATES PATENT OFFICE

2,220,457

GYROSCOPIC NAVIGATIONAL INSTRUMENT

Douglas George King Moss, Sanderstead, England, assignor to Mechanism Limited, Croydon, England, a limited corporation of Great Britain

Application June 15, 1937, Serial No. 148,327
In Great Britain June 19, 1936

9 Claims. (Cl. 33—204)

This invention relates to improvements in gyroscopic navigational instruments and more particularly to azimuth indicating free gyroscopic instruments of the type sometimes referred to as "directional gyroscopes" having three degrees of freedom.

As is known with such instruments, it is necessary to provide for setting the gyroscope scale to a desired course reading and for restoring the scale to the desired course should it have wandered due to frictional or other causes. Hitherto, this result has been achieved by more or less complicated mechanical means for locking the gyroscope with respect to one of its axes and rotating it and/or the scale with respect to its other axis, i. e., in azimuth. The known instruments not only suffer disadvantage due to the complication of the mechanical means but suffer a further important disadvantage in that the scale is brought to the desired position by continual manual operation of the actuating means.

Now, a pilot may not be able conveniently to spare his hand for continued manual operation, and, with a view to obviating this necessity whilst at the same time overcoming the other disadvantages of the known constructions, the chief object of the present invention is to provide an instrument in which the scale is set or re-set by precession of the gyroscope.

A further object is to provide an instrument such that the craft in which it is installed can normally perform a complete roll without disturbance of the instrument reading.

According to the present invention, the scale ring is fast with the outer gimbal and the required setting or re-setting thereof is brought about by the creation of a couple between the inner and outer gimbals to cause precession of the gyro and rotation of the outer gimbal about its vertical axis.

According to a further feature of the invention, the couple may be set up on either side of the gyro wheel to cause precession in either the one direction or the other.

According to a still further feature of the invention, means are provided for erecting the gyro-wheel with respect to the outer gimbal.

The couple may be created by jets of air, mechanical means or electro-magnetic means as is hereinafter made apparent.

In order that the invention may be clearly understood and readily carried into effect, certain embodiments thereof are hereinafter more fully described with reference to the accompanying drawings which are given by way of example only and not of limitation.

In these drawings—

Figure 1 is a front view of the instrument.

Figure 2 is a front view of one form of mechanism without the face plate.

Figure 3 is a side sectional elevation of the mechanism of Figure 2.

Figure 4 is a plan view thereof.

Figure 5 is a section on the line 5—5 of Figure 4 shown on a larger scale.

Figure 6 is a section on the line 6—6 of Figure 3 also on a larger scale.

Figure 7 is a section on the line 7—7 of Figure 6.

Figure 8 is a front view of another form of mechanism with the face plate.

Figure 9 is a plan view of same.

Figure 10 is a side elevation seen from the right.

Figure 11 is a side elevation seen from the left.

Figure 12 is a perspective view thereof.

Figure 13 is an under plan view.

Figures 14 and 15 are detail views of the cam on an enlarged scale.

Figure 16 is a front view of the operating mechanism on an enlarged scale.

Figure 17 is a front sectional elevation of the operating mechanism of yet another form of mechanism.

Figure 18 is a diagrammatic front elevation of a fourth form of mechanism, and

Figure 19 is a side elevation thereof.

Figure 20 is a detail plan view of a modified form of inner gimbal erecting control valve.

In the description which follows of the various embodiments of the invention, like parts bear like reference numerals.

Referring now to the said drawings and in particular to Figures 1 to 7 thereof, an air driven gyro wheel 1, spinning about a normally horizontal axis and mounted in an air-tight housing 2 which constitutes the inner gimbal, is pivoted about a fore-and-aft axis to an outer gimbal 3 which is, in turn, pivoted about a vertical axis to the main frame 4 which forms part of the outer air-tight instrument case 5.

Air is led in, at the back of the instrument, through filter gauzes 6, to a chamber 7 from which extends an inlet duct 8 which passes through the solid frame 4 and opens into an annular channel 9 in the plug 10. A duct 11 leads from the channel 9 to the hollow core 12 of the plug 10, the end of which is truncated and recessed to receive the ball 13. A similar truncated hard-steel bearing element 14, forming the other half of the bearing, is carried by the outer gimbal

3 which is also provided with a tubular extension or shroud 15 which takes into a suitable aperture in the frame 4 and surrounds the plug 10. One or more ducts 16 in the truncated portion of the plug 10 lead from its core 12 to the bore of the extension 15 and corresponding ducts 17 are provided in the element 14 for permitting the air to enter the duct 18 in the outer gimbal 3, which duct extends round to one of the inner gimbal pivots which is hollow for the purpose of leading air through to drive the gyro wheel 1. This pivot comprises a hollow spindle 19, retained by locking screws 20 and apertured at 21 and 23 to allow the air to enter and leave its hollow bore 19'. The air passes around the bearing ball 24 and enters the ducts 25 in the element 26 and so to the jet 27 which causes it to impinge upon and drive the gyro wheel 1. The air leaves the housing 2 through ducts 28 in the trunnion 29 provided with a truncated hard-steel element 30 adapted to receive the bearing ball 31 supported on the opposite side by an element 32 threadedly engaging the part 33 which has a tubular extension 34 which surrounds the trunnion 29. Oppositely disposed air exit orifices are provided in the extension 34, which orifices are concentric to a horizontal axis. The orifices are normally partially obstructed by a semi-circular extension 35 of the trunnion 29. Thus, when the inner gimbal 2 departs from normal position, one of the orifices is opened to a greater extent whilst the other is closed a similar amount, setting up an unbalance of the emergent air which tends to blow the outer gimbal about its vertical axis but in effect, due to precession of the gyro-wheel, restores the inner gimbal to normal with respect to the outer gimbal and a resumption of balance of the air jets. The upper outer gimbal pivot comprises a hard-steel truncated element 67, bearing a ball 68 and co-operating element 69, extending through and threadedly engaging the frame 4, being locked in position by a locking nut 69'.

The accuracy of the balance of the inner gimbal 2 is assured by weights 70 threadedly engaging screwed rods 71, co-axial with the axis of the gyro-wheel, which weights are locked in adjusted position by lock nuts 72. The outer gimbal 3 is similarly balanced by weights 73 and lock nuts 74 on the threaded rods 75.

A scale ring 36 is carried by the outer gimbal 3, which ring bears degree marks 37 and numerals 38 visible through the aperture 40 in the face plate 41 (Figure 1). A representation of an aeroplane 42 having an extended nose serves as indicator and adjacent the tail of the pictured aeroplane 42 is a bubble or ball level 43 which serves to indicate the "side-slip" of the craft on which the instrument is mounted.

The parts so far described are more or less common to all the different forms of the mechanism as will become apparent from the following description taken in conjunction with the drawings.

Movement of the scale ring 36 is brought about by rotation of the outer gimbal 3 about its vertical axis and in the embodiment shown in Figures 1 to 7 this is brought about by means of a couple between the inner and outer gimbals created by jets of air. Air is conveyed from the chamber 7 through the duct 44 in the frame 4 to a chamber 45 therein. Ducts 46, 47 lead from the chamber 45 to annular channels 48, 49 respectively. A duct 50 in the extension 15 and gimbal 3 leads from the channel 48 to an air jet 51 and a similar duct 52 leads from the channel 49 to an air jet 53. Flow of air through the ducts 46, 47 is normally prevented by mushroom valves 54, 55 having heads 56, 57 on the ends of their stems, which valves are spring-urged onto their seats by springs 58 disposed between the heads 56, 57 and the edge of the frame 4. A bifurcated element 59 is pivotally mounted at 60 and within a slot in this element engages a crank pin 61 on the arm 62 fast on the shaft 63 which extends forward through the front of the casing where it is provided with an operating head 64. A ring 65, provided with radial vanes 66, is mounted fast with the inner gimbal 2 or a ring of radial vanes may be mounted on or made integral with the gyro-wheel casing. The air jets 51, 53 are so directed that air from the one jet directed onto the vanes 66 tends to blow the vaned ring 65 round in the one direction whilst the other acts contrarily, i. e., air issuing from the jet 51 by impinging on the vanes 66 tends to blow the ring 65 round in clockwise direction as seen in Figures 2 and 6, whilst the air from the jet 53 tends to blow it round in anti-clockwise direction. By rotating the head 64 a quarter turn in clockwise direction, the member 59 is rocked in anti-clockwise direction about its pivot 60 and so bears on and moves the head 56 thus opening the valve 54, whereupon air passes through duct 46, channel 48 and duct 50 to the jet 51. The effect of the air issuing from the jet 51, in attempting to blow the ring 65 about a horizontal axis, is to cause precession of the gyro-wheel 1 and rotation of the outer gimbal 3, about its vertical axis, and with it the scale ring 36. Rotation of the outer gimbal 3 is allowed to continue until the scale mark 37 of the desired numeral 38 is opposite the nose of the pictured aeroplane 42 whereupon the head 64 is restored to normal—by a quarter turn in anti-clockwise direction—to cut off from the jet 51 by the closing of the valve 54. To cause rotation of the scale in the opposite direction, the head 64 is turned a quarter turn in opposite (anti-clockwise) direction to cause the pin 61 to rock the member 59 in clockwise direction so that its extension 59' will move the head 57 to open the valve 55 and permit the air to pass through duct 47, channel 49, and duct 52 to jet 53. An arrow 64' is provided on the head 64, which arrow stands vertically in the normal position of the head as in Figure 1 but otherwise points in the direction in which the head 64 has been turned. A spring detent, engaging a recessed collar fast on the shaft 63, may be provided for limiting the movement of the head 64 and for holding it in normal and adjusted position.

In Figure 8 to 16, a modified mechanism is illustrated in which the couple between the inner and outer gimbals is created mechanically, the gyro-wheel and gimballing remaining as previously described.

As previously described, air is led into the back of the instrument (see Fig. 3) through filter gauzes 6 which cover the inlet duct 8 which passes through the solid frame 4 and communicates with the hollow vertical glanded pivot of the outer gimbal ring 3, from whence the air is led through a duct 18 in the outer gimbal ring 3 and reaches the hollow inner gimbal pivot, which in this case for convenience is situated at the front in zero position, although equally well it could be at the back, through which the air passes to the driving jet 27 and so impinges upon the gyro-wheel 1 to rotate it. The air passes out of the air-tight inner gimbal 2 through the other inner gimbal pivot which is provided with the

parts 30 to 35 for the purpose previously described. The solid frame also forms part of an outer air-tight instrument case and in this embodiment comprises the back wall thereof.

The ring 65 having radial vanes 66 is also provided—mounted on the pivotal axis of the inner gimbal 2 and connected to the latter for movement therewith—as previously described (Fig. 3).

In the modification, illustrated in Figs. 8 to 16, levers 100, 101, pivoted at 102, 103 respectively to the outer gimbal 3 (see Fig. 9), are arranged one on each side of the inner gimbal 2 with their free ends adjacent the vaned ring 65. Fast with each lever 100, 101 is a depending portion 104, 105 slotted at 106, 107 to receive a pin 108, 109 carried at the bifurcated end of a resilient lever or flat spring 110, 111, the other end of which is held by a lever 112, 113 pivoted at 114, 115 also to the outer gimbal 3. A flanged ring 116 (Figs. 11, 12) is mounted for axial movement on the extension or shroud 15. The bifurcated ends 117, 118 of a forked lever 119, conveniently pivoted at 120 to an extension 4' of the frame 4, take about the ring 116 and are provided with steel rollers 121 which lie between the flanges of the ring 116 but are normally out of contact therewith. At its other end the lever 119 is provided with two spring fingers 122, 123 (Fig. 12) disposed one on each side of a cam 124 on a shaft 125 journalled in the extensions 4^2 of the frame 4 and adapted to be rotated by means of the control head 64. The cam 124 is so arranged that normally the forked lever 119 is so positioned that the flanged ring 116 is in a normal position, but when rotated by the head 65 a quarter turn in the one direction it raises the forked ends 117, 118 of the lever 119 and in the other direction lowers the same. The movement of the lever 119 causes the rollers to engage the flanges of the ring 116 and raise or lower the same according to the direction of movement of the lever 119. The cam 124 is substantially rectangular (Figures 14 and 15) in order that during its passage from one position to another it moves the spring arm acted upon to the required position to move the flanged ring into the desired position—as is shown in chain line as regards the arm 122 in Figure 15—and then allows a slight return movement of the spring arm—seen in full line—to remove the rollers 121 clear of the flange of the ring 116. Thus, after reaching the adjusted position of the flanged ring 116, the slight return movement of the spring arm (either 122 or 123) and, consequentially, of the lever 119, the rollers 121 are moved clear of the flanges of the ring 116 and do not hinder the free rotation thereof. The flanged ring 116 is maintained in normal and adjusted positions by means of pins 126, carried by a plate 127 fast with the ring 116, which pins extend through apertures in the part 3' of the outer gimbal 3 (Fig. 12). Each pin 126 has three recesses 128—corresponding to the three possible positions of the ring 116, i. e., raised, normal and lowered—with which engage the spring rods 129 clamped on the portion 3' of the outer gimbal 3 by screws 130. The plate 127 has oppositely directed extensions 127' and 127^2. On the extension 127' is mounted a pin 131 extending through a slot in the lever 112 and having a head 132 lying above the lever 112 such that when the ring 116 is lowered the lever 112 is rocked about its pivot 114 due to its end 112' being pulled down by the head 132 whereby the lever 100 is raised. On the extension 127^2 (Fig. 16) is mounted a pin 133 having a portion 113 of larger diameter lying under the lever 113 with its portion of smaller diameter extending therethrough such that when the ring 116 is raised the lever 113 is rocked upwardly about its pivot 115 whereby the lever 101 is also raised. The free end of each of the levers 100 and 101 is provided with a hinged element 135 (Figs. 12, 13) normally maintained in horizontal position by a spring 136 when it rests on an extension of the lever. During upward movement of a lever 100, 101 the element 135 engages one of the vanes 66 of the vaned ring 65 and due to the continued upward urge of the lever tends to rotate the vaned ring whereby in effect the gyro wheel precesses and the outer gimbal is rotated about its vertical axis. The necessary resilience in the lever systems is provided for by the flat springs 110, 111 (Fig. 16) which flex to allow movement of the levers 112, 113 and to provide the continued urge of the levers 100, 101 during which the pins 107, 108 slide in the slots in the extensions 103, 104. The slot and pin also serve to prevent the flat springs or resilient levers 110, 111 from separating from the extensions 104, 105 so that when they are lowered the levers 100, 101 fall also. During downward movement of the raised lever, should the element 135 engage or be obstructed by one or more of the vanes 66 it yields and passes the same without exerting any pressure thereon which might cause precession of the gyro-wheel. To prevent displacement of the levers 100, 101—for example during inverted flying—each is provided with a hair-pin spring 138 (Fig. 11) clamped thereon by a screw 139 and engaging a pin 140 on the outer gimbal 3, which also acts as a stop to the extensions 104, 105, which serves to urge the levers 100, 101 into normal position. To set or re-set the scale 36 the pilot has only to rotate the head 64 a quarter turn—in either clockwise or anti-clockwise direction—to raise either the lever 100 or 101 by means of the parts 116 to 125 to cause precession of the gyro-wheel and rotation of the outer gimbal and scale ring in the desired direction until the desired numeral is opposite the nose of the pictured aeroplane 42 whereupon he restores the head 64 to normal position. To hold the shaft 125 in normal and adjusted positions, a collar 141 (Fig. 12)—having three peripheral recesses 142 (Fig. 13) corresponding to the three possible positions of the shaft 125—is mounted fast on the shaft and the recesses 142 in the collar 141 are adapted to be engaged by a projection on a spring 143.

In Figure 17 is shown a further modification in which the couple between the inner and outer gimbals is also brought about by means of jets of air controlled by valves. In this embodiment the valves are actuated through the medium of a flanged ring similar to that in the embodiment last described with reference to Figures 8 to 16. As described in connection with Fig. 3, in the modification illustrated in Fig. 17, the motive air is led from the inlet duct through the channel 9, duct 11, bore 12 and duct 16 of the plug 10, past the ball 13 and so past grooves 150 in the periphery of the hard-steel bearing piece 14 into channel 151 and duct 152 to the chamber 153 from which extends the duct 18 leading to the hollow inner gimbal pivot as previously more fully described with reference to Figure 3. The jet 51 (Fig. 17) communicates via a duct 154 with a chamber 155 communicating with the chamber 153, passage of air from the chamber 153 to the chamber 155 normally being prevented by a valve 156. The other jet 52 communicates via duct 157 with a chamber 158 similarly communicating with

the chamber 153 and having a valve 159. The stems 160, 161 of these valves 156, 159 extend out through the bottom of the chamber 153 and through apertures in an internal flange 162 in the flanged ring 116. The stem 160 is provided with an end head 163 adapted to be engaged by the flange 162 when the flanged ring 116 is lowered to pull down the valve 156 from its seating and allow air to pass from the chamber 153 to the chamber 155 and so to the jet 51. The stem 160 also carries a collar 164 and a coil spring 165 is disposed between the collar 164 and the flange 162, which spring urges the valve 156 onto its seat yet yields to allow upward movement of the flange 162. The stem 161 carries a collar 166 adapted to be engaged by the flange 162 when the flanged ring is raised to lift the valve 159 off its seat to permit air to enter the chamber 158 and pass to the jet 53. A further collar 167 between which and the flange 162 is arranged a coil spring 168 to hold the valve onto its seat yet yield to permit downward movement of the flange 162. The flanged ring 116 is raised and lowered by a lever 119, rollers 121 and the parts 122 to 125 under control of the head 64 as previously described in connection with Fig. 12, and for the purpose specified. The upper flange of the flanged ring 116 is extended to form the extensions $127'$, 127^2 (see Fig. 16) and these extensions similarly carry the recessed pins 126.

In Figures 18 and 19 is shown yet another form of mechanism in which the couple between the inner and outer gimbals is created by electromagnetic means.

Adjacent one of the inner gimbal pivots are disposed oppositely directed radial arms 180, 181 which normally lie in a horizontal plane. From the ends of these radial arms 180, 181 depend the armatures 182, 183 of two solenoids 184, 185 mounted on the outer gimbal 3, the arm desirably being pivotally connected to the armatures.

Electric current is conveyed to the solenoids 184, 185 in any convenient manner under the control of a switch actuated by the head 64, adapted to close the circuit to either solenoid. The switch (not shown) will thus have a normal "dead" position and alternate "live" positions for completing either of the electric circuits, for example the control member (head 64) of the switch may be moved from normal position either to the right or to the left according to the direction of movement it is desired to impart to the scale.

When current is passed through one of the solenoids 184, 185 it exerts a pull on its armature which, acting through the arm, tends to rotate the inner gimbal about its pivotal axis. This effort causes precession of the gyro-wheel which causes the outer gimbel to rotate about its pivotal axis and with it rotation of the scale ring carried thereby. When the scale has been re-set to zero or set to the desired position, the current is switched off. It will be appreciated that the pilot has merely to move the switch control member in the appropriate direction and then restore it to normal at the correct moment, just as in the other embodiments, the setting or re-setting of the scale thus requiring no maintained manual effort on his part.

Whilst it is preferred to employ two solenoids which are separately energized, a single polarised solenoid may equally well be employed in which case the weight of its armature may be counterbalanced. In this embodiment the gyro-wheel may be driven by air, for example as previously described or by electricity in the known manner.

In the various embodiments so far described, the inner gimbal is erected with respect to the outer gimbal by the parts 28 to 35 but in any of the different forms the inner gimbal could be erected to the true horizontal. Controlling means for this purpose are shown in Figure 20, comprising a control valve consisting of a ball 170 free to move in a chamber 171 into which the air enters from the casing 2 through ports 172 in its side in the region of the middle thereof. The channel 171 is reduced in diameter at each end, and form the emergent air orifices 173, 174, through which orifices 173, 174 the air issues into the outer case in the form of jets. Should the inner gimbal tilt, the ball 170 rolls by gravity against the constriction at the lower end and prevents the air from issuing from that orifice whilst allowing the air to emerge from the other, so producing an unbalance of the air jets which react upon the air in the instrument case and so sets up an erecting torque for restoring the inner gimbal to the true horizontal.

What I claim is:

1. In a gyroscopic navigating instrument, an inner gimbal, a rotor spinning about a horizontal axis and carried by said inner gimbal, said inner gimbal being pivoted about a horizontal axis at right angles to the spin axis of said rotor, an outer gimbal pivoted about a vertical axis and carrying said inner gimbal, a scale ring carried by said outer gimbal, mechanical means for creating a couple between said inner gimbal and said outer gimbal to cause said outer gimbal to rotate about its vertical axis, said mechanical means comprising springs mounted on opposite sides of the outer gimbal, levers mounted on the same gimbal as the springs and on opposite sides of the rotor, each lever being connected to a spring to be rocked thereby, a displaceable end piece on each lever, said end pieces being displaceably mounted in one direction so as to pass obstacles when moved in that direction, abutments attached to the inner gimbal and comprising a vaned ring having its vanes disposed radially of the axis of said ring for engagement by said end pieces, the latter being displaced and passing said vanes upon movement of said levers in one direction, while pressure is exerted on said vanes by said end pieces upon movement of said levers in reverse direction, resilient means for holding said levers in a normally rest position with the end pieces exerting no operating pressure on said vanes, and a flanged ring operatively connected with said springs, the displacement of said ring imparting movement to said springs and the levers connected thereto.

2. A gyroscopic navigating instrument, as claimed in claim 1, in which the said levers are arranged for operative engagement with said flanged ring so that a displacement of the latter in one direction out of rest position elevates one lever and movement in the opposite direction out of rest position elevates the other lever.

3. A gyroscopic navigating instrument, as claimed in claim 1, in which the said levers are arranged for engagement with said flanged ring so that displacement of the latter in one direction out of rest position elevates one lever and movement in the opposite direction out of rest position elevates the other lever, and means for displacing the said flanged ring comprising a forked lever, and a cam to control the forked lever.

4. A gyroscopic navigating instrument, as

claimed in claim 1, in which the said levers are arranged for engagement with said flanged ring so that displacement thereof in one direction out of rest position elevates one lever and movement in the opposite direction out of rest position elevates the other lever, and means for displacing the said flanged ring comprising a movable forked lever and a cam to control the movement of said forked lever, said cam having a profile adapted to move the forked lever after the same has moved the flanged ring out of contact with the latter.

5. In a directional gyroscope of the type including an instrument casing, a vertical ring mounted in said casing for rotation in azimuth, a gyro frame mounted in said vertical ring for oscillation about a first horizontal axis, a gyro rotor journaled in said frame for spinning about a second normally horizontal axis perpendicular to said spin axis, and a compass card carried by and rotatable with said vertical ring, the combination with said gyroscope of means for resetting said vertical ring and compass card by causing precession of said vertical ring in either direction in azimuth without locking said gyroscope, said resetting means comprising mechanical means in said casing for producing a torque on said gyroscope in either direction about said first horizontal axis, mechanical means in said casing engaging and directly controlling said torque producing means, and means including a manually actuated shaft extending from the exterior of said casing into the interior thereof and engaging said controlling means to actuate the latter and thereby cause said torque producing means to produce a torque on said gyroscope in one direction or the other about said first horizontal axis.

6. In a directional gyroscope of the type including a vertical ring mounted for rotation in azimuth, a gyro frame mounted in said vertical ring for oscillation about a first horizontal axis, a gyro rotor journaled in said frame for spinning about a second normally horizontal axis at right angles to said spin axis, the combination with said gyroscope of means for resetting the same by causing precession of said vertical ring in either direction in azimuth without locking said gyroscope, said resetting means comprising mechanical means for producing a torque on said gyroscope in either direction about said first horizontal axis, mechanical means engaging and directly controlling said torque producing means, and manually actuated means engaging said controlling means to actuate the latter and thereby cause said torque producing means to produce a torque on said gyroscope in one direction or the other about said first horizontal axis.

7. In a directional gyroscope of the type including an instrument casing, a vertical ring mounted in said casing for rotation in azimuth, a gyro frame mounted in said vertical ring for oscillation about a first horizontal axis, and a gyroscopic rotor, journaled in said frame for spinning about a second normally horizontal axis perpendicular to said first horizontal axis, the combination with said gyroscope of means for resetting the same by causing precession of said vertical ring in either direction in azimuth without locking said gyroscope, said resetting means comprising a vaned ring carried by said gyro frame concentrically with said first horizontal axis, means for applying a force to said vanes on either side of said first horizontal axis, means for controlling said force applying means, and means including a manually actuated shaft extending from the exterior of the casing into the interior thereof and directly engaging said controlling means to actuate said force applying means.

8. In a directional gyroscope of the type including an instrument casing, a vertical ring mounted in said casing for rotation in azimuth, a gyro frame mounted in said vertical ring for oscillation about a first horizontal axis, and a gyroscopic rotor journaled in said frame for spinning about a second normally horizontal axis perpendicular to said first horizontal axis, the combination with said gyroscope of means for resetting the same by causing precession of said vertical ring in either direction in azimuth without locking said gyroscope, said resetting means comprising a vaned ring carried by said gyro frame concentrically with the first horizontal axis, means for applying a force to the vanes of said ring on either side of said first horizontal axis, means directly controlling said force producing means, a manually actuated shaft extending from the exterior of the casing into the interior thereof, and a cam carried by said shaft and engaging said controlling means for actuating the same to produce a force on the vanes of said vaned ring on one side or the other of said first horizontal axis.

9. In a directional gyroscope of the type including an instrument casing, a vertical ring mounted in said casing for rotation in azimuth, a gyro frame mounted in said vertical ring for oscillation about a first horizontal axis, and a gyroscopic rotor journaled in said frame for spinning about a second normally horizontal axis perpendicular to said first horizontal axis, the combination with said gyroscope of means for resetting the same by causing precession of said vertical ring in either direction in azimuth without locking said gyroscope, said resetting means comprising a vaned ring carried by said gyro frame concentrically with said first horizontal axis, means for producing an air jet impinging against the vanes of said vaned ring on one side of said first horizontal axis, means for producing an air jet impinging against the vanes of said vaned ring on the opposite side of said horizontal axis, valve means for controlling both of said air jet means, a manually actuated shaft extending from the exterior of the casing into the interior thereof, and means including a cam actuated by said shaft for actuating said valve means.

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