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G. P. SILBERSTEIN
CARBON PILE GYRO PICK-OFF

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Fig. 2.

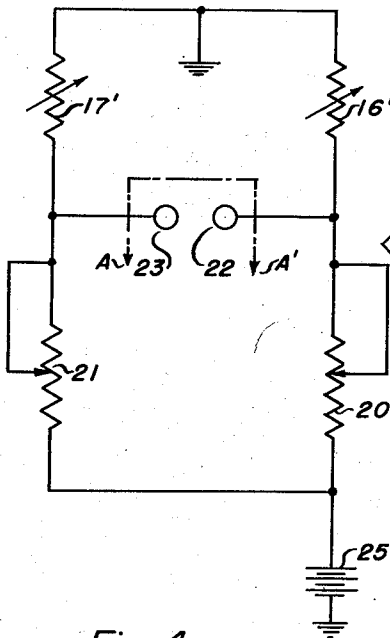


Fig. 3.

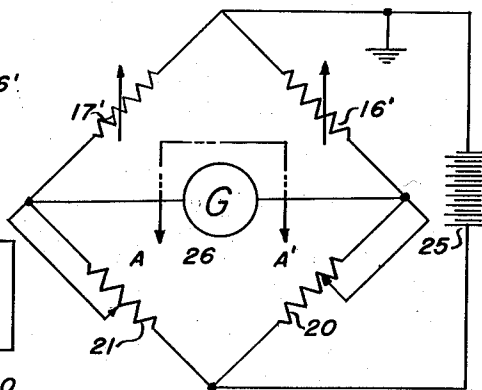


Fig. 1.

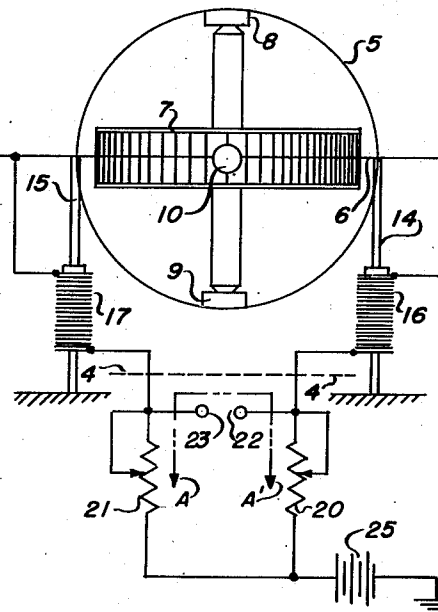
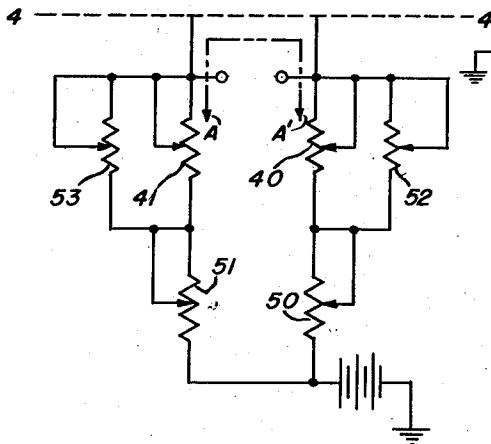


Fig. 4.



Inventor

GEORGE P. SILBERSTEIN

By

M. Hayes

Attorney

UNITED STATES PATENT OFFICE

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CARBON PILE GYRO PICK-OFF

George P. Silberstein, Rochester, N. Y., assignor,
by mesne assignments, to the United States of
America as represented by the Secretary of the
Navy

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5 Claims. (Cl. 323-72)

1

This invention relates to carbon pile gyro pick-offs.

In obtaining useful information from gyros arranged in a craft, many difficulties are encountered in providing movable gimbals and commutating pick-offs. The proposed invention provides means for the elimination of these difficulties.

A primary object of this invention is to provide a carbon pile gyro pick-off.

Another object of this invention is to provide a carbon pile gyro pick-off in which the precession forces of a constrained gyro are utilized.

Another object of this invention is to provide a carbon pile gyro pick-off and associated circuits for controlling a moving craft.

Still another object of this invention is to provide a carbon pile gyro pick-off and associated circuits to indicate the amount of deviation of a craft from a preselected stabilization axis.

Other objects and advantages of this invention will become apparent from the following description and drawings wherein corresponding numbers denote identical parts and in which

Fig. 1 is a schematic elevation view of the proposed invention;

Fig. 2 is a schematic diagram of the electrical equivalent of the proposed invention;

Fig. 3 is an equivalent schematic diagram of the proposed invention in typical Wheatstone bridge arrangement; and

Fig. 4 is a fragmentary view of Fig. 1 below line 4-4 showing a modification adapted for gun laying.

As shown in Fig. 1 there is provided a gyroscope frame consisting of a vertical inner ring 5 and an outer horizontal ring 6, rigidly secured together at their intersection, and fixedly supported thereat by carbon piles 17 and 16 through means of rigid elements 15 and 14, respectively. Inner ring 5 pivotally supports horizontally positioned gyro rotor 7 in a conventional manner. Said supporting carbon piles prevent rotation of the gyro output arm in either direction, and so constructed and arranged as to receive the force of precession as the entire frame is tilted. Outer ring 6 is also pivotally supported by diametrically disposed pivots 10, 90° from the carbon piles, the pivot bearings being supported by the craft to be controlled.

For pitch control the device is mounted in a craft so that the axis of pivots 10 is aligned with or parallel to the longitudinal axis of said craft; for roll control the device is to be mounted in a craft so that the axis of pivots 10 is aligned with

2

or parallel to the lateral axis of said craft; and for yaw control the device is to be mounted in a craft so that the axis of pivots 10 is aligned with or parallel to the normal axis of said craft. In each case the carbon piles are mounted so as to receive the force of precession as the entire frame is tilted through its association with the craft. As described, the equal resistance carbon pile regulators 16 and 17, being rigidly supported at their lower ends, receive the precession forces on their upper ends via members 14 and 15 respectively. An electrical ground is provided for the upper terminal of the carbon pile regulator 17 and a similar electrical ground provided for carbon pile regulator 16 through the gimbals 5 and 6 to already established ground points. The lower ends of the equal resistance carbon pile regulators are electrically connected to the potentiometers 20 and 21, the junctions between the regulators and the potentiometers being provided with terminals 22 and 23 to receive a galvanometer or similar current-indicating devices. The lower ends of the resistors 20 and 21 are connected to a battery 25, the return side of which is grounded.

The equivalent electrical circuit of the drawing of Fig. 1 is shown schematically in Fig. 2. The equal resistance carbon pile regulators 16 and 17 are replaced by the variable resistors 16' and 17' and the circuit completed in accordance with Fig. 1. By a slight rearrangement, Fig. 2 is converted to an equivalent circuit of Fig. 3 which is a basic Wheatstone bridge circuit. The terminals 22 and 23 provided within A-A' in Figs. 1 and 2 have been replaced with a galvanometer 26 in Fig. 3.

Since the two equal resistance carbon pile regulators are mounted so as to prevent rotation of the gyro in either direction, the precession of the spinning gyro as the system of Fig. 1 is rotated is translated into pressure applied to one or the other of the carbon pile regulators 16 or 17, depending on the direction of rotation of the system and of the spinning rotor 7. Thus variable pressures on the carbon pile regulators are translated into inversely variable electrical resistances because of the inherent properties of the carbon piles. Hence any precession force created by a rotation of the system can be detected by the difference in potential at the output terminals 22 and 23. This difference potential may be utilized either to operate a zero-center galvanometer or other current instrument 26 of Fig. 3 or may be utilized to operate a control system affecting angular control of the craft or device containing this system and thereby control its attitude gyroscopically.

3

A definite pressure should be applied to both carbon piles when there are no precession forces present. Thus the carbon piles themselves will provide zero-restoring torque without the use of an external accessory spring. Potentiometers 20 and 21 are provided for adjusting for equilibrium conditions for zero-precession.

By the introduction of variable series and shunt resistors into the circuit of Fig. 1 as shown by Fig. 4, superelevation, drift, range, rate, and wind correction can be introduced into the system for use in gun laying. The customary procedure is to provide the superelevation, drift, and wind correction by series resistors such as resistors 50 and 51 shown in series with the potentiometers 40 and 41 of the preferred embodiment and range and range rate by shunting resistors such as resistors 52 and 53 shown in parallel with potentiometers 40 and 41. Electrical damping can be introduced in the carbon pile system by mechanically linking variable damping resistors to the shunt resistors 52 and 53.

What is claimed is:

1. A carbon pile gyroscope pick-off comprising a gyroscope having an inner ring, a gyro rotor rotatably mounted therein, an outer ring rigidly connected to said inner ring at the intersections thereof, a pair of carbon piles each mounted at one end thereof on the craft to be controlled, each of said carbon piles secured at the other ends to said outer ring at points 90 degrees each way from said intersections, and an electrical circuit including said carbon piles for measuring pressure on said carbon piles due to precession forces of said rotor and rings.

2. A carbon pile gyroscope pick-off comprising a gyroscope rotor rotatable in a relatively immovable gimbal ring, a pair of carbon piles each secured at one end to the craft to be controlled and at the other end to opposite sides of said gimbal ring, and electrical circuits including said carbon piles for measuring the pressure due to the limited movement of said gimbal ring due to precession of said gyro rotor.

3. A gyroscope pick-off comprising a rotatable gyro rotor mounted in gimbal rings, mounting means securing said gimbal rings to the craft to

4

be controlled, said mounting means including electrical pressure responsive means and an adjustable electrical circuit for measuring the pressure on said mounting means due to forces of precession of said rotor as transmitted by said gimbal rings to the relatively immovable pressure responsive means.

4. A gyroscope pick-off as set forth in claim 3 in which said electrical pressure responsive means is a pair of carbon piles responsive to minute movements of one end thereof relative to the other end.

5. A gyroscope pick-off for use with a gyroscope having a rotor mounted in an inner gimbal ring and pivotal supports on an outer gimbal ring for mounting on an aircraft, a pair of initially loaded carbon pile rheostats each mounted at one of its ends on the aircraft and secured at the other end one to each of the two intersections of the inner and outer gimbal rings, an electrical circuit including said carbon pile rheostats for measuring the forces due to precession of the rotor as transmitted by said gimbal rings to the carbon pile rheostats, and means in said circuit for adjusting the current flow in said circuit due to the initial loading of the carbon pile rheostats.

GEORGE P. SILBERSTEIN.

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