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1,440,822.

W. DIETER.

GYROSCOPE STEERING MECHANISM.

FILED JULY 2, 1919.

Fig. 1.

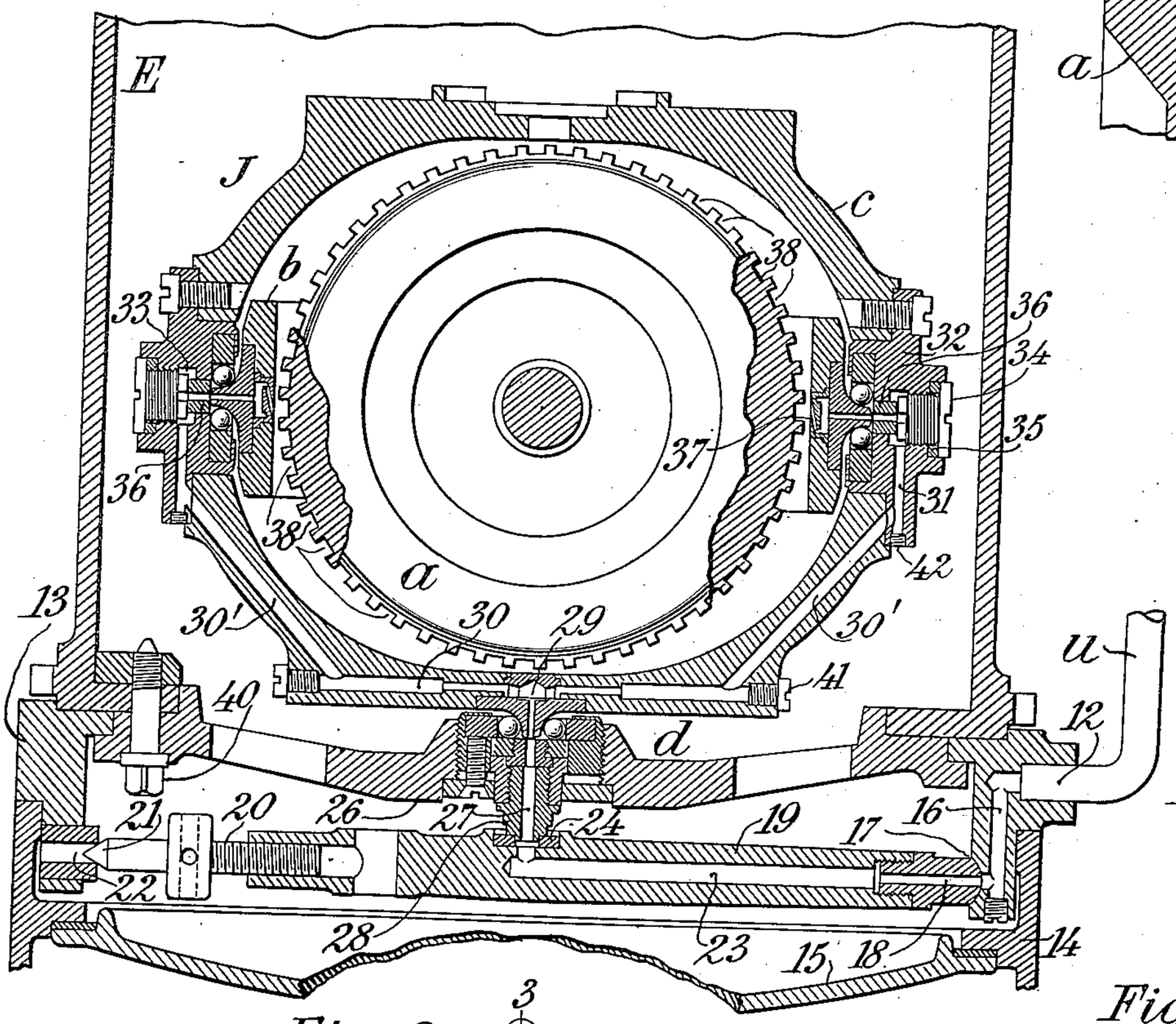

Fig. 5.

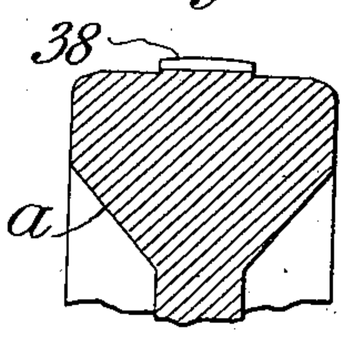

Fig. 7.

Fig. 2.

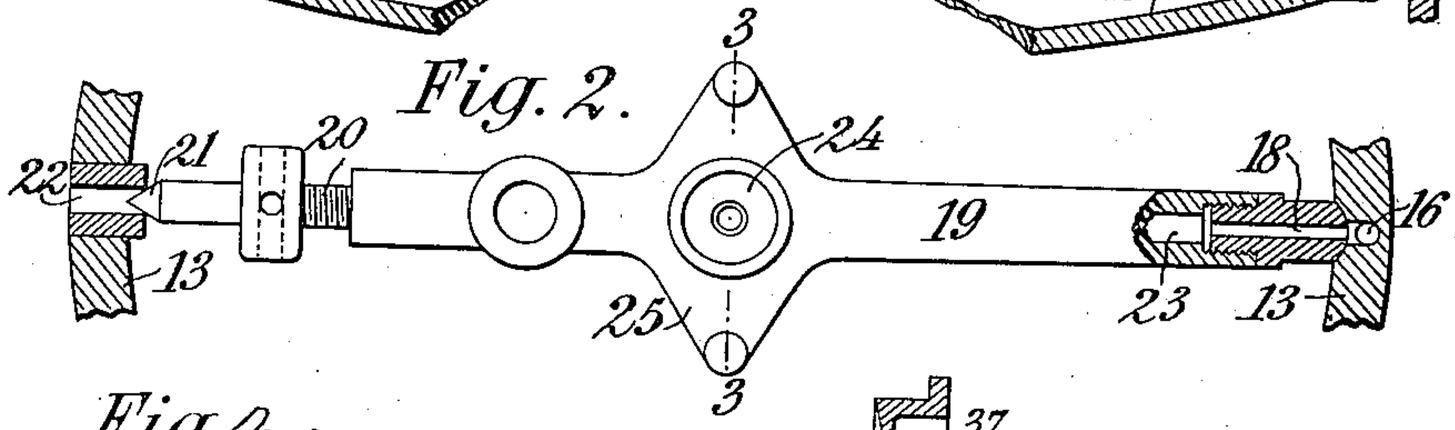

Fig. 3.

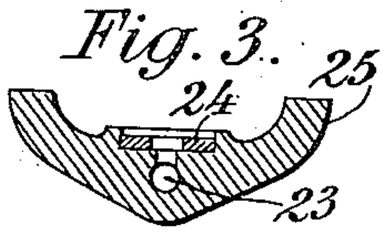

Fig. 4.

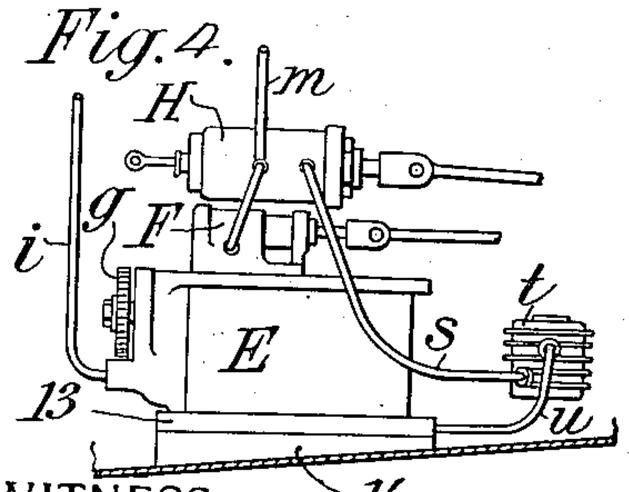

Fig. 6

WITNESS :

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UNITED STATES PATENT OFFICE.

WILLIAM DIETER, OF BROOKLYN, NEW YORK, ASSIGNOR TO VITTLEA DEVELOPMENT CORPORATION, A CORPORATION OF DELAWARE.

GYROSCOPE STEERING MECHANISM.

Application filed July 2, 1919. Serial No. 308,115.

To all whom it may concern:

Be it known that I, WILLIAM DIETER, a citizen of the United States of America, residing in the borough of Brooklyn, county of Kings, city and State of New York, have invented certain new and useful Improvements in Gyroscope Steering Mechanism, of which the following is a specification.

This invention relates to gyroscopic steering mechanisms, such as are used for steering automobile torpedoes. In such mechanisms, the gyroscope is spun up either by a spring motor or by the action of compressed air upon a turbine, this spinning-up occurring while the torpedo is still within the launching tube, or before it loses the direction or aim given it by such tube. It is desirable to provide means for keeping the gyroscope spinning at a sufficiently high speed during its run, and for this purpose the use of compressed air at reduced pressure has been proposed.

According to the present invention, the gyroscope is spun up by air at high pressure, being preferably the full initial pressure in the air flask, and is maintained spinning by the turbine effect of jets of air at reduced pressure taken from any convenient source, preferably from the exhaust of one or both the servo-motors of the torpedo, as set forth in my application filed August 27, 1918, Serial No. 251,641.

The present invention provides certain improvements in construction, the nature and purpose of which will be developed as the description proceeds.

Referring to the accompanying drawings, which show the preferred embodiment of the invention,—

Figure 1 is a vertical section through the gyroscope box of a torpedo, the section being mainly in the plane of the outer gimbal ring;

Fig. 2 is a fragmentary horizontal section showing the parts at the lower part of Fig. 1 mainly in elevation;

Fig. 3 is a transverse section on the line 3—3 in Fig. 2;

Fig. 4 is a general view on a small scale, showing the connection with the servo motors of the torpedo;

Fig. 5 is a fragmentary cross-section of the fly wheel.

Fig. 6 is an enlarged cross-section of one of the nozzles.

Fig. 7 is an oblique elevation showing a floating bushing on a magnified scale.

For convenience, I will apply the same letters of reference as in my said prior application, so far as the parts are identical or substantially so.

E is the gyroscope case or box, within which is mounted in usual manner the gyroscope J which comprises the usual fly wheel *a* hung in a normally horizontal gimbal ring *b*, which in turn is hung on an axis at right angles in an outer gimbal ring *c*, this ring being pivoted on a vertical axis within a supporting framework of which the lower member is shown at *d*. The pivots comprise ball bearings of usual construction, and require no special description.

High pressure air is taken from the high pressure side of the usual reducing valve, and conducted by a pipe *i* to the spinning-up mechanism of the gyroscope, which is of the usual construction, comprising a turbine *g*. F and H are the servo-motors, the former being the horizontal steering engine, and the latter the depth engine. Air at reduced pressure is taken through pipe *m* to the inlet valves of these motors, and exhaust air from one or both motors is taken by a pipe *s* to an intermediate reservoir *t*, from which the air is conducted by a pipe *u* leading to the gyroscope mounting, this air serving for maintaining the gyroscope in rotation, so as to prevent deceleration or slowing down of the fly wheel during a run of the torpedo.

The air is taken from the reservoir *t* by the pipe *u*, and is led to an opening 12 in a ring 13 which is introduced between the gyroscope casing E and the usual base ring 14, which latter is made fast in the shell or hull of the torpedo. The ring 14 serves in the usual manner as the seat for the cover 15 which closes the bottom opening through which the gyroscope may be reached. The opening 12 communicates with a duct 16 leading through the ring 13 and terminating in a seat 17 which is preferably concave or the segment of a sphere, being ground to fit a similarly shaped convex portion 18 formed at one end of a tubular member 19, which for convenience I will call a "strut". This strut has at its opposite end a screw 20 having a conical point 21 which enters a hole 22 suitably located in the ring 13, so that upon screwing out the pin 20 it presses the con-

vex seating face 18 against the concave seat 17 and makes a substantially air-tight joint. Within the strut 19 is formed a duct 23 which leads to a point beneath the central bearing of the gyroscope. The duct here is directed upward and is located within a socket containing a gasket 24. To hold the strut 19 in level position, it is formed with lateral arms 25 terminating in feet which engage the bottom face 26 of the supporting frame *d*. The duct 23 is continued up by means of a duct 27 extended through a nipple 28 which is conveniently screwed into the lower member of the bearing, and which may be made in two pieces, as shown. The cone member of the ball bearing attached to the gimbal ring *c* is drilled through centrally to form a duct 29 which communicates with the duct 27, being aligned therewith, and receives the jet of air therefrom. This duct 29 discharges into a lateral duct 30 drilled in the ring *c* and extending to both sides, and communicating with oblique ducts 30′ and vertical ducts 31, the latter leading to the two ball bearings by which the inner ring *b* is hung in the outer ring *c*. Each duct 31 is formed in a bearing member 32 and terminates in a chamber 33 which is closed by a screw 34, the head of which screws up against a ring or gasket 35. In line with the screw 34 is a floating bushing or loosely mounted cylindrical piston 36, shown separately in Fig. 7, through which is a central bore forming a duct communicating between the duct 31 and a duct formed centrally through the cone of the ball bearing which is fixed to the inner ring *b*. Within this cone is mounted a nozzle piece 37 having on one side a hollow forming a chamber for receiving the air, and on the other side an oblique jet orifice, as clearly shown in Fig. 1. This nozzle is shown on a magnified scale in Fig. 6. The nozzles on opposite sides are precisely alike, but are inverted the one relatively to the other, so that jets from both shall impinge in the same rotative direction against the fly wheel. The fly wheel *a* is provided with peripheral cross grooves 38 forming buckets to receive the impingement of the jets. The shape of the fly wheel and of these grooves in cross-section, is shown in Fig. 5. The grooves are preferably abrupt on both sides, being thus symmetrical in opposite rotary directions, the fly wheel being thus reversible so that the fly wheel may be inserted indifferently either way around, without affecting the operation. The air from duct 31 communicates with the bore of piston 36 by means of cross grooves in the end of the screw 34. The bushing or piston 36 is made a free but close fit with the opening through which it passes, and, receiving on its outer end the pressure of the air, is thereby caused to move inwardly, so that its inner end bears gently against the conical tip portion of the bearing cone, whereby to feed the air into the duct of the latter with the minimum leakage, as otherwise the air would tend to escape through the ball bearing. By this means a sufficiently close joint is provided without appreciable friction, since the air pressure employed is very moderate.

As compared with the construction set forth in my said former application, the present invention has the advantage of applying the air for maintaining the fly wheel in rotation at points substantially coincident with the pivots of the inner ring, and consequently at points which cannot vary in their relation with the fly wheel, because, the fly wheel being mounted in the inner ring, the latter accompanies the fly wheel in any tilting movement. It results that the jets for exerting the turbine effect for maintaining the gyroscope in rotation, are applied to the best advantage and without any disturbing reactions, their effect being the same whether the gyroscope wheel is turning on a horizontal axis or upon an axis displaced therefrom to a considerable angle.

Access to the gyroscope is readily had by removing the bottom cover 15 in the usual manner; thereupon, by turning the screw 20, the strut 19 can be quickly released and taken away. This at once gives access to the duct 16 in the adapter ring 13, also to the ducts 27 and 29 in the lower gimbal pivot. If the gimbal system is to be removed, the lower pivot frame *d* is taken out in the usual manner by removing its screws 40, of which one only is shown. The several bored ducts are closed by screw plugs 41, 42, which can be removed for cleaning in case of necessity. When the strut 19 is replaced, the screwing up of the conical screw 20 forces the strut upwardly and thereby presses the gasket 24 against the nipple 28 to make an air-tight joint.

The gaskets 35 limit the screwing in of the screws 34, while making an air-tight joint; the thickness of these gaskets should be such as to limit the screwing in of the screws, so as to give just the required play to the floating bushings 36, and if this play is too much or too little, thinner or thicker gaskets 35 should be substituted.

The floating bushings 36 should be precise duplicates, so as to present the same area to receive the pressure of the air, in order that they may exert balanced pressures against the two ball bearing cones at the inner ring.

The present construction is well adapted to a torpedo gyroscope which is adjustable for "angle-fire." In such adjustment the box or shell E is rotated around a vertical axis which coincides with the axis of the pivotal mounting of the outer gimbal ring *c*, and by arranging the nipple 28 and gasket 24 concentric with this axis, the turning

movement in adjusting for angle fire simply turns the nipple on the gasket, while pressing the air-tight connection between the ducts 23 and 27.

It is not to be inferred from the detailed description given that the invention is limited to the precise construction shown, it being understood that it may be subject to a wide range of variation within the scope of the following claims. For example, the invention is not necessarily limited to the duplication of the nozzles 37 whereby the gyroscope fly wheel is subjected to the balanced action of two like air jets, although this provision is decidedly preferable.

On the whole, the construction provided by the present invention adapts itself readily to the existing construction of the torpedo.

I claim as my invention:—

1. In a gyroscope, in combination, inner and outer gimbal rings having fluid conducting passages therein communicating through the bearings thereof, a rotor journaled in one of said rings, and fluid directing means, carried by one of said rings and communicating with said passages, for driving said rotor, and means responsive to air pressure, located at a bearing for packing the air duct against leakage.

2. In a gyroscope, in combination, inner and outer gimbal rings having fluid conducting passages therein communicating through the bearings thereof, a rotor journaled in one of said rings, and fluid directing means, carried by one of said rings and communicating with said passages, for driving said rotor, a bearing between said rings formed as a ball bearing with a ball recess in one ring, a cone on the other, and intervening balls, and packing means bearing against said cone for preventing leakage where the duct passes through such bearing.

3. In a gyroscope, in combination, inner and outer gimbal rings having fluid conducting passages therein communicating through the bearings thereof, a rotor journaled in one of said rings, and fluid directing means, carried by one of said rings and communicating with said passages, for driving said rotor, a bearing between said rings formed as a ball bearing with a ball recess in one ring, a cone on the other, and intervening balls, and packing means comprising a member impinging against such cone, the duct passing through the cone and packing member.

4. A gyroscope comprising gimbal rings, with bearings connecting them, and a rotor, and driving means comprising ducts passing centrally through a bearing, and a floating bushing at such bearing receiving the pressure of the air on its outer end and making contact with an element of the bearing on its inner end, whereby the air pressure forces it into close engagement therewith and makes a suitably close joint.

5. Gyroscope driving means according to claim 2, the packing means comprising a floating bushing receiving the pressure of the air on its outer end and making contact with a bearing cone on its inner end, whereby the air pressure forces it into close engagement therewith and makes a suitably close joint.

6. The combination with a gyroscope, of a source of air under low pressure, and air-impelled means fed therefrom for maintaining the gyroscope in rotation, said means comprising a turbine nozzle, and an air duct entering from the exterior through a gimbal ring pivot to said nozzle, the parts traversed by said duct including a strut adapted at one end to seat against a fixed part having a lateral opening, and a screw for pressing said strut into place adapted to simultaneously make tight joints with the contacting parts containing portions of said duct.

7. In combination with a gyroscope, driving means comprising a turbine nozzle and a duct entering from the exterior to such nozzle through a gimbal ring pivot, a strut through which a portion of such duct is formed, a connecting part having a continuing part of said duct and making socket engagement with one end of said strut, and another part having a continuation of said duct, making lateral engagement with the middle of said strut, and a cone screw for pressing said strut into place adapted to thrust it both endwise and laterally to make tight joints with the continuing portions of said duct.

8. In a gyroscope, the combination of outer and inner gimbal rings, and a rotor having journal bearings in the inner ring, fluid-conducting means passing through both rings and through a pivotal bearing between said rings, and a circular nozzle piece applied to the inner ring in the axis of said pivotal bearing, formed with a jet orifice adjacent the axis, directed tangentially relative to said rotor to discharge a jet of fluid tangentially against its peripheral portion, and the gimbal ring having a circular recess concentric with the axis of the bearing between the rings receiving the nozzle piece.

9. A gyroscope comprising a rotor and inner and outer gimbal rings, a fluid passage through the bearing between said rings, the inner ring at said bearing having a smaller and larger concentric recess, with a nozzle piece fitting the smaller recess and a bearing member fitting the larger recess and holding such nozzle piece in its place.

In witness whereof, I have hereunto signed my name.

WILLIAM DIETER,