

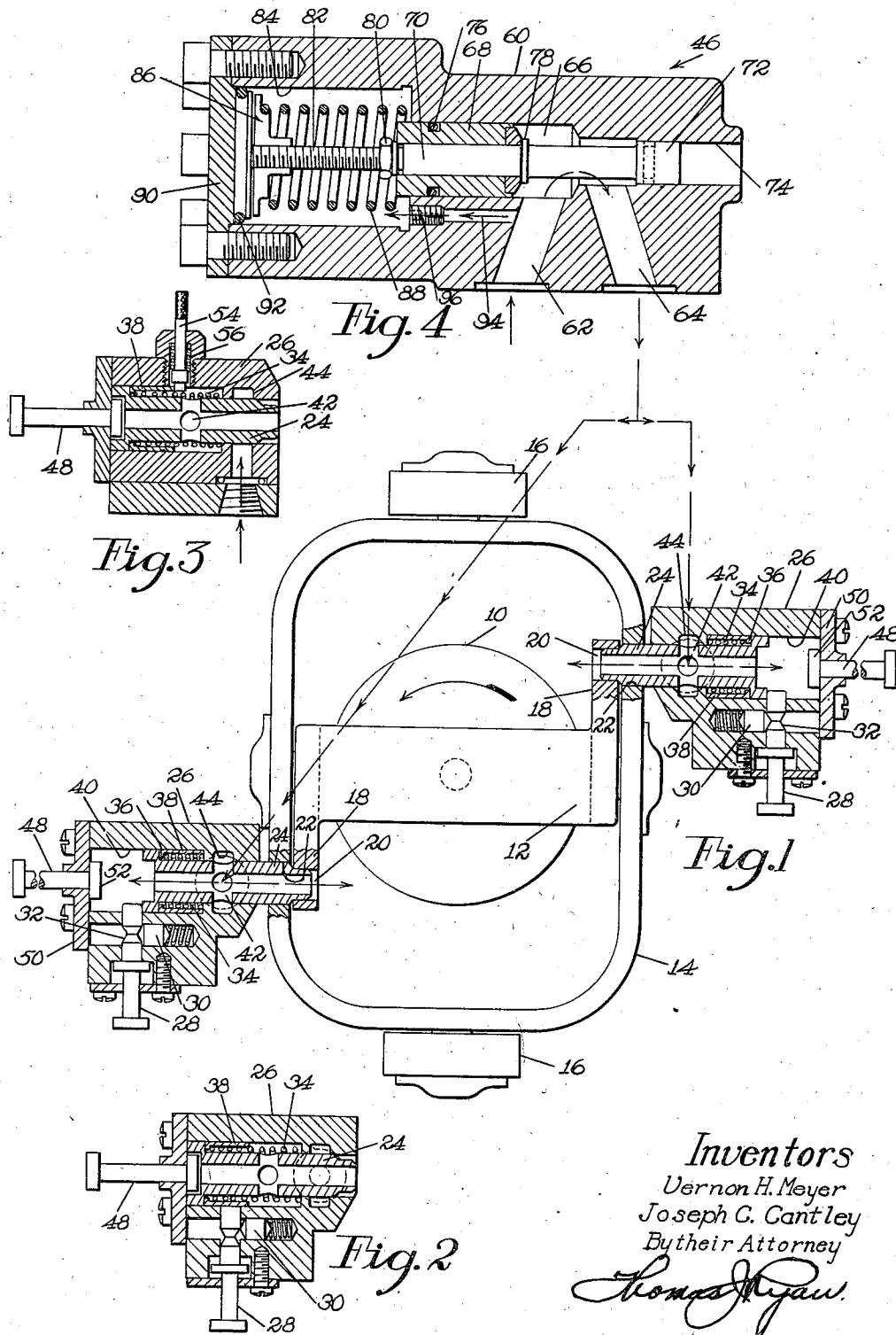
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GYROSCOPE

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GYROSCOPE

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This invention relates to locking mechanisms and more particularly to mechanisms for locking the gimbals of a gyroscope until the rotor is brought up to speed, the locking means being automatically retracted in response to the interruption of the motive force used to initiate spinning of the rotor.

In gyroscopically controlled bodies, such as torpedoes, the gimbals of the gyroscope are customarily locked relatively to the body of the torpedo until the torpedo is launched. During the launching, motive power, such as air under high compression, is provided for imparting rapid spinning movement to the rotor. After a predetermined time, the rotor is brought up to the desired speed and the high pressure air is automatically cut off.

It is an object of the present invention to provide improved mechanism for locking the gimbals of the gyroscope until the rotor has been brought up to speed and for thereafter releasing the locking means so that the gyroscope can perform its normal control functions. In the accomplishment of the above, the gimbals of the gyroscope are locked by nozzles through which the high pressure air passes to the rotor to impart spinning movement thereto. The nozzles pass through aligned apertures in the inner and outer gimbals and are urged into retracted positions by springs. Pins, subjected to the pressure of air passing through the nozzles, maintain the nozzles in their locked positions before the torpedo is launched. Upon the application of air pressure through the nozzles to the rotor to spin it, the locking pins are retracted by the air pressure but the nozzles remain in their locked positions by the pressure of air acting thereon. The air is automatically cut off after a predetermined time and the drop in pressure behind the nozzles permits retraction of the nozzles under the influence of the springs aforementioned whereupon the gimbals of the gyroscope are free to move about their individual axes.

The above and other features of the invention, including various novel combinations of parts and details of construction will now be described by reference to the accompanying drawing and pointed out in the claims.

In the drawing,

Fig. 1 is a view partly in elevation and partly in section of a gyroscope in which the present invention is embodied, the locking mechanisms being shown with the nozzles in locking positions;

Fig. 2 is a vertical section through one of the

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locking mechanisms showing the nozzle in its retracted position;

Fig. 3 is a horizontal section through the locking mechanism of Fig. 2 with the nozzle locked in retracted position, and

Fig. 4 is a section through a valve by which the pressure of air to the starting nozzles is automatically shut off after a predetermined length of time.

In Fig. 1 is illustrated a gyroscope comprising a rotor 10 mounted in an inner gimbal 12 which is in turn rotatable in an outer gimbal 14 rotatable in bearings 16 which may be supported within the body of the torpedo. The inner gimbal 12 is provided with laterally extending arms 18 having apertures 20 which are in axial alinement with apertures 22 in the outer gimbal when the parts are in the positions illustrated. These apertures are in turn in axial alinement with nozzles 24 slidably mounted in housings 26 for movement into locking engagement with the inner and outer gimbals, as illustrated in Fig. 1.

Before launching the torpedo, the nozzles are held in locking engagement with the inner and outer gimbals by pins 28 which are held in the positions illustrated in Fig. 1 by spring-pressed detents 30 cooperating with annular grooves 32 in the pins. Springs 34 surround the nozzles 24 and act on flanges 36 of sleeves 38 slidably in bores 40 of the housings 26, these sleeves in turn engaging flanges on the inner ends of the nozzles.

With the nozzles in locking engagement with the gimbals in the gyroscope the passage therethrough communicates by way of ports 42 with annular grooves 44 in the housings 26, these grooves in turn communicating with a supply of air under pressure through a valve 46, the construction of which will be explained hereinafter.

For moving the nozzles 24 against the forces of the springs 34 into locking engagement with the gyroscope, pins 48 slidably in caps 50, secured to the outer portions of the housings 26, are provided with heads 52 engageable with inner ends of the nozzles 24. By moving the pins 48 inwardly the nozzles are moved against the forces of the springs 34 through the apertures of the inner and outer gimbals which have previously been alined therewith after which the pins 28 are pushed inwardly into engagement with the rearward surfaces of the nozzles, thereby locking them in the positions shown in Fig. 1.

At the time of launching the torpedo, air under very high pressure is introduced by way of the valve 46 to the nozzles 24 impinging on vanes provided in the periphery of the rotor thereby to spin

the rotor at high speed. The air under pressure also passes rearwardly of the nozzles into the bores 40 of the casing 26 acting on the inner ends of the pins 28 and forcing them outwardly of the casings 26 out of locking engagement with the nozzles as shown in Fig. 2. However, the nozzles do not move rearwardly under the forces of the springs 34 at this time because of the action of the high pressure air on the rearward ends of the nozzles. Consequently as long as the air under pressure flows through the nozzles they remain in locking engagement with the gimbals in the gyroscope. As soon as the air is cut off, however, the pressure, acting on the rearward surfaces of the nozzles, drops and the springs 34 move the nozzles into retracted positions out of engagement with the gimbals of the gyroscope, as indicated in Fig. 2.

In the event that the torpedo is dropped from an airplane the impact of the torpedo with the water might be such as to cause movement of the nozzles from their now retracted positions against the forces of the springs 34. In order to insure against this possibility, additional locking means are provided for holding the nozzles in their retracted positions once they have been so moved. This locking means is illustrated in Fig. 3 and comprises a pin 54 mounted in the side of each casing 26 and urged inwardly by a spring 56 into engagement with the forward surface of the sleeve 38 after the nozzle has been retracted by the springs 34. Consequently when such a locking pin is provided this pin must be withdrawn from engagement with the sleeve 38 before the nozzle can be moved into locking engagement with the gimbals of the gyroscope.

For shutting off automatically the flow of air to the starting nozzles after a predetermined time, the valve 45 is provided. This valve includes a valve casing 60 having inlet and outlet ports 62, 64 respectively, which communicate with a bore 66 extending lengthwise in the valve casing. The outlet port 64 communicates with the annular grooves 44 in the casings 26 as indicated by the arrows. Slidable in a portion of the bore 66 is a cylindrical valve element 68 mounted on a rod 70 having at its outer end an enlarged portion 72 slidable in a reduced portion 74 of the bore 66. The valve element 68 is provided with a suitable packing ring 76 for preventing leakage of air thereby, the valve element being held against a flange 78 of the rod 70 by a nut 80 on a threaded portion 82 of the rod. The threaded portion of the rod is received in a chamber 84 of the valve casing and carries at its outer end a retainer 86 for one end of a compression spring 88 the other end of which engages a shoulder in the valve casing, thereby to urge the valve element into the position shown in Fig. 4. The left end of the valve casing is closed by a cover 90 there being a suitable sealing element 92 to prevent leakage of air from the chamber 84.

The inlet port 62 communicates with the chamber 84 by way of a passageway 94 in which is threaded a plug 96 having a small restricted passageway therethrough. When the air is admitted into the port 62 it passes therefrom through the port 64 to the nozzles and also through the passageway 94 through the restriction in the plug 96 into the chamber 84. After a short time, depending on the pressure of the air and the size of the restriction through the plug 96, the pressure of the air in the chamber 84 builds up sufficiently so that, acting on the left end of the valve element 68, it moves this element against the force of the

spring 88 to the right to shut off the air flow from the port 62 into the bore 66. The chamber 84, however, is still in communication with the inlet port 62 so that the pressure of the air therein remains high enough to maintain the valve element 68 in its closed position.

The time required for the valve element 68 to be shifted is sufficient to cause the rotor of the gyroscope to be brought up to speed by the air flowing through the nozzles 24. As soon, however, as the flow of air is cut off the nozzles 24 are moved into their retracted positions by the springs 34, the pins 28 having previously been retracted by the pressure of air against them and the gimbals of the gyroscope are now free to move in their bearings. The nozzles are held in their retracted positions against any possible movement toward the gimbals by the locking pins 54.

From the above it will be seen that the starting nozzles are also utilized to lock the gimbals of the gyroscope in their initial positions, the nozzles being held in locking positions by easily manipulated locking pins which move outwardly in response to the pressure of air against them during the starting of the rotor in its spinning movement, but the nozzles stay in their locking positions by the pressure of air against them until the pressure is cut off by the valve 46 whereupon they are retracted and the gyroscope is free to control the torpedo. While the invention has been described particularly by reference to a gyroscope for use in a torpedo, it will be understood that the invention is not thus limited in its application.

Having thus described the invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. In combination with a gyroscope having a rotor provided on its periphery with vanes adapted to receive a blast of air to spin the rotor, locking means for the gimbals of the gyroscope to maintain them in predetermined positions during acceleration of the rotor, said locking means including a nozzle through which air under pressure is directed to said rotor, spring means acting to move said nozzle out of locking position, and positive means for holding said nozzle in locking position against the action of said spring means, said positive means being arranged to be operated by pressure of air against it to release said nozzle for movement by said spring means out of locking position to release said gimbals.

2. Mechanism for locking the gimbals of a gyroscope in predetermined positions while at rest, comprising a nozzle through which air under high pressure is passed to impart rotation to the rotor, a housing supporting said nozzle for sliding movement, a spring urging said nozzle away from the gimbals of the gyroscope, a locking pin engageable with the rear end of the nozzle for holding the nozzle in locking engagement with the gimbals of the gyroscope, said nozzle having a passageway for air to the interior of the housing rearwardly of the nozzle whereby the locking pin is operated to release the nozzle which is held in locking position against the resistance of said spring by the pressure of air against it until the air supply is subsequently interrupted.

3. Mechanism for locking the gimbals of a gyroscope in predetermined positions while at rest, comprising a nozzle through which air under high pressure is passed to impart rotation to the rotor, a housing supporting said nozzle for sliding movement, a spring urging said nozzle

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away from the gimbals of the gyroscope, a locking pin engageable with the rear end of the nozzle for holding the nozzle in locking engagement with the gimbals of the gyroscope, said nozzle having a passageway for air to the interior of the housing rearwardly of the nozzle whereby the locking pin is operated to release the nozzle which is held in locking position against the resistance of said spring by the pressure of air against it until the air supply is subsequently interrupted, and means operative in response to retraction of the nozzle for locking it in its retracted position.

4. Mechanism for locking the gimbals of a gyroscope in predetermined positions while the rotor of the gyroscope is at rest comprising a nozzle through which air under high pressure is directed to the periphery of the rotor, a housing supporting said nozzle for sliding movement toward and away from the gimbals, said gimbals having alined openings in which the nozzle is positioned when in locking engagement therewith, a spring acting on said nozzle tending to move it out of locking engagement with the gimbals, a pin movable through a wall of the housing into engagement with the rear end of the nozzle to hold the nozzle in locking engagement with the gimbals, said nozzle having a passageway for air rearwardly thereof to act on the pin and move it out of engagement with the nozzle in response to the introduction of air under high pressure thereto, a spring-pressed detent for maintaining said pin in locking engagement with the nozzle while the rotor is at rest, the rearward end of the nozzle presenting a surface subject to the action of the air under high pressure for maintaining the nozzle in locking position after said pin has been moved out of locking engagement with the nozzle until the interruption of the flow of high pressure air through the nozzle.

5. Mechanism for locking the gimbals of a

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gyroscope in predetermined positions while the rotor of the gyroscope is at rest comprising a nozzle through which air under high pressure is directed to the periphery of the rotor, a housing supporting said nozzle for sliding movement toward and away from the gimbals, said gimbals having alined openings in which the nozzle is positioned when in locking engagement therewith, a spring acting on said nozzle tending to move it out of locking engagement with the gimbals, a pin movable through a wall of the housing into engagement with the rear end of the nozzle to hold the nozzle in locking engagement with the gimbals, said nozzle having a passageway for air rearwardly thereof to act on the pin and move it out of engagement with the nozzle in response to the introduction of air under high pressure thereto, a spring-pressed detent for maintaining said pin in locking engagement with the nozzle while the rotor is at rest, the rearward end of the nozzle presenting a surface subject to the action of the air under high pressure for maintaining the nozzle in locking position after said pin has been moved out of locking engagement with the nozzle until the interruption of the flow of high pressure air through the nozzle, and means for moving said nozzle into locking engagement with the gimbals of the gyroscope against the action of said spring.

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