L. B. TAYLOR.

GYROSCOPE.

APPLICATION FILED APR. 17, 1917.

1,296,137.

Patented Mar. 4, 1919.

2 SHEETS—SHEET 1.

Fig. 1.

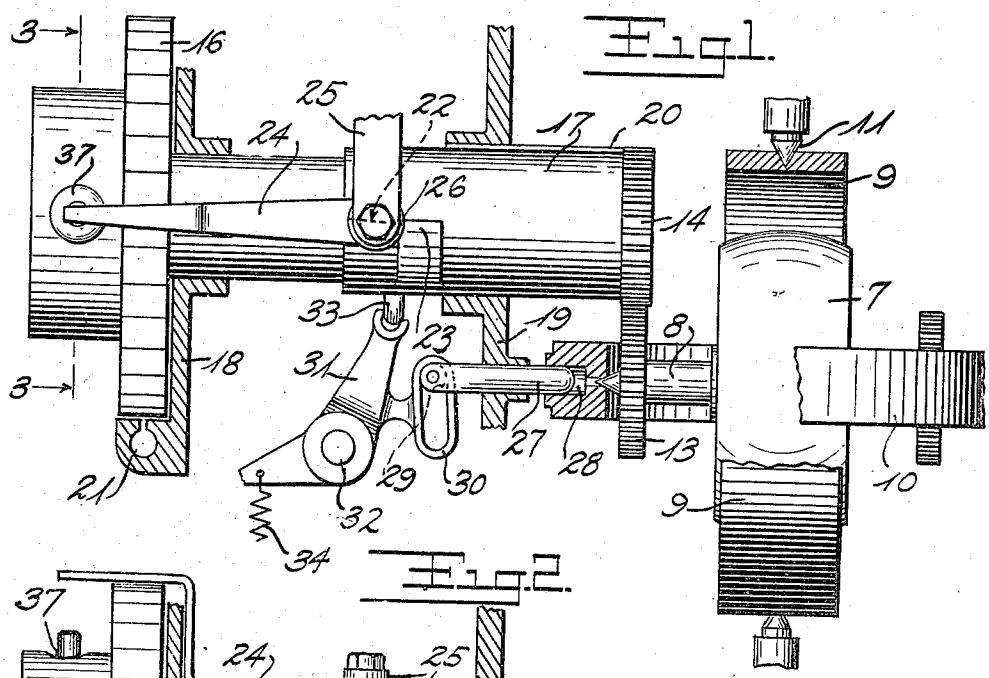


Fig. 2.

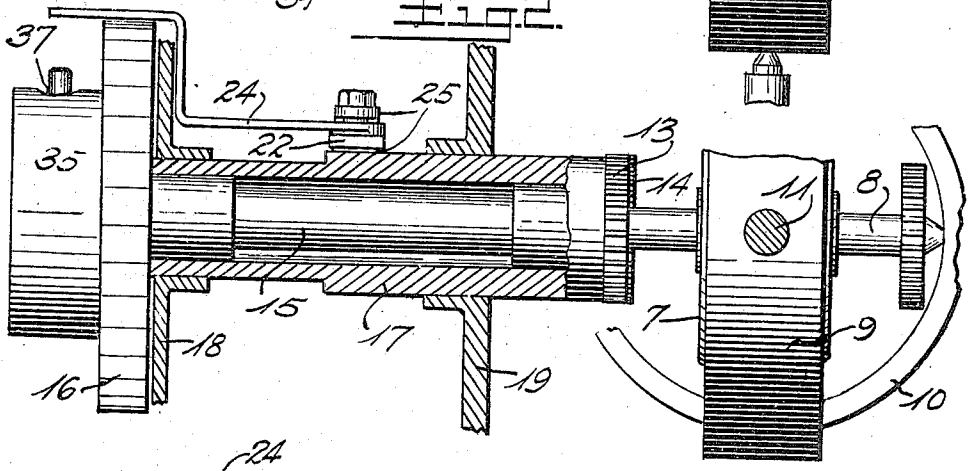
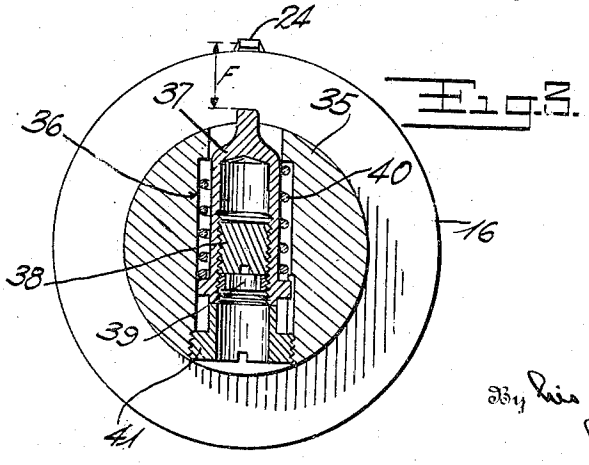


Fig. 3.



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2 SHEETS—SHEET 2.

Fig. 4.

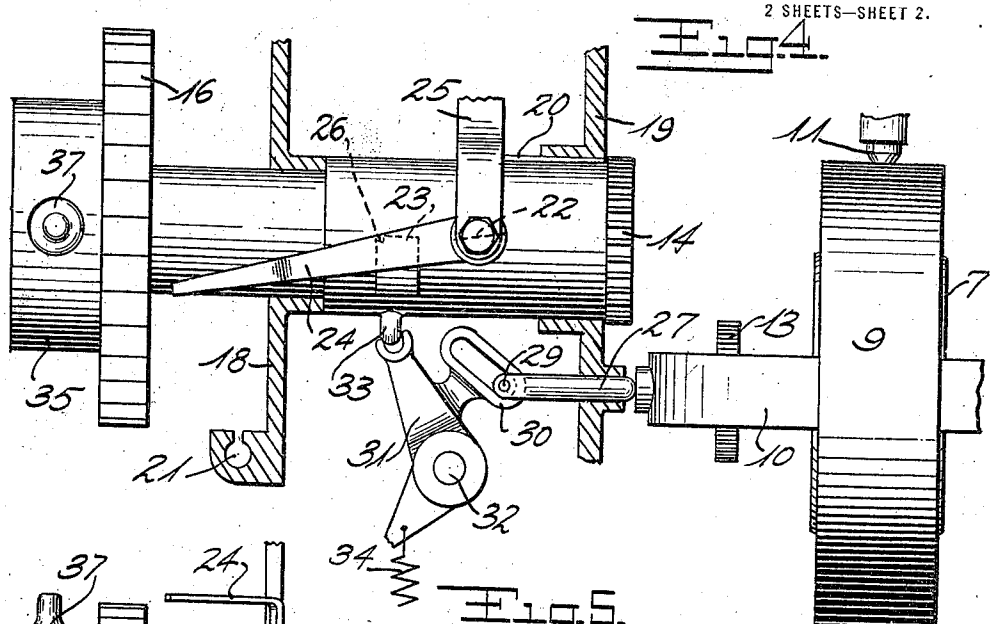


Fig. 5.

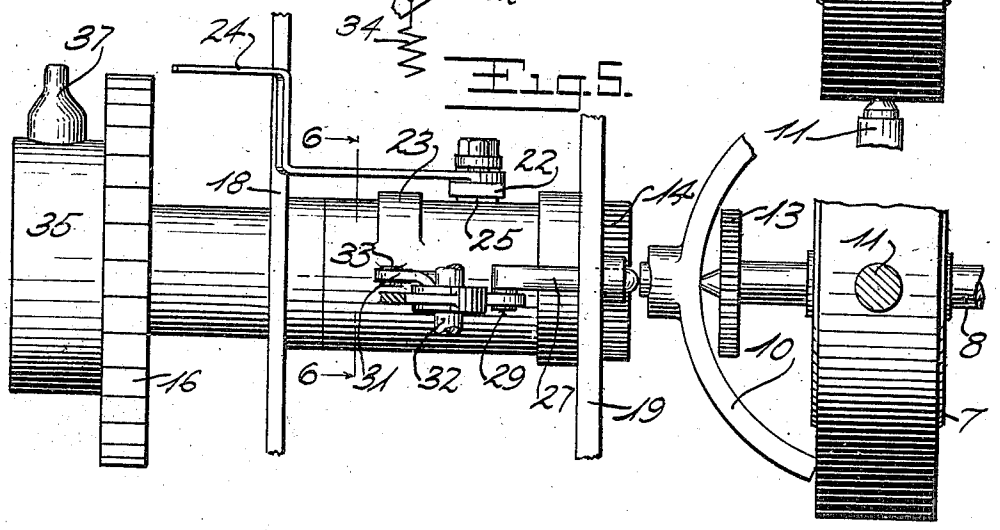
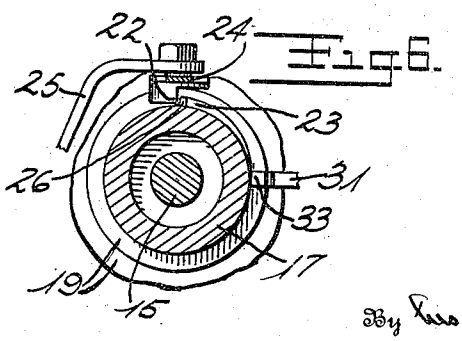


Fig. 6.



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GYROSCOPE.

1,296,137. Specification of Letters Patent. Patented Mar. 4, 1919.

Application filed April 17, 1917. Serial No. 162,783.

To all whom it may concern:

Be it known that I, LYNDON B. TAYLOR, a citizen of the United States, residing in the city of Newport, county of Newport, and State of Rhode Island, have invented certain new and useful Improvements in Gyroscopes; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to mechanism for controlling gyroscopes, and more particularly contemplates the provision of an improved gyroscope and gyroscope spinning mechanism for employment in automobile torpedoes.

In launching gyroscope-controlled automobile torpedoes, that is, torpedoes which after launching are kept on a predetermined course by means of a rudder operated by mechanism within the torpedo controlled by a gyroscope, it is important that the arrangement be such that the gyroscope fly-wheel may be spun up from idle condition to a very high rate of speed, say 10,000 revolutions per minute, before its gimbal rings are unlocked, and that then the rings be unlocked, all within a very small fraction of a second. This time interval is sometimes as small as one-tenth of a second, it being measured from the time when the expulsion valve of the torpedo launching tube is actuated to the time when the torpedo in issuing from the tube ceases to be wholly guided by the tube.

No difficulty is experienced in providing means for spinning the gyroscope fly-wheel to the high speed required in the short space of time available, a compressed-air driven turbine being generally employed for the purpose. When this high speed is reached, however, it is necessary to release the gimbal rings and to complete their release within the time limit specified. To attain this object, several more or less successful and well known systems have been employed. One of these systems involves the use of a time fuse, clockwork or the like, started automatically when the fly-wheel commences to rotate, and causing the release of the gimbal rings after a predetermined lapse of time. Another of these systems includes means for unlocking the gimbal rings after the gyroscope's fly-wheel has made a predetermined total number of revolutions. These prior constructions, however, admit of the possibility that the gimbal rings may be prematurely unlocked and the torpedo may be lost or may miss its mark.

The object of the present invention is to provide a gyroscope and gyroscope spinning mechanism, whereby the gyroscope is spun up to a selected rate of speed irrespective of the time or of the total number of revolutions required to attain that speed, before the gyroscope gimbals are released. The advantages of this type of spinning mechanism over the existing types are its simplicity of construction, and its substitution of a definite and constant initial rate of spin of the gyroscope for a variable initial rate of spin. This second advantage insures that the controlling effect of the gyroscope, throughout the run of the torpedo, will be influenced in a less variable manner by disturbing influences existing in the gyroscope mechanism, and therefore any phenomena tending to disturb the perfect balance of the gyroscope while it is directing the course of the torpedo will tend to give a constant error which can be corrected or allowed for. To this end, the invention involves the combination of a gimbal ring or gimbal, a gimbal lock, and means carried by some one of the rotating parts of the gyroscope and gyroscope spinning mechanism, preferably operated by centrifugal force, to actuate the gimbal lock to free the gimbal the instant the gyroscope is spun up to the selected rate of speed, irrespective of the time or the total number of revolutions required to attain that speed.

By providing a centrifugally operated means of this kind, the marked advantage is obtained of having a gimbal-lock actuator which may be embodied in a very simple and compact structure and which is adapted for quick and convenient preliminary adjustment to predetermine its degree of response to centrifugal force and consequently the rate of speed of the fly-wheel which is to bring about a release of the gimbal lock. It will be understood that when the present invention is applied to mechanisms for gyroscopically directing an automobile torpedo, some means should be provided for adjusting in advance the rate of speed of the fly-wheel which is to bring about a release of the gimbal lock as de-

scribed. This is so because the effective range of the torpedo after launching, that is, the range of the torpedo subject to the directive influence of the gyroscope, depends directly on the rate of speed to which the gyroscope is spun up before the gimbal is unlocked prior to launching the torpedo. It is important, in order to increase the factor of safety, that the gyroscope fly-wheel be spun up to a speed of rotation not materially greater than is required by the conditions to be met, that is, the speed of rotation of the fly-wheel at the instant when the gimbal is unlocked should be just adequate for proper functioning of the gyroscope during the entire time interval corresponding to the range of the target being attacked, to the end that no time is needlessly consumed in spinning up the fly-wheel during the fraction of a second elapsing between the opening of the expulsion valve of the launching tube and the release of the gimbal lock by the centrifugally operated mechanism.

The invention will be understood more clearly from the following description when taken in connection with the accompanying drawings illustrating the invention as applied to the gyroscope and gyroscope spinning mechanism of an automobile torpedo. In these drawings Figure 1 is a side elevation of such mechanism, partly in section, showing the gimbals locked; Fig. 2 is a bottom plan view with some of the parts removed and some shown in section; Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1; Fig. 4 is a view similar to Fig. 1 but showing the gimbals unlocked; Fig. 5 is a bottom plan view of the parts as illustrated in Fig. 4; and Fig. 6 is a section on the line 6—6 of Fig. 5.

Referring to the drawings, 7 designates the fly-wheel or gyro-wheel of the gyroscope, 8 the gyro-shaft, and 9 and 10 the gimbal rings. The outer, vertical gimbal 9 is hung as usual in a support 11 which is fixedly mounted in the hull of the torpedo. The gyro-shaft carries a spur gear 13 which may mesh with a similar gear 14 carried upon one end of what may be termed the turbine-shaft 15. The opposite end of this shaft 15 carries the turbine-rotor 16, and the shaft is journaled in a tubular casing 17. This casing 17 is slidably supported by walls 18 and 19 in the torpedo whereby the casing is adapted for axial movement, but it is held against rotative movement by means of a key and key-way as indicated at 20. The wall 18 has the nozzle 21 of the turbine formed therein. The turbine-shaft 15 may be rotated by compressed air issuing from the nozzle 21 when such shaft and the casing 17 are arranged as shown in Figs. 1 and 2, that is, when disposed to place the gears 13 and 14 in mesh to drive the fly-wheel shaft 8. In other words, casing 17 when in one extreme position (Fig. 1) holds the turbine-shaft 15 so as to bring the gears 13 and 14 into mesh and at the same time bring the turbine-rotor 16 opposite the turbine-nozzle 21. In the other extreme position of the casing 17 (Fig. 4), the gears 13 and 14 are unmeshed and the turbine-rotor is carried away from the turbine-nozzle.

The casing 17 is normally maintained as illustrated in Fig. 1 by means of a latch engagement between a pivoted dog 22 and a notched boss 23 formed on the casing 17. This dog is in the form of a semi-cylindrical member secured to a latch-arm 24 which is pivoted on a suitable support 25 fixed in the hull of the torpedo. When the casing 17 is arranged as illustrated in Fig. 1, the dog engages with the notch of the boss 23 as indicated in Fig. 1, this notch being shown at 26 in Figs. 4 and 6. This is the arrangement of these parts during the operation of spinning up the gyro-wheel.

In order that the gimbals may be locked immovable relative to the torpedo during the spinning up of the gyro-wheel, a locking bolt 27 is slidably mounted in wall 19 for coaction with a suitable recess 28 formed in ring 10, the parts being arranged so that when the plane of the ring 10 is horizontal and shaft 8 extends fore and aft, the locking bolt may enter the recess as shown in Fig. 1. The butt end of the locking bolt is provided with an anti-friction roller 29 working in a slotted extension 30 of a lever 31 fixedly pivoted at 32. The upper arm of this lever is forked to coact with a finger 33 dependent from casing 17. It will be seen from Fig. 1 that when the casing 17 is arranged to put gears 13 and 14 into mesh, the lever 31 is rocked to dispose the bolt 27 within recess 28 to hold the gimbal rings immovable.

A strong retractile spring 34 is attached at one end to lever 31 so that upon rocking the latch arm 24 from the position of Fig. 1 to that of Fig. 4 to cause momentary disengagement of dog 22 and the notched boss 23 on casing 17, this spring 34 will actuate the lever 31 to shoot the casing 17 to the left and thereby unmesh gears 13 and 14 and move the turbine-rotor 16 away from the turbine nozzle 21. During this actuation of lever 31, the slotted extension 30 functions to withdraw the locking bolt 27 from the recess 28, the parts being so designed that a minute interval of time elapses between the unmeshing of gears 13 and 14 and the complete withdrawal of the locking bolt from the recess.

Centrifugally operated means are provided for rocking the latch-arm 24 from the position shown in Fig. 1 to that shown in Fig. 4 to permit the casing 17 and the parts operatively connected therewith to assume the positions shown in Fig. 4. This means,

which is illustrated in detail in Fig. 3, is housed in a hub-member 35 secured to the turbine-rotor 16 adjacent to the free end of the latch-arm 24 as indicated in Figs. 1, 2 and 3. The hub member 35 is slotted to form a housing 36 for a centrifugal or weight device, the housing extending transverse to the axis of rotation of the turbine-rotor. The weight device comprises a plunger or slide-piece 37, a weight member or element 38 and a locking member 39. The slide-piece 37 acts as a support or carrier for the weight member 38, these two parts having coacting threads as indicated. The locking member is of annular form and is provided with threads which also coact with the threads of the slide-piece. An expansile coil-spring 40 surrounds the slide-piece 37 and acts to restrain the weight device in retracted position against an end-plug 41 threaded into and forming a part of the housing. This end-plug is of annular form to facilitate adjustment of the weight member 38 and of the locking member 39 on the slide-piece 37. Such an adjustment of the weight and locking members on the slide-piece determines the location of the center of gravity of the weight device as a whole, and the less the distance between this center of gravity and the axis of rotation of the turbine-rotor, the greater the rate of speed which the rotor must attain before the weight device will be displaced a given distance. Therefore, this construction involves the provision of means for setting the mechanism in advance to predetermine the degree of response of the weight device to centrifugal force, and, consequently to predetermine the rate of speed of the gyro-wheel which will bring about a release of the locking-bolt 27. It will be noted in this connection that with the gyroscope and gyroscope spinning mechanism arranged in the torpedo to permit ready access to the mechanism in the usual manner, an important advantage of the centrifugally operated means illustrated in Fig. 3 is the quick and convenient manner in which the center of gravity adjustment may be made without dismounting the weight-device from the hub-member or even removing the end-plug 41. The fixed distance which the weight-device must travel when the gyro-wheel is spun up to the desired speed, is indicated at F in Fig. 3. After the nose of the slide-piece 37 reaches the position shown in Fig. 5, the maximum lapse of time between the assumption of this position and the time when the nose engages the edge of the latch arm 24 to disengage the dog 22 and the notched boss 23, will be the time required for the turbine-rotor 16 to make one complete revolution.

The present invention is not confined to the construction or arrangement of mechanism shown, which may of course be varied within considerable limits, as will be apparent to those skilled in the art and as may be required for any special purpose for which the mechanism is to be adapted. Furthermore, although the steering of an automobile torpedo is the principal practical use now contemplated for such gyroscopic apparatus, and although the apparatus illustratively disclosed is peculiarly adapted to the requirements of such use, yet the apparatus is not limited to employment in such a relation.

No claim is made herein to the specific construction employed in the centrifugal controlling device illustrated in detail in Fig. 3, as that forms the subject-matter of another application filed by me on April 17, 1917, and serially numbered 162,784.

I claim:

1. In a gyroscope and gyroscope spinning mechanism, the combination of a gimbal, a gimbal lock, and means carried by a rotating part of said gyroscope and gyroscope spinning mechanism and operated by centrifugal force for actuating the gimbal lock to free the gimbal; substantially as described.

2. In a gyroscope and gyroscope spinning mechanism, a gimbal ring, a fly-wheel, means for holding the gimbal ring against movement during spinning of the fly-wheel, and centrifugal means for causing the gimbal-holding means to free the gimbal ring when the fly-wheel is spun to a predetermined rate of speed; substantially as described.

3. In a gyroscope and gyroscope spinning mechanism, the combination of a gimbal, a gimbal lock, a rotary member, and a centrifugal device carried by the rotary member operating in synchronism with the gyroscope to release the gimbal lock when the rotary member attains a certain rate of speed; substantially as described.

4. The combination with a gyroscope and gyroscope spinning mechanism having a gimbal ring and gyro-wheel, of means controlled by the speed of the gyroscope and operating to release the gimbal ring when the gyro-wheel attains a predetermined speed; substantially as described.

5. In a gyroscope and gyroscope spinning mechanism, the combination of a fly-wheel, a fly-wheel shaft, rotary means for driving the fly-wheel shaft when rotated, centrifugal operating means carried by one of the parts mentioned, gimbal rings for the fly-wheel shaft, and a gimbal ring lock adapted to be released by the centrifugal operating means when the member carrying the latter attains a predetermined rate of speed; substantially as described.

6. In a gyroscope and gyroscope spinning mechanism, the combination of a gimbal, a gimbal lock, and means carried by a rotat-

ing part of said gyroscope and gyroscope spinning mechanism and operated by centrifugal force to free the gimbal when said rotating part attains a given rate of speed, the centrifugally operated means being adapted to be adjusted when said rotating part is idle to predetermine said given rate of speed; substantially as described.

7. In a gyroscope and gyroscope spinning mechanism, the combination of a gyroscope having a gimbal ring, means for spinning up the gyroscope, means for holding the gimbal ring fixed while spinning up the gyroscope, means for actuating such holding means to release the gimbal ring, and means operating automatically to actuate such releasing means when the gyroscope is spun up to a speed of a certain number of revolutions per minute; substantially as described.

8. In a gyroscope and gyroscope spinning mechanism, the combination of a fly-wheel, a gimbal ring, a device engaging the gimbal ring to hold the same fixed, a shaft geared to the fly-wheel, means for driving the shaft, and centrifugally operated means for disconnecting said shaft from the fly-wheel and for withdrawing said device to release the gimbal ring; substantially as described.

9. In a gyroscope and gyroscope spinning mechanism, the combination of a gimbal, a gyro-wheel, a shaft on which the wheel is mounted, a second shaft, intermeshing gears on the two shafts, a motor for driving the second shaft, a lock for the gimbal, and a member rotated by the second shaft and operated by centrifugal force for effecting disconnection of said intermeshing gears and subsequent operation of said lock to release the gimbal; substantially as described.

10. The combination with a gyroscope and gyroscope spinning mechanism, of means controlled by the speed of the gyroscope and operating to release the gimbal rings when the gyro-wheel attains a predetermined speed, said means including a plurality of parts one of which may be preliminarily manually adjusted to predetermine such speed; substantially as described.

11. In a gyroscope and gyroscope spinning mechanism, the combination of a gimbal, a gimbal lock, a gyro-wheel, a rotary member adapted to drive the gyro-wheel, and a centrifugal device carried by the rotary member and adapted to release the gimbal lock when the rotary member attains a certain rate of speed, the centrifugal device including an adjustable weight element adapted to be adjusted when the rotary member is idle to vary the distance separating the center of gravity of said device and the axis of rotation of said member; substantially as described.

In testimony whereof I affix my signature.

LYNDON B. TAYLOR.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents. Washington, D. C."