March 17, 1925. 1,529,720

T. ROSENBAUM

MECHANISM FOR SUPPORTING MAGNETICALLY GYROSCOPES

Filed Sept. 1, 1921 2 Sheets-Sheet 1

Fig. 1

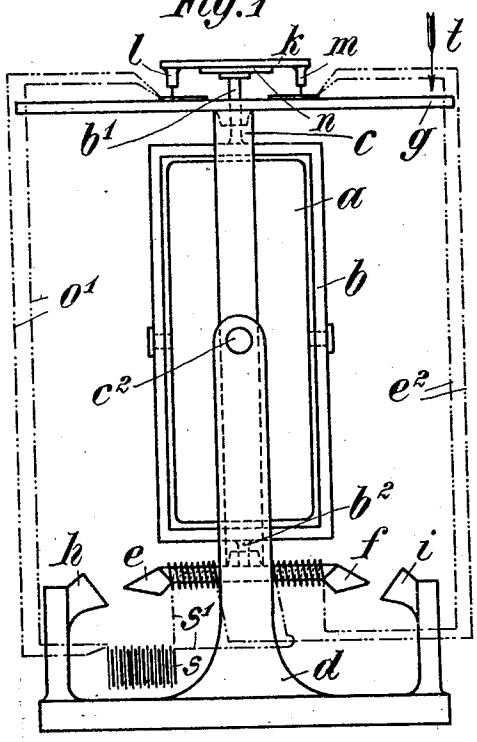
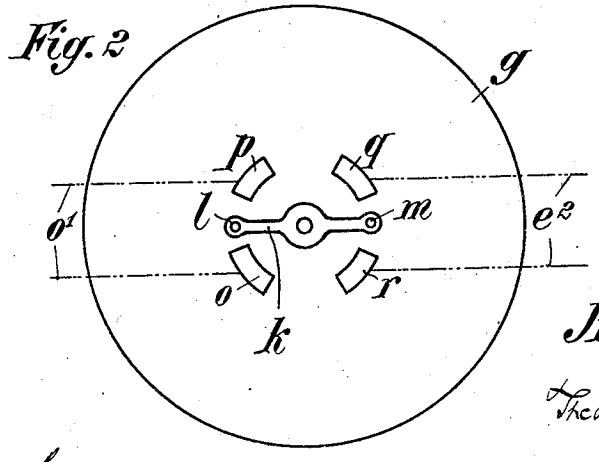


Fig. 2



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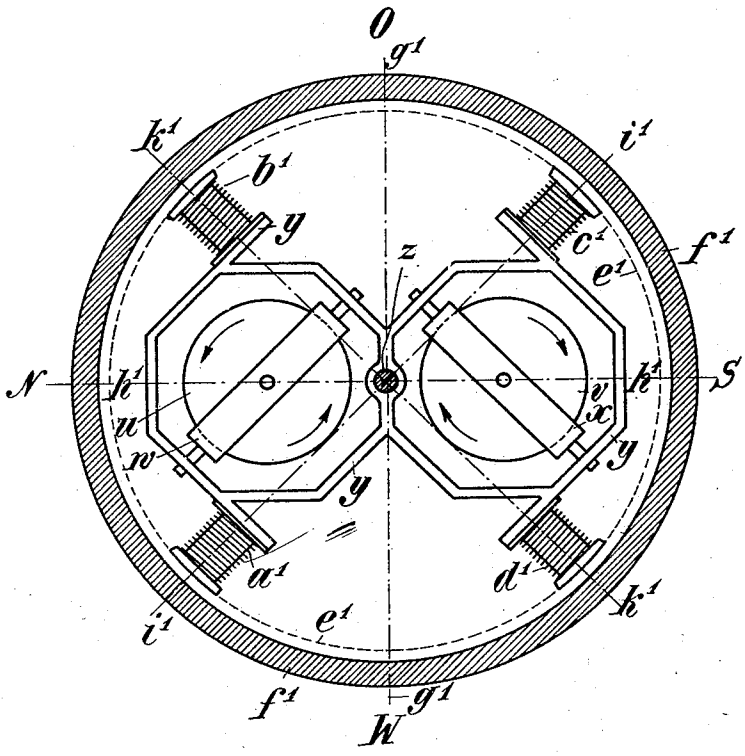
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Fig. 3



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UNITED STATES PATENT OFFICE.

THEODOR ROSENBAUM, OF BERLIN, GERMANY.

MECHANISM FOR SUPPORTING MAGNETICALLY GYROSCOPES.

Application filed September 1, 1921. Serial No. 497,788.

To all whom it may concern:

Be it known that I, THEODOR ROSENBAUM, of Germany, and residing at Berlin, Germany, have invented certain new and useful Improvements in a Mechanism for Supporting Magnetically Gyroscopes (for which I have filed applications for patent in Germany, Jan. 30, 1920; Germany, Feb. 20, 1920; and France, Jan. 29, 1921), of which the following is a specification.

This invention relates to improvements in a mechanism for magnetically stabilizing gyroscopes and the object of the invention is to provide an apparatus in which the gyroscope or gyroscopes are suspended in such a manner that the masses may be turned on several axes.

With this and other objects in view the invention consists of an improved combination of parts hereinafter fully described in the specification and pointed out in the claims forming a part of this specification.

The invention is clearly illustrated in the accompanying drawings, in which:—

Fig. 1 is a side elevation of the invention in connection with one gyroscope,

Fig. 2 is a top plan view thereof, and

Fig. 3 is a top plan view partly in section of a system containing two gyroscopes in connection with mechanism for magnetically stabilizing the same.

Referring now, more particularly, to the accompanying drawings there is provided a rotary mass a pivoted in the inner frame or ring b, the frame b being mounted for horizontal rocking movement as at b^1 b^2 in the rectangular outer frame c, the latter revolving in turn on the standards d by reason of the horizontal axis c^2. Attached to the lower part of the rectangular frame c are the electromagnets e and f while the circular plate g is carried by the top of said frame c for a purpose that will appear. Beyond the path of swinging movement of the frame c and the parts carried thereby are armature pieces h and i, the same being arranged opposite to the magnets e and f for coaction therewith. A lever k is fixed to the upper journalling trunnion of the inner frame b and carries conducting pins l and m which move back and forth on the plate g in directions corresponding to the movements of the gyroscope. The lever k is insulated from its support by a disk n of non-conducting material. On the plate g are arranged in circular series a plurality of spaced contacts, o, p, q, and r for coacting with the pins l and m. Conducting wires e^1 extend from the contacts o and p and connect with a source of electricity such as a battery s, the latter in turn being arranged in circuit with the coils of the magnets e and f by wires s^1. The other contacts q and r are electrically connected with the opposite ends of the coils of the magnets e and f by conducting wires e^2 thereby completing the circuits between the contacts and the magnets.

The stabilizing feature of the mechanism is effected in the following manner. An impulse acting on the system revolving on the axis c^2 indicated in the drawing by the arrow t is equal to a static moment M to the same axis. In opposition to the pressure the gyroscope remains substantially stationary while the frame c rocks counter-clockwise on the vertical axes b^1, b^2 causing the pins l and m to engage the contacts o and q thereby closing the corresponding circuits. This action energizes the magnets causing them to attract the armature pieces for reversing the rocking movement of the frame c thereby producing another moment M^1 opposite to the moment M which, if M^1 is greater than M, forces the gyroscope to swing back until the pins have reached their neutral positions, whereupon this operation may be repeated or continued. In consequence of the coaction just mentioned the electric circuits are alternately made and broken for the sake of carrying the impulses indicated by the arrow t.

In Fig. 3 a stabilizing system is shown containing two or more gyroscopes. The rotary masses u and v are pivoted in the rings w and x the latter in turn being pivoted in the duplex rotating frame y on the axis z. Radially of the vertical axis z are electromagnets a^1, b^1, c^1 and d^1, the latter being affixed to the frame y. The magnets a^1 and c^1 act as the stabilizers for the rotary body u on the one side while the magnets b^1 and d^1 act as stabilizers for the rotary body v on the other side and as apparent these magnets may be electrically connected with the rings w and x by circuits of a character similar to those represented by the form shown in Figures 1 and 2. Beyond the path e^1 of swinging movement of the gyroscopic system an iron ring f is opposed to the four magnets a^1, b^1, c^1 and d^1 in such a manner that the lines of magnetic power

must be directed tangential to the center of the swinging, that is to say, the iron ring representing the stabilizing system must lie either below or above the plane of the magnetic poles.

Owing to the use of the magnetic stabilizers illustrated with a system of two gyroscopes, such as shown in Fig. 3, the idea in matter will be easily understood. The main purpose of the invention is the mechanism for magnetically stabilizing the gyroscopes and by reason of the mounting of the mechanism the gyroscopes are allowed perfect liberty in revolving within the stabilizing mechanism without the possibility of contact. In addition all impulses acting on the apparatus of rotating masses immediately produce reactionary impulses working from one system to the other by magnetic attraction. The peculiarity of this invention is the fact that within the same system several gyroscopes are simultaneously arrested from without by magnetic impulses since the rotating masses have the tendency of evading the impulses falling upon them rectangularly and of thus producing magnetic powers counteracting and annulling the primary effect until they have reached again their normal positions.

Under the four axes in the drawing g^1, h^1, i^1 and k^1, the axis g^1 is distinguished by falling in with the symmetrical plane of the vertical direction whereupon it may be called the symmetrical axis of the system. The axis h^1 is rectangular to the symmetrical axis g^1 while the axes i^1 and k^1 again inclosing with the symmetrical axis angles of 45° are situated parallel of the rings of the rotary bodies. The direction of the movements of the gyroscope may be derived from the tendency of the rotating masses slowly to enter with their swinging planes into the directions of impulses applied therefor. The fettering of the system to the axis k^1 is effected by the rotary body u supported by the magnets a^1 and c^1, the fettering to the axis i^1 by the rotary body v supported by the magnets b^1 and d^1. Impulses around the axis h^1 must produce symmetrical movements while impulses to the axis g^1 effect divergent positions of the gyroscopes.

One may obtain a new and useful result from the magnetic stabilizing mechanism represented in Fig. 3 by providing the rotary bodies u and v with a fixed symmetric angular elevation. In consequence thereof from the rotation of the two gyroscopes annulling each other within the system until a resulting swing arises, for instance, if p is the angle of elevation and q the swing of either gyroscope,

$$= q\sqrt{2} \sin p$$

and inasmuch as the whole system obtains a momentum in the horizontal direction from the rotation of the earth it will act as a compass.

A peculiar effect which the gyroscope has as a compass depends upon three conditions incident to and in accordance with the preceding description. These conditions are as follows:—

Firstly, the angular elevation of the disks or rotary bodies u and v give the gyroscopic system a resulting plane of rotation in the vertical direction.

Secondly, the frame y is fettered in the horizontal plane by gravity and

Thirdly, the rotary masses u and v are fettered in a settled angle of elevation by gravity or by an elastic or magnetic material.

Thus it is apparent that the system represented by the frame y in reaction to the rotation of the earth working as a single top revolving on the axis h^1 is meridian seeking at any rate in the same manner as it is known from other gyroscopic compasses.

It is also to be noted that the frame y must in each instance be suspended so as to swing with respect to two horizontal axes, the iron ring f^1 may be either rigid as by being fixed on a vessel or suspended so as to swing. When the iron ring f^1 is rigid as mentioned there must be a sufficiently great space between the plane of this ring on the one hand and the pole plane of the magnets a^1, b^1, c^1 and d^1, on the other, so that under certain conditions, for example, heaving twisting movement of the vessel; the magnetic impulses acting on the frame y are prevented from taking an undesired, for example, reverse direction. On the other hand, when the iron ring is oscillatably suspended, the space between the two planes mentioned may be less, if the ring is stabilized by a special gyroscope horizontally. The oscillation may be free with respect to one as well as two horizontal axes. On marine vehicles it is generally sufficient to have the ring f^1 movable only relatively to the longitudinal axis of the vessel.

Having thus fully described the invention what is claimed and desired to be secured by Letters Patent is:

1. In a gyroscopic apparatus in combination a system of gyroscopes, a device for magnetically stabilizing the apparatus including a number of electromagnets arranged around the vertical central axis of the apparatus, automatic means for exciting the said magnets in correspondence with the precession of the gyroscopes, and a horizontal ring of magnetic material situated outside gyroscopic system and working as opponent pole of the said magnets.

2. In a gyroscopic apparatus in combination a system of gyroscopes, a device for magnetically stabilizing the apparatus including a number of electromagnets ar-

ranged round the vertical central axis of the apparatus, automatic means for exciting the said magnets in correspondence with the precessions of the gyroscopes, and a horizontal oscillatably suspended ring of magnetic material situated outside the gyroscopic system and working as opponent pole of the said magnets.

3. In a gyroscopic apparatus in combination a system of gyroscopes, a device for magnetically stabilizing the apparatus including a number of electromagnets arranged round the vertical central axis of the apparatus, automatic means for exciting the said magnets in correspondence with the precessions of the gyroscopes, a horizontal oscillatably suspended ring of magnetic material situated outside the gyroscopic system and working as opponent pole of the said magnets and means adapted to stabilize the said ring in its horizontal plane.

4. In a gyroscopic apparatus in combination a system of gyroscopes, a device for magnetically stabilizing the apparatus including a number of electromagnets arranged round the vertical central axis of the apparatus, automatic means for exciting the said magnets in correspondence with the precessions of the gyroscopes, a horizontal ring of magnetic material situated outside the gyroscopic system and working as opponent pole of the said magnets, two disks, symmetrical and oblique, rotating in rings, the axes of said rings being arranged to each other in an angle in a horizontal plane, means securing the oblique situation of the disks and means indicating a horizontal direction.

5. In a gyroscopic apparatus in combination a system of gyroscopes, a device for magnetically stabilizing the apparatus including a number of electromagnets arranged round the vertical central axis of the apparatus, automatic means for exciting the said magnets in correspondence with the precessions of the gyroscopes, a horizontal oscillatably suspended ring of magnetic material situated outside the gyroscopic system and working as opponent pole of the said magnets, two disks, symmetrical and oblique, rotating in rings, the axes of said rings being arranged to each other in an angle in a horizontal plane, means securing the oblique situation of the disks and means indicating a horizontal direction.

6. In a gyroscopic apparatus, in combination a system of gyroscopes, a device for magnetically stabilizing the apparatus including a number of electromagnets arranged round the vertical central axis of the apparatus, automatic means for exciting the said magnets in correspondence with the precessions of the gyroscopes, a horizontal oscillatably suspended ring of magnetic material situated outside the gyroscopic system and working as opponent pole of the said magnets, means adapted to stabilize the said ring in its horizontal plane, two disks, symmetrical and oblique, rotating in rings, the axes of said rings being arranged to each other in an angle in a horizontal plane, means securing the oblique situation of the disks and means for indicating a horizontal direction.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

DR. THEODOR ROSENBAUM.

Witnesses:

R. HEERING,

K. MARQUARD.