Dec. 12, 1944. P. A. NOXON 2,364,810

SPEED GOVERNING MEANS

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FIG. 1.

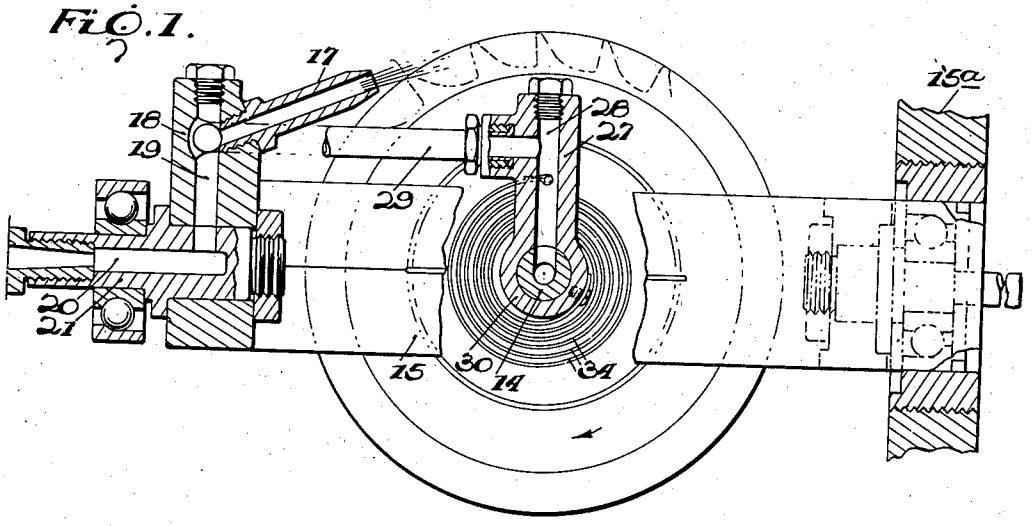
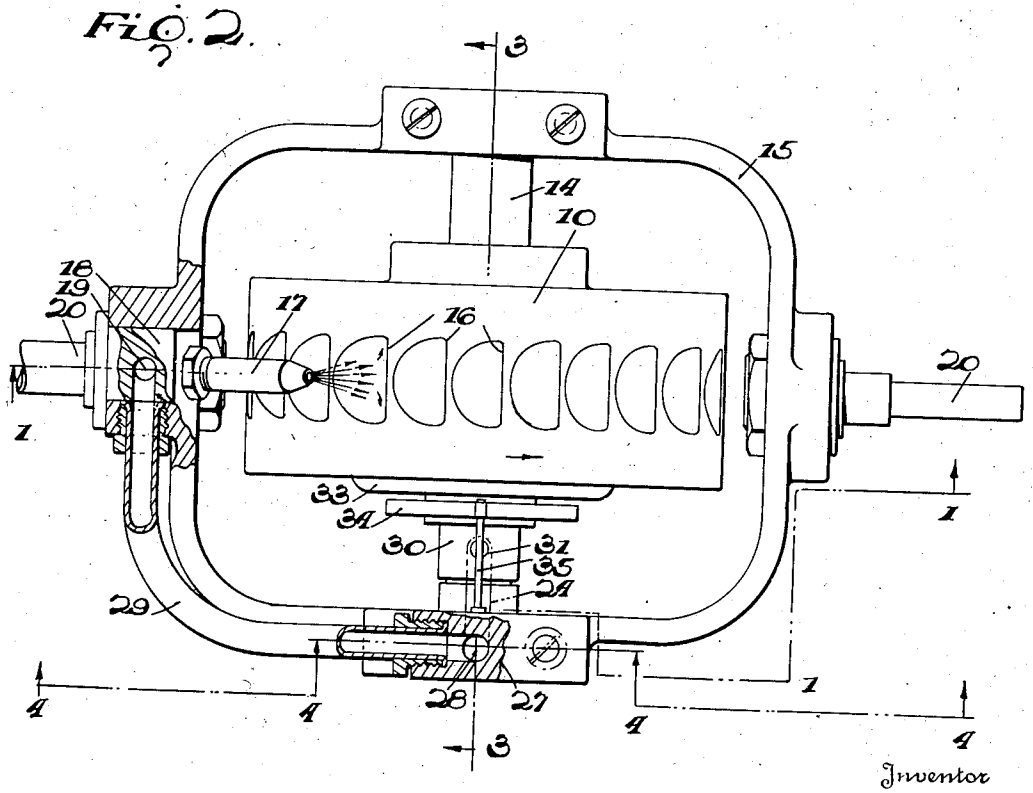


FIG. 2.



Inventor

Paul A. Noxon.

By C. J. Kalman.

Attorney

Dec. 12, 1944. P. A. NOXON 2,364,810

SPEED GOVERNING MEANS

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FIG. 3.

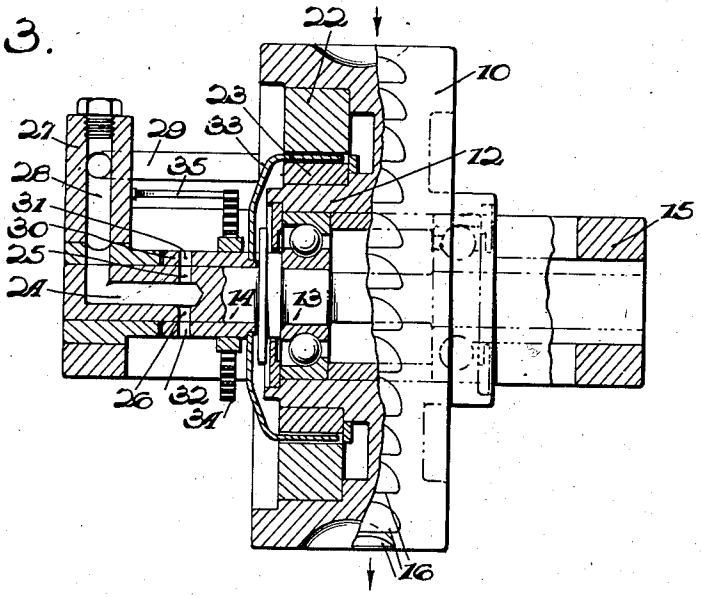
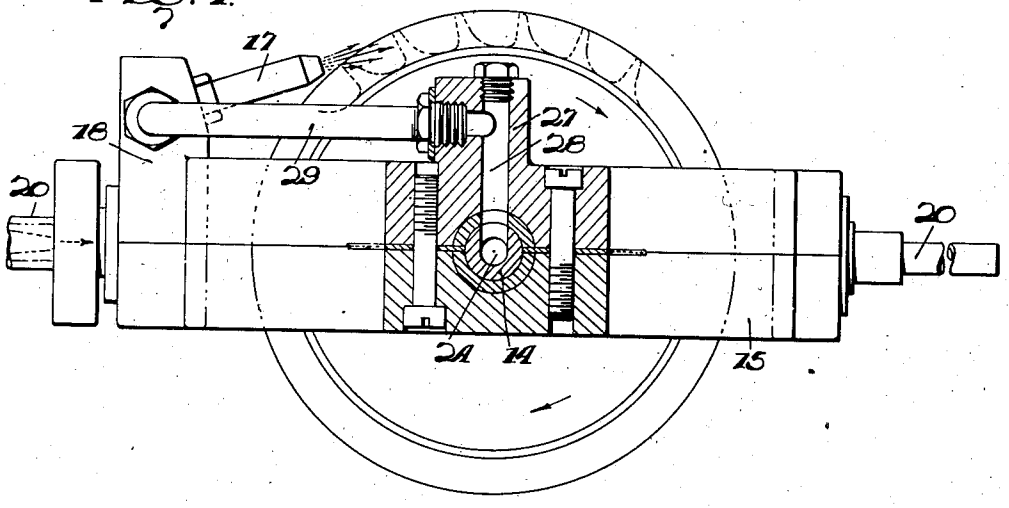


FIG. 4.



Inventor

Paul A. Noxon.

By C. J. Kalman.

Attorney

Dec. 12, 1944. P. A. NOXON 2,364,810

SPEED GOVERNING MEANS

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FIG. 5.

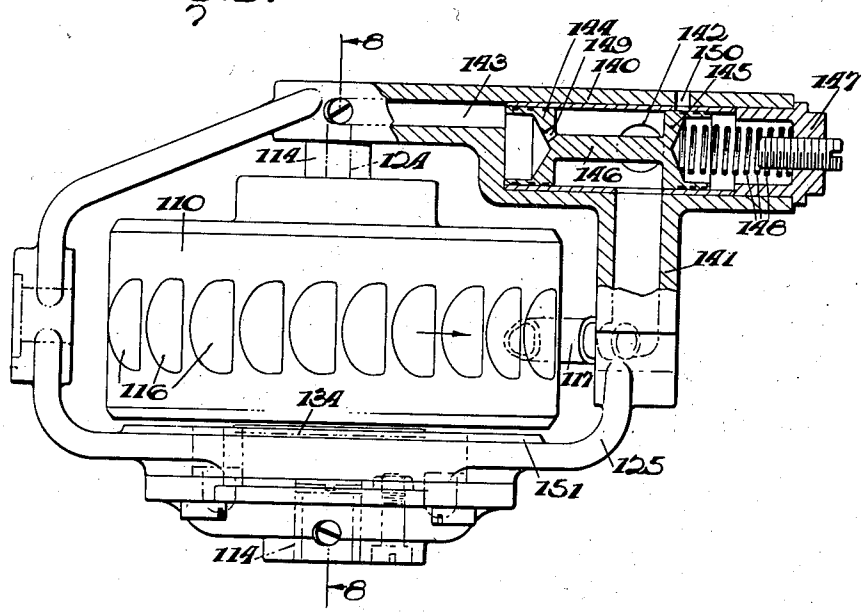
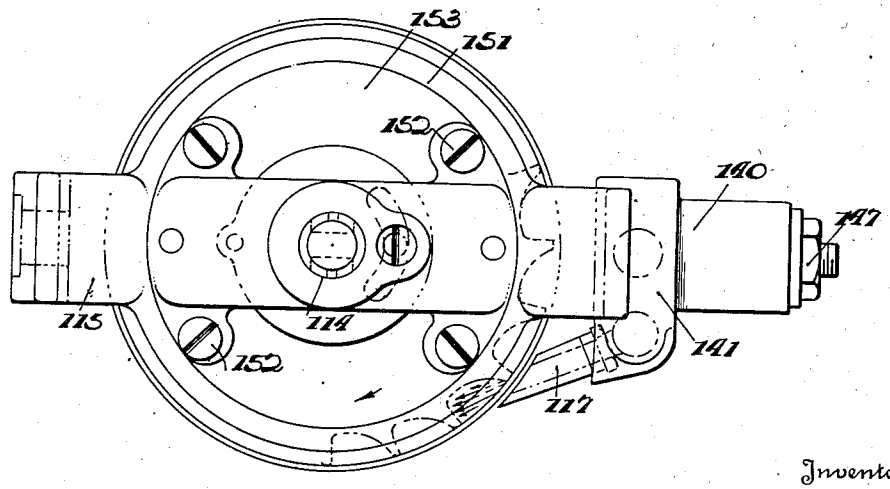


FIG. 6.



Inventor

Paul A. Noxon.

By C. J. Kalman.

Attorney

Dec. 12, 1944. P. A. NOXON 2,364,810

SPEED GOVERNING MEANS

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Fig. 7.

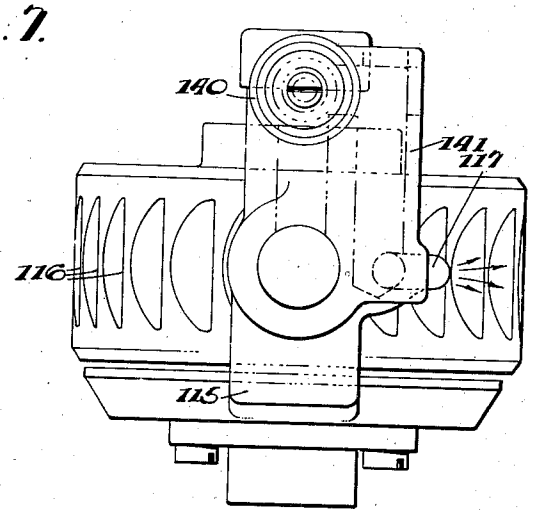
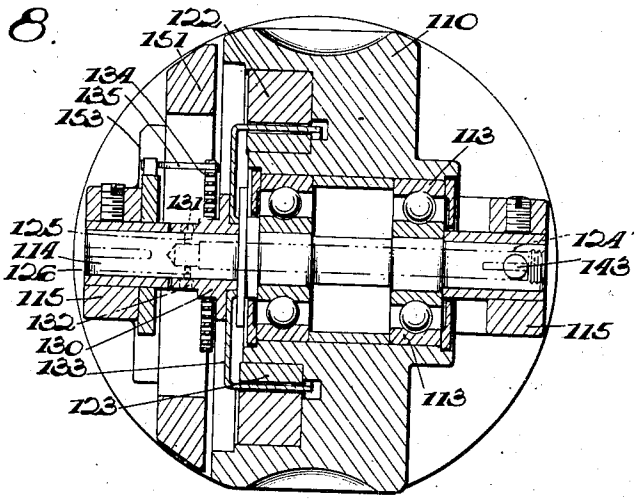


Fig. 8.



Inventor

Paul A. Noxon.

By C. J. Kalman.

Attorney

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2,364,810

UNITED STATES PATENT OFFICE

2,364,810

SPEED GOVERNING MEANS

Paul A. Noxon, Tenafly, N. J., assignor to Bendix Aviation Corporation, Bendix, N. J., a corporation of Delaware

Application October 29, 1941, Serial No. 417,047

19 Claims. (Cl. 253—52)

The present invention relates generally to speed governing means and more particularly to means for governing the speed of rotation of air driven devices.

An object of the present invention is to provide novel means for maintaining substantially constant the speed of rotation of air driven devices, such as, for example, gyroscopic rotors.

Another object of the invention is to provide a novel air driven rotor which will rotate at a substantially constant speed.

A further object of the invention is to provide novel speed governing means for maintaining substantially constant the speed of rotation of air driven gyroscopic rotors notwithstanding changes in operating conditions which ordinarily occur, such as, for example, changes in absolute pressure, variations in relative pressure in the supply line, changes in bearing friction, etc.

Another object of the invention is to provide novel speed control means for gyroscopic rotors whereby during a sudden change in the pressure of the driving fluid issuing from the nozzle, normally directing fluid pressure to impinge upon the rotor, a proportional amount of the fluid pressure is by-passed prior to reaching the nozzle so that the rotor speed is maintained substantially constant notwithstanding the pressure change in the supply line.

A further object of the invention is to provide novel speed control means for maintaining substantially constant the speed of rotation of a fluid pressure driven gyroscopic rotor comprising a pneumatic relay having means associated with the fluid pressure directing nozzle for automatically maintaining substantially constant the pressure of the fluid issuing from the nozzle notwithstanding variation in the pressure in the supply line.

Another and still further object is to provide a novel and sensitive pneumatic relay or pressure equalizer which will automatically maintain substantially constant the pressure of fluid issuing at its output notwithstanding variation in pressure of the fluid at its input.

The above and further objects and novel features of the invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for purposes of illustration only and are not intended as a definition of the limits of the invention, reference for the latter purpose being had to the appended claims.

In the drawings, wherein like reference characters refer to like parts, throughout the several views,

Figure 1 is a side elevation, partially in section which is taken substantially along line 1—1 of Figure 2, of a fluid pressure driven gyroscopic rotor embodying the invention;

Figure 2 is a top plan view of the rotor of Figure 1;

Figure 3 is a sectional view taken substantially along line 3—3 of Figure 2;

Figure 4 is a side elevation view, similar to Figure 1, partially in section which is taken along line 4—4 of Figure 2;

Figure 5 is a top elevation view, partially in section, of a fluid pressure driven gyroscopic rotor illustrating a second embodiment of the invention;

Figure 6 is a side elevation view of the gyroscopic rotor of Figure 5;

Figure 7 is an end view of the gyroscopic rotor of Figure 5; and,

Figure 8 is a sectional view taken substantially along line 8—8 of Figure 5.

Referring now to the drawings and more particularly to Figure 3 thereof, there is shown a gyroscopic rotor 10 having a hollow hub portion 12 provided with ball bearing races 13 for mounting the rotor for rotation or spinning about a stationary shaft 14 carried by a gimbal frame or ring 15. The rotor is also provided with buckets or vanes 16 at its outer periphery whereby fluid under pressure is directed against the vanes in a conventional manner by way of a nozzle 17 to cause spinning of the rotor about shaft 14.

Nozzle 17 is mounted in any suitable manner upon a standard 18, carried by gimbal ring 15 having a passage 19 formed therein, as shown in Fig. 1, which communicates with and supplies the nozzle 17 with fluid under pressure from a suitable source, not shown, in a manner to presently appear.

Gimbal ring 15 is provided with trunnions 20, Fig. 1, which mount the ring 15 on a stationary support if the gyro is to be used as a rate of turn gyroscope or within a second gimbal 15a which is adapted for angular movement about an axis perpendicular to trunnions 20. Since the present invention can be used in any gyroscopic instrument, no specific application has been shown since all of them are well known in the art.

One of the trunnions 20 is provided with a longitudinal passage 21 which communicates fluid under pressure from any suitable source, (not shown) to passage 19 of standard 18 and from

there to nozzle 17. This is the known manner of driving a gyroscopic rotor, however, the difficulty with such structures has been that the rotor speed varies with line pressure variation thus disturbing the accuracy of the gyroscope.

The novel means of the present invention for overcoming the foregoing difficulty and maintaining the rotor speed substantially constant comprises, as better shown in Figure 3, an annular permanent magnetic member 22 which is embedded or otherwise suitably mounted within the rotor to form a part thereof and an annular flux return ring 23 which is keyed or otherwise secured about the hub portion of the rotor, an air gap being provided between the magnet and the return ring.

Shaft 14, as shown in Fig. 3, is provided with a longitudinal passage 24 which communicates with two transverse bores 25, 26 likewise formed in the shaft. Bores 25 and 26 define an air bleed for passage 24, as will likewise presently appear.

A second standard 27, shown in Fig. 4, is carried by gimbal ring 15 at a point substantially 90° away from the first standard 18 and has a longitudinal passage 28 therein which, at one end, communicates by way of a conduit 29, shown in Fig. 2, with passage 19 of standard 18 at a point adjacent the input of nozzle 17, better shown in Fig. 1, and at its other end communicates with channel 24 of shaft 14.

A valve or sleeve member 30 is rotatably mounted about shaft 14 and is provided with transverse ports 31, 32 which, under certain predetermined conditions register with transverse bores 25, 26 of shaft 14 to bleed fluid pressure to the atmosphere from passage 24.

An eddy current drag cup 33 having an outer rim disposed within the air gap between annular magnet 22 and the return ring 23 is attached to one end of sleeve 30. Upon rotation of rotor 10 a torque is exerted upon the drag cup 33 by virtue of eddy currents set up in the rim of the drag cup, such torque being proportional to the rotor speed. The drag cup is caused to move angularly because of the eddy currents induced in its rim and this movement is opposed by a hair spring 34 anchored at one end to sleeve 30 and at its other end to a pin 35 fastened to standard 27. Spring 34 is designed so that its restoring torque is proportional to its deflection and thus the drag cup 33 during rotor rotation will assume an angular position away from its rest position which will be a measure of the gyro speed.

In operation, during the starting period, sleeve ports 31, 32 will be out of registry with bores 25, 26 of shaft 14 so that full line pressure is available at nozzle 17 for impingement upon rotor vanes 16 to drive the rotor. As the rotor comes up to speed, a corresponding angular displacement of sleeve 30 about shaft 14 is effected by reason of the angular displacement of the drag cup 33 until ports 31, 32 are brought into partial registry with bores 25, 26 whereby some of the fluid pressure is bled from passage 24 of shaft 14 so that an equilibrium is established between rotor speed, nozzle pressure and sleeve displacement.

In the event of a surge in the line pressures, the fluid pressure issuing from nozzle 17 is increased causing an increase in the rotor speed. Such increase in rotor speed causes a further displacement of sleeve 30 by way of drag cup 33 against the action of spring 34 so that the ports 31, 32 and bores 25, 26 will be in full registry, bleeding fluid pressure from passage 24 thereby reducing nozzle pressure. Reduction in nozzle pressure results in reduced rotor speed and spring 34 drags sleeve 30 and drag cup 33 back to the equilibrium position. If less than normal pressure is available at the nozzle, rotor speed decreases causing a complete closure of bores 25, 26 by sleeve 30 thereby building up full pressure at the nozzle.

The greater the characteristic of nozzle pressure can be made relative to sleeve displacement the less change will be required to compensate for a given change in operating condition.

In order to provide a more sensitive speed control of the nature hereinabove described a second embodiment of the present invention proposes the use of a novel pneumatic relay as shown in Figures 5 to 8, inclusive.

Referring now more particularly to Figures 5 to 8, inclusive, wherein parts corresponding to similar parts in Figures 1 to 4, inclusive, are designated by the same reference characters plus 100, a rotor 110 is mounted by way of suitable ball bearing races 113 for rotation about a stationary shaft 114 carried by a gimbal frame or ring 115. Rotor 110 is further provided with vanes 116 about its outer periphery whereby fluid pressure issuing from nozzle 117 impinges thereon to spin the rotor about shaft 114.

Gimbal ring 115 is provided with an enlarged cylindrical member 140 and a transverse hollow box 141 communicating with member 140 at one end and with nozzle 117 at its other end, the nozzle being suitably secured to and carried by box 141 as shown in Figure 6.

Fluid under pressure is introduced into cylindrical member 140 by way of a port 142, Figure 5, formed therein and communicates with nozzle 117 by way of hollow box 141.

Mounted within rotor 110 is an annular permanent magnet 122 and an annular flux return ring 123, the magnet and return ring being spaced apart from each other so as to define an air gap therebetween. A drag cup 133, having its rim disposed within the air gap between magnet 122 and return ring 123, is secured to a sleeve 130 mounted for rotation about shaft 114 against the action of a hair spring 134 which is anchored at one end to the sleeve and at its other end to gimbal 115 by way of a pin 135.

Sleeve 130 is provided with orifices or ports 131, 132 which normally register with transverse bores 125, 126 drilled in shaft 114 to communicate with a longitudinal channel 124 also formed within shaft 114, better shown in Fig. 8. Channel 124 communicates at its extreme end with a passage 143, shown in Fig. 5, formed in a portion of gimbal 115 which, in turn, communicates with one end of the cylindrical member 140, for a purpose to presently appear.

Mounted for reciprocal movement within the cylindrical member 140 are two pistons 144 and 145 carried by a common rod 146 which comprise a throttling means for the nozzle 117. The open end of member 140 is provided with an adjustable abutment 147, the inner end of which is engaged by one end of a spring 148, the other end of spring 148 being in engagement with piston 145 so as to normally maintain the latter together with piston 144, which is provided with a vent 149, in the extreme left position as shown in Figure 5. In this position a bleed orifice 150, formed in member 140, is closed by way of piston 145 so that substantially all of the fluid pressure entering member 140 through port 142 is available at nozzle 117 while some of the fluid pressure passes into

channel 124 of shaft 114 by way of vent 149 of piston 144 and passage 143.

In order to balance the system because of the added weight of members 140 and 141, a balancing disc 151, Figure 8, may be provided which surrounds shaft 114 and is fastened by way of suitable means such as screws or bolts 152 and a plate 153 to gimbal frame 115 as better shown in Figure 6.

In operation, during the starting period, the drag cup 133 and sleeve 130 are so positioned that ports 131, 132 of the sleeve are in registry with bores 125, 126 whereby fluid pressure from member 140 passing through vent 149 of piston 144, passage 143 and channel 124 is bled to the atmosphere, preventing a build up in pressure on the left side of piston 144. The only force on piston 144 at this time is the pressure exerted by spring 148 holding it in its left hand position thereby keeping bleed orifice 150 closed by virtue of piston 145 thus allowing fluid pressure to discharge through nozzle 117.

As rotor 110 comes up to its normal speed, eddy currents are induced in drag cup 133, in the manner hereinbefore described, causing an angular displacement of the drag cup together with sleeve 130 so that communication is partially closed between ports 131, 132 and bores 125, 126. This partial closure of the bleed from channel 124 causes pressure to be built up on the left hand side of piston 144 whereby the piston is moved to the right against the action of spring 148 thereby partially opening bleed orifice 150 because of the simultaneous movement of piston 145 with piston 144. The rotor 110, therefore, cannot run faster than the speed at which equilibrium has been established.

The pneumatic relay is more sensitive as a control for maintaining the rotor speed substantially constant. It also acts in the nature of a pressure equalizer for the reason that with a given opening between ports 131, 132 and bores 125, 126, a sudden increase or surge in line pressure will increase rotor speed whereby the drag cup 133 and sleeve 130 are further displaced to close registry between ports 131, 132 and bores 125, 126. Such closure increases pressure on piston 144 to move it further to the right together with piston 145 against spring 148 to completely open bleed orifice 150 and thus compensate for the increased rotor speed by by-passing fluid pressure from member 140 to the atmosphere through orifice 150. As soon as rotor speed decreases, spring 134 acts to return sleeve 130 and drag cup 133 to a position where ports 131, 132 are brought into registry with bores 125, 126 to relieve pressure on the left side of piston 144 whereupon spring 148 acts to move piston 144 to the left together with piston 145 to close bleed orifice 150.

There are thus provided novel means for maintaining substantially constant the speed of rotation of a gyroscopic rotor so that during line surges the pressure at the nozzle is by-passed to compensate for any increase in speed due to such a pressure surge.

Although only two embodiments of the invention have been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes and modifications may be made in the design and arrangement of parts without departing from the spirit and scope of the invention, as will now be understood by those skilled in the art. For example, provision may be made for compensating for temperature variation in the drag cup torque in the nature of a spiral bi-metallic strip which will move the free end of hair spring 34 or 134, in accordance with temperature changes. For a definition of the limits of the invention, reference will be had primarily to the appended claims.

I claim:

1. In combination with a fluid pressure driven rotor, a nozzle for directing said fluid pressure to spin said rotor, means comprising a by-pass valve communicating with said nozzle for varying the fluid pressure supplied to said nozzle, magnetic field producing means carried by and rotatable with said rotor, and means comprising a resiliently constrained member operatively connected to said valve and inductively associated with and mounted for angular movement by said magnetic field producing means an amount proportional to the speed of said rotor and responding to a predetermined speed of rotation of said rotor for operating said valve.

2. In combination with a fluid pressure driven rotor, a nozzle for directing said fluid pressure to spin said rotor, a valve comprising two relatively movable members, one of said members communicating with the fluid pressure supplied to said nozzle and the other of said members adapted to by-pass fluid pressure communicated to said first member, magnetic field producing means carried by and rotatable with said rotor, and means connected with the other of said members inductively associated with and mounted for angular movement by said magnetic field producing means an amount proportional to the speed of said rotor and responding to a predetermined speed of rotation of said rotor for producing relative movement between said members whereby the fluid pressure supplied to said nozzle is varied.

3. In combination with a fluid pressure driven rotor, a nozzle for directing said fluid pressure to spin said rotor, a valve comprising two relatively movable members, one of said members communicating with the fluid pressure supplied to said nozzle and the other of said members being adapted to by-pass fluid pressure supplied to said first member and being resiliently constrained against movement, magnetic field producing means carried by and rotatable with said rotor, and means including a disc connected with said other member and inductively associated with and mounted for angular movement by said magnetic field producing means an amount proportional to the speed of said rotor and responding to a predetermined speed of rotation of said rotor for moving said other member against said resilient constraint whereby the fluid pressure supplied to said nozzle is varied.

4. In combination with a fluid pressure driven rotor, a shaft mounting said rotor for rotation thereon, a nozzle for directing said fluid pressure to spin said rotor about said shaft, said shaft being provided with means therein communicating with the fluid pressure supplied to said nozzle and having venting means at the outer periphery thereof, a sleeve member surrounding said shaft for angular movement thereon having passages therethrough adapted for communication with said venting means, means resiliently constraining said sleeve member against angular movement about said shaft, means carried by said sleeve member being angularly movable with said rotor an amount proportional to the speed of said rotor, and means carried by said rotor for actuating said last-named means for angularly moving said sleeve member against said constraining means thereby providing relative move-

ment between said venting means and said passages whereby the fluid pressure supplied to said nozzle is varied.

5. In combination with a fluid pressure driven rotor, a shaft mounting said rotor for rotation thereon, a nozzle for directing said fluid pressure to spin said rotor about said shaft, said shaft being provided with means therein communicating with the fluid pressure supplied to said nozzle and having venting means at the outer periphery thereof, a sleeve member surrounding said shaft for angular movement thereon having passages therethrough adapted for communication with said venting means, means resiliently constraining said sleeve member against angular movement about said shaft, magnet means carried by said rotor, and means carried by said sleeve member inductively associated with said magnet means thereby being angularly movable with said rotor an amount proportional to the speed of said rotor and responding to a predetermined speed of rotation of said rotor for angularly moving said sleeve member against said constraining means to bring said passages in registry with said venting means to partially relieve the fluid pressure supplied to said nozzle.

6. In combination with a fluid pressure driven rotor, a shaft mounting said rotor for rotation thereon, a nozzle for directing said fluid pressure to spin said rotor about said shaft, said shaft being provided with means therein communicating with the fluid pressure supplied to said nozzle and having venting means at the outer periphery thereof, a sleeve member surrounding said shaft for angular movement thereon having passages therethrough adapted for communication with said venting means, means resiliently constraining said sleeve member against angular movement about said shaft, throttling means for by-passing a portion of the fluid pressure supplied to said nozzle, actuating means for said sleeve member being angularly movable with said rotor an amount proportional to the speed of said rotor, and means carried by said rotor for operating said actuating means, said actuating means responding to a predetermined speed of rotation of said rotor for angularly moving said sleeve member against said constraining means to displace said passages relative to said venting means whereby said throttling means are actuated to by-pass a portion of the fluid pressure supplied to said nozzle.

7. Speed control means for a fluid pressure driven rotor adapted for rotation in a fixed plane comprising means directing said fluid pressure to spin said rotor, valve means communicating with said directing means, means connected with said valve means and mounted for angular movement with said rotor an amount proportional to the speed of rotation of said rotor and responding to a predetermined speed of rotation of said rotor for actuating said valve means to by-pass fluid pressure therethrough to vary the fluid pressure supplied to said directing means, and means carried by said rotor for operating said last-named means.

8. Speed control means for a fluid pressure driven rotor comprising means directing said fluid pressure to spin said rotor, valve means communicating with said directing means, throttling means for by-passing fluid pressure supplied to said directing means, resiliently constrained means mounted for angular movement with said rotor an amount proportional to the speed of rotation of said rotor and responding to a predetermined speed of rotation of said rotor for actuating said valve means to operate said throttling means thus varying the fluid pressure supplied to said directing means, and means supported by said rotor for actuating said resiliently constrained means.

9. Speed control means for a fluid pressure driven rotor comprising means directing said fluid pressure to spin said rotor, a pneumatic relay comprising a cylinder having an inlet and an outlet for said fluid pressure and a normally closed bleed means, said directing means communicating with said outlet, a piston mounted for reciprocal movement within said cylinder and closing said bleed means, valve means in restricted communication with said cylinder normally by-passing a portion of said fluid pressure from said cylinder, resiliently constrained means mounted for angular movement with said rotor an amount proportional to the speed of rotation of said rotor and responding to a predetermined speed of rotation of said rotor for acuating said valve means whereby fluid pressure builds up to move said piston to open said bleed means thereby by-passing fluid pressure from said cylinder thus modifying fluid pressure flow to said directing means, and means rotatable with said rotor for actuating said resiliently constrained means.

10. Speed control means for a fluid pressure driven rotor comprising means directing said fluid pressure to spin said rotor, a pneumatic relay comprising a cylinder having an inlet and an outlet for said fluid pressure, said directing means communicating with said outlet, a piston mounted for reciprocal movement within said cylinder, valve means communicating with said cylinder normally by-passing a portion of said fluid pressure from said cylinder, magnetic means rotatable with said rotor, resiliently constrained means inductively associated with said magnetic means being adapted for angular movement with said rotor an amount proportional to the speed of rotation of said rotor and responding to a predetermined speed of rotation of said rotor for actuating said valve means whereby pressure builds up on said piston to move the latter, and means operable during movement of said piston for venting fluid pressure from said cylinder thereby modifying the fluid pressure supplied to said directing means.

11. Speed control means for a fluid pressure driven rotor comprising means directing said fluid pressure to spin said rotor, a pneumatic relay comprising a cylinder having an inlet and an outlet for said fluid pressure, said directing means communicating with said outlet, a piston mounted for reciprocal movement within said cylinder, valve means communicating with said cylinder normally by-passing a portion of said fluid from said cylinder, magnetic means carried by and rotatable with said rotor, a resiliently constrained drag cup associated with said magnetic means mounted for angular movement with said rotor an amount proportional to the speed of rotation of said rotor and responding to a predetermined speed of rotation of said rotor for actuating said valve means whereby pressure builds up on said piston to move the latter, and means operable during movement of said piston for venting fluid pressure from said cylinder thus modifying the fluid pressure supplied to said directing means.

12. In combination with a fluid pressure driven rotor, a shaft mounting said rotor for rotation

thereon, a nozzle for directing said fluid pressure to spin said rotor about said shaft, said shaft being provided with means therein communicating with the fluid pressure supplied to said nozzle and having venting means at the outer periphery of said shaft, a sleeve member surrounding said shaft for angular movement thereon having passages therethrough adapted for communication with said venting means, means resiliently constraining said sleeve member against angular movement about said shaft, a pneumatic relay comprising a cylinder having an inlet and an outlet for said fluid pressure, said nozzle communicating with said outlet, a piston mounted for reciprocal movement within said cylinder, actuating means for said sleeve member mounted for angular movement with said rotor an amount proportional to the speed of rotation of said rotor, means carried by said rotor for operating said actuating means, said actuating means responding to a predetermined speed of rotation of said rotor for actuating said valve means whereby pressure builds up on said piston to move the latter, and means operable during movement of said piston for venting fluid pressure from said cylinder thus modifying the fluid pressure supplied to said directing means.

13. Speed control means for a fluid pressure driven rotor comprising means directing said fluid pressure to spin said rotor, a valve comprising two relatively movable members, one of said members communicating with the fluid pressure supplied to said nozzle and the other being resiliently constrained against movement, magnetic field producing means rotatable with said rotor, and means connected with said other member inductively associated with said magnetic field producing means and mounted for angular movement thereby an amount proportional to the speed of rotation of said rotor and responding to a predetermined speed of rotation of said rotor for moving said other member against said resilient constraint to vary the fluid pressure supplied to said directing means whereby the speed of rotation of said rotor is decreased, said angularly movable means being returned to its initial position at decreased rotor speed whereby the fluid pressure supplied to said directing means is again varied thereby maintaining the speed of rotation of said rotor substantially constant.

14. Speed control means for a fluid pressure driven gyro rotor comprising means directing said fluid pressure to spin said rotor, a valve comprising two relatively rotatable members, one of said members having means communicating with the fluid pressure supplied to said directing means and the other being resiliently constrained against movement, said valve normally by-passing a portion of the fluid pressure supplied to said directing means, pressure operated throttling means for said directing means communicating with said one member, means defining a by-pass normally closed by said throttling means, actuating means connected with said other member mounted for angular movement with said rotor an amount proportional to the speed of rotation of said rotor, and means carried by said rotor for operating said actuating means, said actuating means being operative during a predetermined speed of rotation of said rotor for angularly moving said other member against said resilient constraint thereby building up pressure on said throttling means to open said by-pass means thus varying the fluid pressure supplied to said directing means to decrease rotation of said rotor, said angularly movable means being returned to its initial position at decreased rotor speed whereby the pressures operating said throttling means are by-passed through said valve so that said throttling means close said by-pass means thus maintaining the speed of rotation of said rotor substantially constant.

15. In combination with a fluid pressure driven member, a pressure relay for maintaining substantially constant the speed of operation of said fluid pressure driven member comprising a cylinder having venting means and an inlet and outlet for said fluid pressure, and piston means mounted for reciprocal movement within said cylinder normally closing said venting means, said piston means responding to an increased speed of operation of said driven member due to an increased fluid pressure flow through said outlet to open said venting means thereby by-passing fluid pressure from said cylinder thus modifying the fluid pressure flow at said outlet.

16. In combination with a fluid pressure driven member, a pressure relay for maintaining substantially constant the speed of operation of said fluid pressure driven member comprising a cylinder provided with venting means and having an inlet and an outlet for said fluid pressure, piston means mounted for reciprocal movement within said cylinder, and resilient means normally maintaining said piston means in a predetermined position to close said venting means, said piston means being movable against said resilient means in response to an increased speed of operation of said driven member due to an increased fluid pressure flow through said outlet to open said venting means thereby by-passing fluid pressure from said cylinder thus modifying the fluid pressure flow at said outlet.

17. In combination with a fluid pressure driven rotor, speed control means therefor comprising means directing fluid pressure to spin said rotor, magnetic field producing means carried by and rotatable with said rotor, and control means communicating with said directing means and inductively associated with said magnetic field producing means for operation thereby to vary the fluid pressure supplied to said directing means.

18. In combination with a fluid pressure driven rotor, speed control means therefor comprising a nozzle for directing fluid pressure to spin said rotor, a permanent magnet carried by and rotatable with said rotor, and control means communicating with said nozzle and inductively associated with said magnet for operation thereby to vary the fluid pressure supplied to said nozzle.

19. In combination with a fluid pressure driven rotor, speed control means therefor comprising means for directing fluid pressure to spin said rotor, magnetic field producing means carried by and rotatable with said rotor, means connected to said directing means for by-passing fluid pressure supplied thereto for modifying the fluid pressure issuing from said directing means, and control means operatively connected to said by-passing means and inductively associated with said magnetic field producing means for operation thereby.

PAUL A. NOXON.