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F. LAUCK

2,237,077

REPEATING DEVICE

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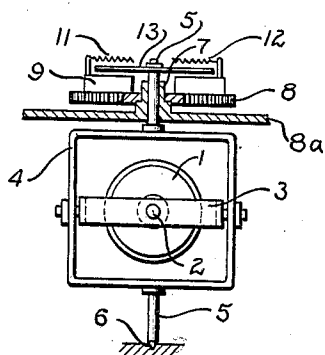


Fig 1

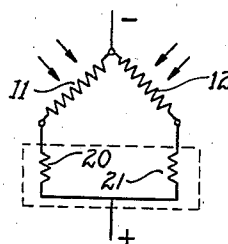


Fig 5

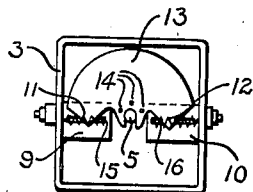


Fig 2

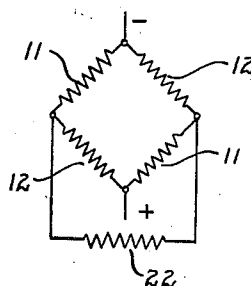


Fig 6

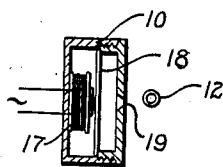


Fig 4

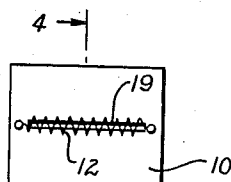


Fig 3

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REPEATING DEVICE

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2 Claims. (Cl. 201—48)

This invention relates to repeating devices actuated by angular deviation of directional instruments such as gyroscopes, compasses and the like and has for an object to provide a repeating device which is actuated by the angular deviation of the directional instrument without introducing any appreciable retarding force or friction to the turning moment of the instrument.

Another object is to provide a device of the above type adapted for use with small gyroscopes or compasses which are capable of producing only a small torque.

Another object is to provide a system of the above type adapted to provide an electrical repeating system which operates without phase displacement and which does not react upon the directional instrument.

These objects, and others which will be apparent as the nature of the invention is more fully disclosed, are accomplished in accordance with the present invention by utilizing a resistor, the resistance of which varies according to temperature, hereinafter called a temperature responsive resistor, and varying the temperature of the resistor in accordance with the angular position of the directional instrument.

In one embodiment, a pair of nozzles are provided to direct an air current onto a heated resistor. A baffle plate is attached to a shaft of the directional instrument to turn therewith so that it variably controls the discharge of air from the nozzles onto the heated resistors, thereby controlling the relative temperatures of the resistors. The resistors may be connected in a balanced circuit in such a way that any inequalities in the resistance thereof, due to variations in temperature, produce a current which is used to control the selected apparatus, such, for example, as a repeater compass or a servo-motor course-control mechanism.

The above and further objects and novel features of the invention will more fully appear from the following detailed description when the same is taken in connection with the accompanying drawing. It is to be expressly understood, however, that the drawing is for the purpose of illustration only and is not intended as a definition of the limits of the invention, reference for this latter purpose being had primarily to the appended claims.

In the drawing,

Fig. 1 is a side elevation, partly in section, illustrating the present invention as applied to a course gyroscope;

Fig. 2 is a top plan view thereof;

Fig. 3 is a detail view of the nozzle;

Fig. 4 is a section taken on the line 4—4 of Fig. 3; and,

Figs. 5 and 6 are diagrammatic views showing representative electrical connections for the temperature responsive resistors.

In the following description and in the claims, specific terms are used for convenience in referring to the various details of the invention. These terms are, however, to be given as broad an interpretation as the state of the art will permit.

Referring to the figures more in detail, the invention is shown as applied to a directional gyroscope 1 which may be driven in any suitable manner (not shown) and is mounted for rotation about a horizontal axis 2, the gyroscope 1 being cardanically suspended by means of gimbal rings 3 and 4. The ring 4 is mounted on a shaft 5 which is journaled in bearings 6 and 7. The bearing 7 carries a disc 8 which is rotatably disposed thereon and is provided with peripheral teeth 8a adapted to be engaged by suitable follow-up mechanism, (not shown). The disc 8 carries a pair of nozzles 9 and 10 which, as shown more in detail in Figs. 3 and 4, are provided with elongated slots 19 adapted to direct a current of air against temperature responsive resistors 11 and 12, respectively. A shield 13 is mounted on the shaft 5 and is adapted to rotate between the nozzles 9 and 10 and their respective resistors 11 and 12. The shield 13 is removably attached to the shaft 5 by means of screws 14 and is substantially semi-circular in form. The shield may be provided with angularly disposed control edges 15 and 16 which, in the embodiment shown, are in the form of isosceles triangles. These control edges are so arranged that, in the normal position of the gyroscope, they equally intercept the currents of air from the nozzles 9 and 10, respectively.

The current of air is derived from any suitable source. In the embodiment shown, it is derived from a generator constructed on the acoustic nozzle principle, comprising an electromagnet 17 acting on a flexible diaphragm 18 which extends between the walls of a nozzle housing. The air current passes out through the elongated slot opening 19 in the nozzle which has sharp outer edges and rounded inner edges so as to direct the air in a thin film or curtain against the temperature responsive resistor 12. The slot nozzle is particularly advantageous in that the jet is sharply defined and is uniformly

directed against the resistor; whereas a round nozzle would tend to develop a whirling air stream.

The temperature responsive resistors may be connected in various ways. In Fig. 5, windings 20 and 21 represent the windings of a rotary magnet of the repeater type which is adapted to assume an angular position dependent upon the current passed through said windings. The windings 20 and 21 are connected in series with the temperature responsive resistors 11 and 12, respectively, to form a bridge, the neutral points of which are connected to a suitable source of direct current.

In this system, when the resistors 11 and 12 are of equal value, equal currents will flow through windings 20 and 21. Any relative change in the resistors 11 and 12, however, causes a corresponding relative change in the currents passing through the windings 20 and 21.

In Fig. 6, resistors 11 and 12 are connected in the form of a Wheatstone bridge, the neutral points of which are connected to a winding 22 of a rotary magnet of the repeater type. A source of direct current is connected to the opposite corners of the bridge.

In this system, no current passes through the winding 22 when the resistors 11 and 12 are equal. When the relative values of these resistors are changed, however, a current will pass through the winding 22 which is proportional to such change.

The resistors 11 and 12 are preferably heated by the passage of current from the direct current source, as shown in Figs. 5 and 6, to a temperature such that the heat produced by the current is equal to that radiated. The radiation is dependent upon the surface of the conductor, the temperature of the surrounding air and the movement of the air. Hence, the movement of air caused by the jet of air from the nozzles 9 and 10 is utilized to increase or diminish the heat radiation.

As applied to a system in which the gyroscope is mounted in an aircraft, and used for maintaining a predetermined course, the baffle 13 normally remains symmetrically disposed with respect to the nozzles 9 and 10. In this position, the triangular edges 15 and 16 are equally interposed in the jets of air emanating from the nozzles 9 and 10, the radiation from the two resistors 11 and 12 is equal and the resistors remain at the same temperature and have the same ohmic resistance. Hence, equal currents will flow through the windings 20 and 21. If, however, the craft deviates from its predetermined course, the baffle 13 is deflected with reference to the nozzles 9 and 10 to cut off one of the air streams to a greater extent than the other. One of the resistors is thus cooled to a greater extent than the other and causing an unbalance in the windings 20 and 21 which is utilized to actuate the rotary magnet or other repeater. In the embodiment of Fig. 6, the current in the winding 22 is proportional to the differential effect of the resistors 11 and 12. This is used to operate the rotary magnet or other repeater. This rotary magnet or repeater may, in turn, be used to actuate any control device such as a servo-motor to cause the aircraft to automatically resume its predetermined course. An arbitrary adjustment or change of course may be effected through a driving means, not shown, which may be connected to operate the disc 8.

As explained above, the present system oper-

ates without introducing additional frictional forces to the gyroscope and without reacting upon the gyroscope. Consequently, a small gyroscope may be employed.

The range of the control mechanism may be readily varied by changing the strength of the air jet which, in turn, can be altered by varying the strength of the alternating current applied to the magnets 17. Furthermore, baffle 13 may be readily removed and substituted by a baffle having different characteristics, such as a control edge having a different shape.

The repeating mechanism above described may be disposed in any convenient position with respect to the gyroscope. If desired, a similar repeating mechanism may be disposed on each side of the gyroscope, one of which may act on the steering mechanism and the other on an indicating instrument. The device may also be used for repeating the movement of a plurality of the gyroscope axes, as in the case of a gyroscopic horizon and the like.

Although certain embodiments of the invention have been shown for purposes of illustration, it is to be understood that the invention is not to be limited thereto, but is only to be limited in accordance with the following claims when interpreted in view of the prior art.

What is claimed is:

1. In an aircraft instrument comprising a directional gyroscope having a gyro rotor mounted for spinning about a horizontal axis, means mounting said rotor for precession about a second axis perpendicular to said spin axis and for angular movement about a third axis mutually perpendicular to said first and second axes, said mounting means including a vertical trunnion, a bearing for said trunnion whereby said trunnion and mounting means move angularly with said rotor about said third axis in said bearing, a temperature responsive resistor having current flow therein, a source of fluid pressure whose temperature differs from the temperature of said resistor, a disc member mounting said fluid source and said resistor supported on said bearing, and means carried by said trunnion interposed between said source and said resistor for normally shielding said resistor from said fluid pressure flow and adapted for angular movement during angular movement of said mounting means about said third axis whereby said fluid pressure flow impinges upon said resistor varying the temperature and resistance of said resistor whereby current flow therethrough is varied in accordance with the angular movement of said mounting means about said third axis.

2. In an aircraft instrument comprising a directional gyroscope having a gyro rotor mounted for spinning about a horizontal axis, means mounting said rotor for precession about a second axis perpendicular to said spin axis and for angular movement about a third axis mutually perpendicular to said first and second axes, said mounting means including a vertical trunnion, a bearing for said trunnion whereby said trunnion and mounting means move angularly with said rotor about said third axis in said bearing, a temperature responsive resistor having current flow therein, a source of fluid pressure whose temperature differs from the temperature of said resistor, a disc member mounting said fluid pressure source and said resistor rotatably supported on said bearing, and means carried by said trunnion interposed between said source and said

resistor for normally shielding said resistor from said fluid pressure flow and adapted for angular movement during angular movement of said mounting means about said third axis whereby said fluid pressure flow impinges upon said resistor varying the temperature and resistance

of said resistor whereby current flow therethrough is varied in accordance with the angular movement of said mounting means about said third axis, said rotatably supported disc member constituting a portion of a follow-up mechanism.

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