June 8, 1943. B. G. CARLSON 2,321,543

GYRO DRIFT CONTROL

Filed Feb. 21, 1942

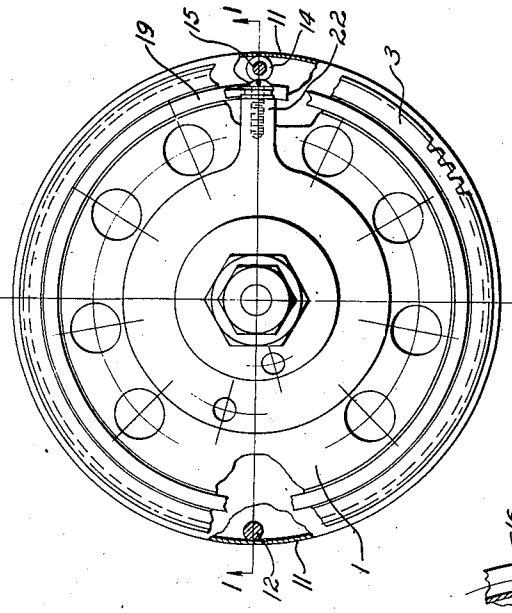


Fig. 2.

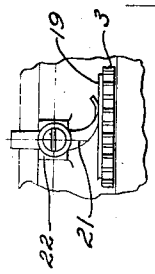


Fig. 3.

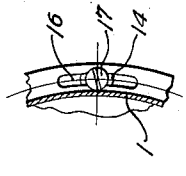


Fig. 4.

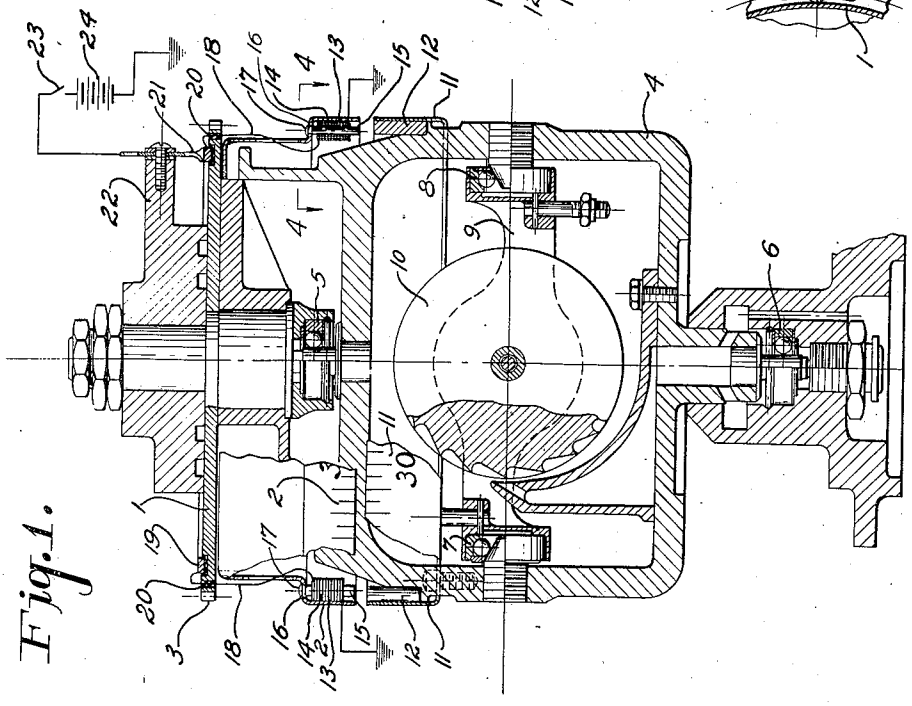


Fig. 1.

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GYRO DRIFT CONTROL

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1 Claim. (Cl. 33—204)

This invention relates to improvements in directional gyroscopes and has particular reference to means for preventing the gradual drift of the gyroscope away from a set course or azimuth position.

While a gyroscope will theoretically maintain a fixed orientation in space indefinitely, it is found in practice to exhibit a tendency to slowly drift or creep away from the position in which it is set. This tendency to drift out of the set position is the result of physical limitations and imperfections which cannot be entirely eliminated, regardless of the skill and precision in the manufacture of the instrument.

It is therefore the general object of the present invention to provide means to prevent the drift of a gyroscope from its set position.

Specifically the object of the present invention is to provide magnetic means associated with the index cards of a directional gyro to counteract the tendency of the gyroscope to drift away from its set position.

In the description which follows, reference is made to the accompanying drawing in which Fig. 1 is a vertical sectional view, on the line 1—1 of Fig. 2, through a directional gyroscope embodying the features of the present invention, certain parts being shown in elevation.

Figure 2 is a top plan view of the instrument shown in Figure 1 with parts broken away to show other parts.

Figure 3 is a fragmentary elevational view showing the brush and slip ring arrangement associated with the rotatable frame element.

Figure 4 is a fragmentary sectional view of the adjustable mounting for one of the electromagnets, taken on the line 4—4 in Fig. 1.

The numeral 1 indicates a rotatable circular frame carrying the customary card or scale 2, the combination being adjustable in rotation by means of gear teeth 3. A gimbal ring 4 is supported in vertical bearings 5 and 6 and carries horizontal bearings 7 and 8 supporting the usual rotor frame 9. A conventional air driven rotor is indicated at 10, carried by the frame 9. The gimbal ring 4 carries a circular compass card 11 for rotation closely adjacent the card 2. The foregoing structure is conventional directional gyroscope construction.

Novel means embodying the principles of the present invention will now be described for resisting the creep or drift of the directional components of the gyroscope with respect to the relatively fixed card 2. The compass card 11 carries therewithin at two diametrically opposite points small, lightweight elements of magnetic material 12. This material may be soft iron or other substance having the characteristic of low magnetic retentivity.

The card 2 carries a pair of similarly positioned miniature electromagnets 13. Each of the magnets 13 comprises a magnetizing coil 14 and a core 15 also having the characteristic of low magnetic retentivity. Each electromagnet 13 may be positioned as desired within a small range of adjustment by means of a slot 16 receiving a screw 17 engaging the core 15. The adjustment of the magnets 13 in the slots 16 should be such that the magnetic attraction between the magnets 13 and the magnetic elements 12 will tend to maintain the cards 2 and 11 exactly in zero-zero relationship, corresponding to "on course" position.

One terminal of each coil 14 is grounded on the gyroscope and the other terminal is connected by means of a lead 18 to a conductor ring 19 attached to and insulated from the rotatable frame 1. In the preferred embodiment the conductor 18 is shown passing through insulated openings 20 in the rotatable frame 1. A collector brush 21 is insulatedly mounted on a stationary part 22 of the gyroscope supporting structure, the energizing circuit being completed through a manual switch 23 and battery 24 to ground.

The electromagnets 13 in association with their armatures 12 are designed to exert an attractive force in the form of a couple which is just sufficient to prevent the drift of the directional element with respect to the relatively fixed card 2, and which force is insufficient to have any effect upon the operation of the gyroscope in maintaining its true orientation in space. That is to say that the gyroscopic force which causes rotation of the compass card 11 so far exceeds the magnetic force developed by the electromagnets 13 that the free rotation of the card 11 in its direction indicating function is in no way hindered or interfered with. The optimum ratio between the gyroscopic force and magnetic force may easily be determined by experiment with a complete sample gyro instrument. Since the tendency to drift arises largely through small physical imperfections in manufacture, evaluation of the ratio is best determined by each manufacturer individually. The strength of the magnetic force may be controlled at the time of manufacture by the design of the electromagnets and their spacing from the armatures, as is well understood in the art. In ordinary aerial or marine navigation it is customary to navigate in a straight line course for considerable periods of

time during which periods the electromagnetic means herein described will be effective to prevent drifting of the gyroscope, so that the drift occurring during the relatively short interval of turning will be, for all practical purposes, inconsequential.

The invention is capable of modifications. Changes therefore in the construction and arrangement of parts may be made which do not depart from the spirit and scope of the appended claim.

I claim:

A directional gyroscope for aircraft comprising a stationary arm, a circular toothed frame member rotatable on a vertical axis beneath said arm, a depending reference card having a graduated lower portion secured on the under side of said rotatable frame member, an annular shelf-like shoulder extending around said reference card just above the graduated portion thereof, there being a pair of arcuate slots in said shoulder on diametrically opposite sides thereof, mounting screws extending through said slots, a pair of small electromagnets secured by said screws in arcuately adjustable clamping relation with said shoulder, said electromagnets having pole faces adjacent the inside lower edge of the graduated portion of said card, a conductor ring on the upper side of said rotatable frame member for energizing said electromagnets, a brush on said stationary arm for contacting said conductor ring, an electrical supply circuit connected with said brush, a switch in said circuit, a gyro directional element mounted for rotation on said vertical axis, a compass card surrounding said directional element adjacent and concentric of said reference card, and a pair of pieces of magnetic material secured on diametrically opposite sides of said directional element behind said compass card for coaction with said electromagnets to tend to resiliently hold said directional element in zero-zero relation with said frame member when said switch is closed.

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