

J. PERRY & S. G. BROWN.
GYRO COMPASS.
APPLICATION FILED NOV. 10, 1915.

Patented Sept. 25, 1917.

1,240,872.

Fig. 1.

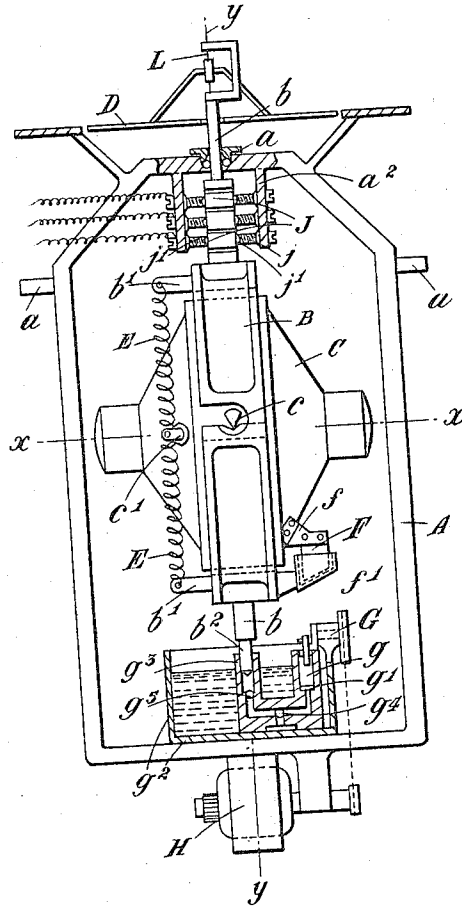


Fig. 3.

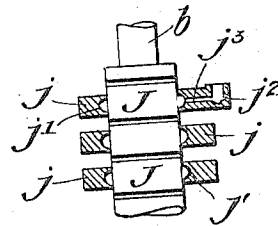
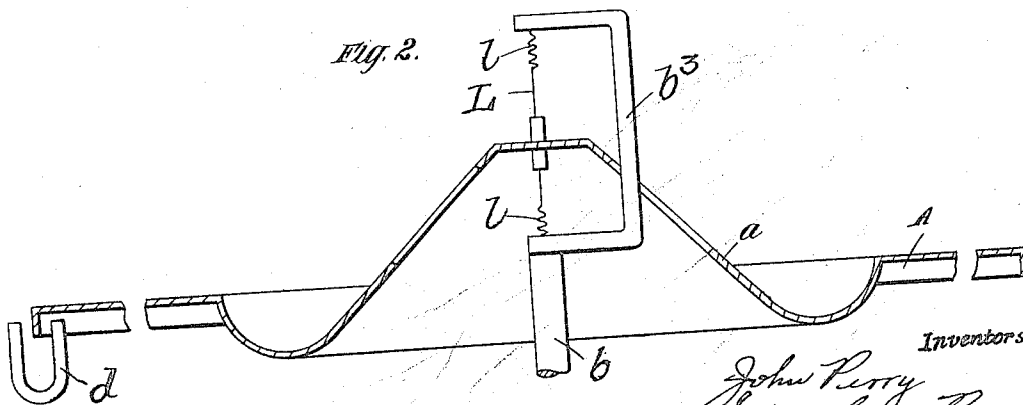


Fig. 2.



Inventors.

John Perry
Sidney George Brown
by Lemie Goldsmith & Co. Attys

UNITED STATES PATENT OFFICE.

JOHN PERRY, OF KENSINGTON, LONDON, AND SIDNEY GEORGE BROWN, OF NORTH ACTON, ENGLAND.

GYRO-COMPASS.

1,240,872.

Specification of Letters Patent.

Patented Sept. 25, 1917.

Application filed November 10, 1915. Serial No. 60,770.

To all whom it may concern:

Be it known that we, JOHN PERRY and SIDNEY GEORGE BROWN, both subjects of the King of Great Britain, residing, respectively, at 25 Stanley Crescent, Kensington, in the county of London, England, and Edward Road, Willesden Lane, North Acton, in the county of Middlesex, England, have invented certain new and useful Improvements in or Relating to Gyro-Compasses, of which the following is a specification.

This invention relates to gyro-compasses, particularly for use on ships, the chief objects being to eliminate as far as possible disturbing influences due to motions of the ship, to enable the compass quickly to take up its N—S position and rapidly resume such position after becoming displaced from any cause and to reduce to a minimum the friction occurring in the vertical bearings of the north-seeking parts of the compass.

In a gyro-compass frictional resistance to movement of the orienting frame around its vertical axis may prevent the orienting frame settling quite accurately, and for accurate pointing of the compass it is necessary to reduce the frictional resistance around the vertical axis to a minimum. According to our invention a continuously operating vertical or longitudinal reciprocating movement is provided between the orienting frame and the bearing in which it is supported, which movement without giving rise to any rotation, allows of almost complete suppression of frictional resistance to relative rotation of the parts. For this purpose the lower end of the vertical spindle or member carrying the outer frame may be supported in its bearing in a pendulous frame or support upon a lubricating liquid, such as oil pumped into the bearing in impulses which give a small vertical or axial oscillation or reciprocation to the frame relatively to the bearing.

We may also employ special means for suppressing oscillations of the frame by connecting the gyroscopic wheel casing (which is mounted on a horizontal axis in the said frame) to the frame by centralizing springs and interposing between the frame and casing a damping device employing a very viscous substance, such, for example, as cobbler's wax, adapted to flow very slowly and

to give a long sustained drag so as to damp the slow precessional tilting oscillations due to oscillations through the N—S position.

In order that the said invention may be clearly understood and readily carried into effect, we will describe the same more fully with reference to the accompanying drawings, in which:—

Figure 1 is an elevation partly in section of the main part of the gyro-compass.

Fig. 2 shows the compass card and its mounting to a larger scale.

Fig. 3 is a detail view of an electrical contact device.

A is the pendulous or swinging support, the trunnions of which are carried in gimbals. B is the orienting frame, mounted on the vertical spindle *b* comprising top and bottom members. C is the inner frame or casing within which is the gyroscopic wheel rotating at high velocity around the horizontal axis *x—x*. The casing is carried in the orienting frame on the knife edge bearing *c*, at right angles to the axis *x—x*. D is the compass card mounted on the spindle *b*. E, E are springs connecting the frames B and C. F is a brake member interposed between the said frames. G is a lubricant pump for effecting the reciprocation of the frame B. H is a motor driving the pump. J, J are slip rings for conducting current to the gyro-motor. L is a spring suspension for the card.

Dealing first with the mounting of the casing C it will be seen that the axis *x—x* of this casing is free to tilt around the knife edge bearing *c* but this freedom is controlled by the two springs E connected between the arms *b'* on the orienting frame B and the arm or post *c'* on the casing C these springs always acting to bring the axis *x—x* to a neutral position in which it is at right angles to the axis *y—y* around which the frame B is free to turn in its pendulous support A. The casing C may therefore oscillate in the frame B but these oscillations are very small compared to the oscillations around the axis *y—y*, a point on the axis *x—x* tracing a very elongated ellipse of which the vertical axis is the short one. When the tilting oscillations of the axis *x—x* are damped the orienting frame is brought back to and steadied in its N—S

position without the application of any external forces. As the tilting angle is small the damping must be sustained and powerful and a convenient and efficient device consists of the blade F mounted on the bracket *f* on the casing C and dipping into cobbler's wax or other slow flowing material in the cup *f'* carried by the frame B. The wax yields slowly but steadily to the motion of the blade F and a viscous brake of considerable power is thus put upon the tilting oscillations of the axis *x-x*. This braking action, in conjunction with the springs E, brings back the orienting frame to its N-S position in a comparatively short time and introduces no danger of errors such as are involved in a direct action on the frame B around the axis *y-y*.

In order that the frame B may be guarded from external disturbance around its axis *y-y* the frictional resistance of its bearings in the pendulous support A must be reduced to a minimum and, as is well known the friction between moving surfaces is much less than between the same surfaces at rest. We therefore arrange for a continuous relative oscillation between the two elements of the bearing of the frame spindle, along the axis *y-y*. In the construction illustrated this oscillation is effected by means of the small pump G driven by the motor H, both pump and motor being mounted on the bottom bar of the support A. The plunger *g* of the pump reciprocates in the small cylinder *g'* of the pump casing which is placed in the tank *g²* containing an ample supply of oil, the pump casing having a second cylinder or bearing socket *g³* receiving the pointed lower end *b²* of the spindle *b* which forms an easy fit in the socket but allows of slow leakage of oil forced into the bearing. The oil at each suction stroke of the pump plunger *g* is drawn from the tank into the pump casing through the suction valve *g⁴* and on the following delivery stroke is forced through the delivery valve *g⁵* at the bottom of the bearing socket *g³* into the cup formed by the socket. The pressure of the oil is sufficient to lift the frame B in the support A but as the oil continually escapes past the spindle end *b²*, the frame (together with the inner frame C and gyroscopic wheel) falls again through a short distance. The amount of lubricant pumped is carefully adjusted to give a supply which keeps the end of the spindle *b* always supported upon the oil so that practically only fluid friction has to be dealt with. In case, however, of the spindle dropping too far it would still be supported on a point bearing of small frictional resistance. The continuous oscillatory movement reduces to a minimum any slight surface friction which may occur between the spindle end *b²* and the walls of the socket *g³*

and also at the ball bearing *a* which gives lateral support to the upper end of the spindle *b*.

To supply the current to the motor maintaining the rotation of the gyroscopic wheel in the inner frame or casing C, with the least restraint to the spindle *b*, the slip ring device shown to an enlarged scale in Fig. 3 may be provided. The arrangement is illustrated for a three-phase current supply and three slip rings J are provided on the spindle *b*, around which are placed three contact rings *j* secured in the split cylindrical bracket *a'* (Fig. 1) of the pendulous support A, the inner edges of these rings being channeled to receive a ring *j'* of mercury. Owing to surface tension the mercury rings are retained in the annular channels between the rings J and *j* without the edges of the latter rings meeting the rings J, so that fluid friction only has to be considered, while perfect contact is maintained through the mercury during the oscillations of the spindle. The mercury may be supplied to the rings by small cups *j²* (of which one is shown in Fig. 3) fitted to the edge of the rings *j* and communicating with the channels by small passages *j³* in the rings.

As shown in Fig. 2 the resilient mounting of the card D is embodied in the wire or filament suspension L with small spiral springs *l* at top and bottom. The card is suspended in the bracket or arm *b²* mounted on the vertical spindle *b* and the resilient suspension, the tension of which is preferably adjustable, is set to give to the card a period of oscillation long in comparison with the rolling or pitching period of the ship. The springs *l* keep the suspension sufficiently taut to maintain the card substantially horizontal. The wire L may be in the form of a thin metallic strip or of any other suitable type. The suspension is similar to that commonly employed in galvanometers. In this wire suspension frictional resistance practically disappears and as the directive forces acting on the card are very small, owing to the necessity of getting a long oscillation period, the absence of friction is a matter of great importance.

Oscillations of the card may be damped by means, for example, of a magnetic brake as shown in Fig. 2 in which the edge of the card passes between the poles of a permanent magnet *d* which acts to damp the swing of the card.

In the case of a gyro-compass repeater the spindle *b* of Fig. 2 may be regarded as part of an orienting frame or member caused to move in unison with the orienting frame of the gyro-system in any suitable manner.

What we claim and desire to secure by Letters Patent of the United States is:—

1. In a gyro-compass, an orienting frame

under gyroscopic control, a bearing for the said frame and means for giving a longitudinal reciprocating movement to the frame relatively to its bearing.

5 2. In a gyro-compass, an orienting frame, a bearing for the said frame containing liquid supporting the frame and means for giving an intermittent motion to the said liquid so as to reciprocate the frame rela-
10 tively to the bearing.

3. In a gyro-compass, an orienting frame, a bearing for the said frame containing liquid supporting the frame, and a pump adapted to pump the said liquid into the
15 bearing in impulses so as to reciprocate the frame.

4. In a gyro-compass, a pivoted support, an orienting frame having a spindle mounted to turn in the said support, a socket
20 bearing receiving the lower end of the spindle and supplied with lubricating liquid and a continuously operating pump adapted to pump the liquid into the bearing in impulses.

25 5. In a gyro-compass, a pivoted support, an orienting frame having a spindle mounted to turn in the said support, a socket bearing receiving the lower end of the spindle and supplied with lubricating liquid which
30 overflows the bearing, a lubricant tank placed around the bearing and a continuously operating pump adapted to pump the liquid in impulses from the tank into and through the bearing.

6. In a gyro-compass, an orienting frame, 35 a bearing for the said frame containing liquid supporting the frame, a pump adapted to pump the said liquid into the bearing in impulses so as to reciprocate the frame and an electric motor adapted continuously
40 to drive the said pump.

7. In a gyro-compass, an orienting frame adapted to receive a reciprocating motion, a spindle for the said frame, contact slip
45 rings on the spindle forming part of the electrical circuit for the gyro motor, fixed contact rings surrounding the said slip rings and rings of mercury lying in channels between the said slip and contact rings.

8. In a gyro-compass, an orienting frame 50 under gyroscopic control, a bearing for said frame, means for giving a longitudinal reciprocating movement to the frame relatively to its bearing, a gyro-wheel casing mounted
55 to turn around an axis in the said frame and a centralizing spring connection between the frame and casing.

9. In a gyro-compass, an orienting frame under gyroscopic control, a bearing for said frame, means for giving a longitudinal re- 60 ciprocating movement to the frame relatively to its bearing, a gyro-wheel casing mounted to turn around an axis in the said frame, and a centralizing spring connection and a damping device both interposed between the
65 frame and casing.

JOHN PERRY.

SIDNEY GEORGE BROWN.