

Aug. 24, 1954

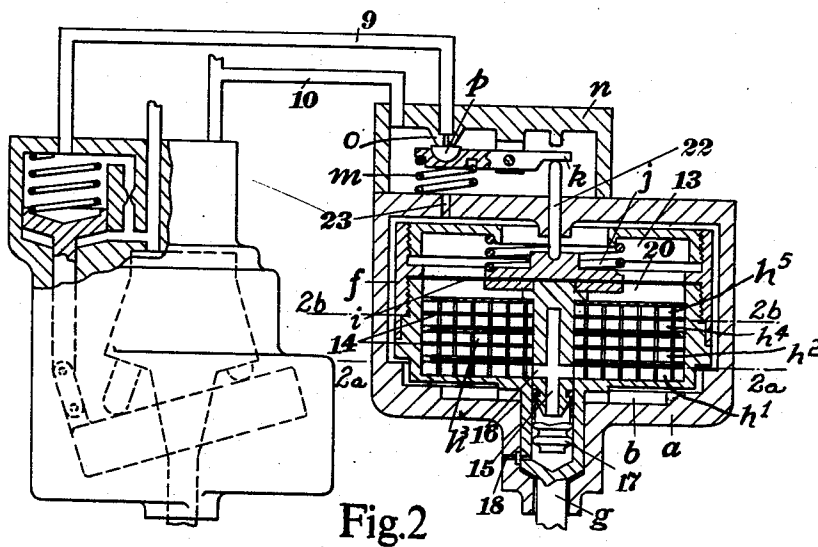
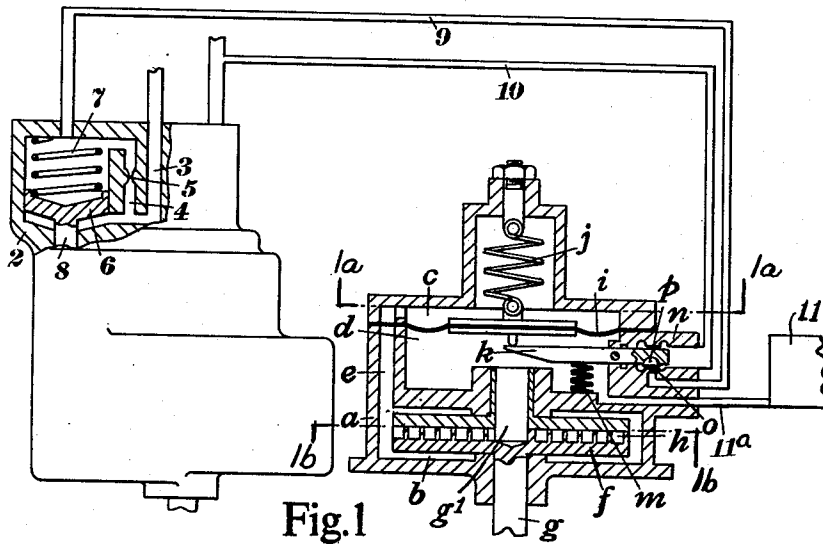
R. J. IFIELD

2,687,291

HYDRAULIC SPEED RESPONSIVE PUMP AND MOTOR TYPE GOVERNOR

Filed July 10, 1952

2 Sheets-Sheet 1



Inventor
R. J. Ifield
By *Glenn Downing*
Attys.

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R. J. IFIELD

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2 Sheets-Sheet 2

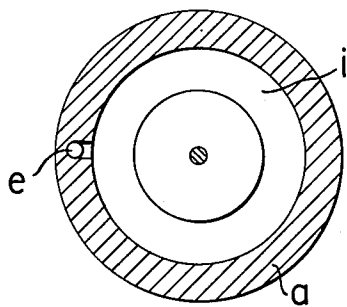


FIG. 1a.

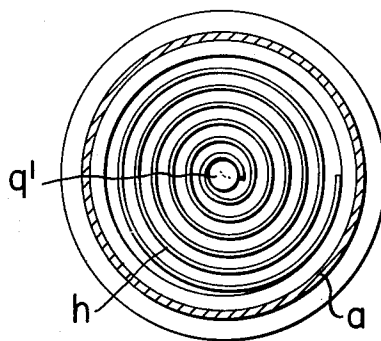


FIG. 1b.

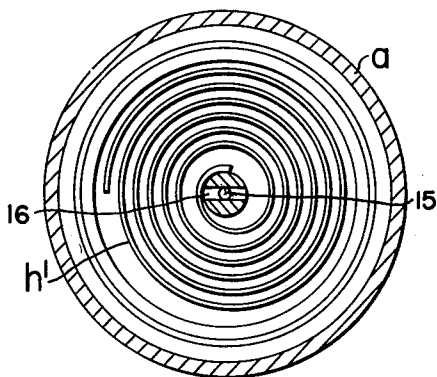


FIG. 2a.

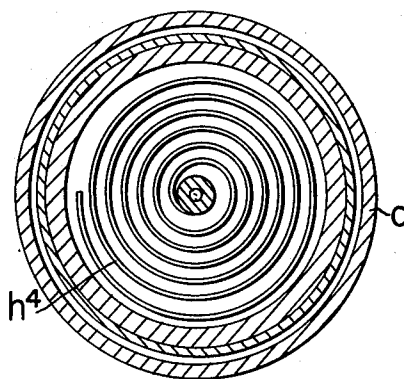


FIG. 2b.

INVENTOR

R. J. IFIELD

BY *Garret Downing Seabolt*
ATTORNEY

UNITED STATES PATENT OFFICE

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HYDRAULIC SPEED RESPONSIVE PUMP AND
MOTOR TYPE GOVERNORRichard Joseph Ifield, Dural, New South Wales,
Australia, assignor to Joseph Lucas (Indus-
tries) Limited, Birmingham, England

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5 Claims. (Cl. 264-14)

1

This invention relates to speed-responsive governors of the kind adapted to utilise the centrifugal pressure of a rotating liquid. The object of the invention is to enable the desired stability to be obtained in a simple manner.

The invention comprises a governor of the kind aforesaid which consists in part of a rotary member having at least one liquid-flow passage of spiral form, and a displaceable and spring-loaded member responsive to the centrifugal pressure of the liquid.

In particular the invention comprises a governor as above specified having therein a series of intercommunicating spiral passages, the said passages being alternately of opposite hand.

The invention will be described hereinafter with reference to the accompanying drawings, in which:

Figure 1 is a part sectional view diagrammatically illustrating one embodiment of the invention,

Figures 1a and 1b are sectional views taken respectively along the lines 1a-1a and 1b-1b of Figure 1,

Figure 2 is a view similar to Figure 1 but diagrammatically illustrating another embodiment of the invention, and

Figures 2a and 2b are sectional views taken respectively along the lines 2a-2a and 2b-2b of Figure 2.

Referring to Figure 1, there is provided a hollow body part *a* which includes three chambers respectively marked *b*, *c*, *d*, the two chambers *b*, *c* being in communication with each other by way of a passage *e*. In the chamber *b* is contained a rotor *f* provided with a driving spindle *g*. The rotor comprises a pair of discs on one of which is formed a spiral passage *h*, the open side of this passage being closed by the other disc. The rotor is supported in the body part *a* by a bearing for the spindle *g*, and also by a bearing for a stub spindle extending from the opposite side of the rotor. The stub spindle is made hollow affording a vertical opening *g'* and is in communication at its ends with the compartment *d* and the central part of the spiral passage in the rotor.

The chambers *c*, *d* are separated by a flexible diaphragm *i* loaded by a tension spring *j*, and in the chamber *d* is contained one part of a lever *k* loaded by a spring *m*, this part of the lever being operable by the diaphragm. The other part of the lever extends through a seal into a valve box *n* containing a valve seating *o* with which co-operates a closure member *p* on the lever *k*.

In the example shown the governor is arranged to control the output of a fuel pump for a jet engine, gas turbine or the like, the pump being of the swash plate type having combined with

2

it a liquid-operated servo mechanism, as described in the specification of Letters Patent No. 2,403,371 to R. J. Ifield et al. The servo-mechanism comprises a cylinder 2 which at one end communicates with the delivery passage 3 of the pump. Both ends of the cylinder are in communication with each other by way of a passage 4 containing a restricted orifice 5. In the cylinder is contained a piston 6 loaded by a spring 7, and connected by a rod 8 with the angularly adjustable swash plate of the pump. Movement of the piston in one direction results in reduction of the pump output, and movement in the opposite direction is accompanied by increase of the pump output. The end of the cylinder 2 remote from the connection with the passage 3 is connected by a pipe 9 to the seating *o* of the governor, and the governor valve box *n* is connected by a pipe 10 with the pump inlet or a sump.

The mode of action of the governor is as follows:

The chambers *b*, *c* are filled with any convenient liquid. With the rotor in action centrifugal pressure is set up in the spiral passage of the rotor, and this pressure is transmitted through the ambient liquid to the diaphragm. Normally the valve in the valve box is closed, and in this condition the spring 7 acting on the piston 6 of the servo-mechanism moves the piston in the direction for obtaining maximum output from the pump. When the governor rotor reaches a predetermined speed, the pressure of the liquid acting on the diaphragm *i* displaces the latter and causes it to move the lever *k* in the direction for opening the associated valve. Liquid can then pass through the valve along the pipe 9 from the servo-mechanism and the preponderating liquid pressure then acting on the side of the piston 6 remote from the spring 7 moves the piston in the direction for effecting a corresponding reduction of the pump output.

With fall of speed of the rotor the spring *j* returns the diaphragm *i* to its initial position and liquid in the chamber *c* is displaced to the chamber *a* and rotor.

By making the spiral passage in the rotor of appropriate length and cross section any desired degree of inherent damping and consequent stability of action of the governor can be obtained during changes of speed in a simple and convenient manner.

Replenishment of loss of liquid from the chambers *b*, *c* of the governor is effected from the chamber *d*, this chamber being supplied from any conveniently arranged reservoir 11 through a pipe 11a.

In the example shown in Figure 2, the hollow body part *a* is shaped to provide a single chamber *b* for enclosing the rotor *f*. The rotor is con-

structed to form two chambers, one of which is totally enclosed and the other (13) is open to the chamber *b*. The two chambers in the rotor are separated by a flexible diaphragm *i*, this being loaded by a compression spring *j* in the chamber 13. The rotor comprises a plurality of discs on each of which is formed a spiral passage, the alternate passages being of opposite hand to the others. Also the discs are grouped as shown, and the groups are separated by partitions 14. The spindle *g* carrying the discs is hollow along a portion of its length and comprises two parts in one of which are formed an axial passage 15 and lateral ports 16. Also at one end of one of the spindle parts is secured a closed and collapsible capsule 17. For admission of air to the portion of the spindle containing the capsule breathing apertures 18 are provided in the spindle and the adjacent portion of the body part. Alternatively liquid may be admitted to the last mentioned portion of the spindle from the chamber *b*.

Starting with the bottom disc shown in the drawing, and assuming the rotor to be in motion, liquid can be displaced outwardly during a change of speed along the associated spiral passage *h*¹. This displacement is accompanied by an inward displacement along the next passage *h*² (the spiral of which is of opposite hand to the first). The inner end of the second passage is in communication with the adjacent end of the third passage *h*³, and its outer end is in communication with the outer end of the fourth passage *h*⁴ (which is similar to the second passage *h*²). The inner end of the fourth passage communicates with the inner end of the fifth passage (which is similar to the first), the whole forming a series of passages along which liquid displacements occur alternately in opposite directions. Liquid displaced from the last passage *h*⁵ acts on the diaphragm. Avoidance of cavitation in the liquid is effected by the capsule 17 which can collapse under atmospheric pressure when liquid is drawn from its interior. By an arrangement as above described a restricted channel of any desired length for effecting the required damping action on the liquid during changes of speed can be accommodated in a compact form.

Pressure of the liquid on the diaphragm *i* serves to actuate a valve in a similar manner to that described with reference to Figure 1. On the body part *a* is mounted a valve box *n* containing a lever *k* loaded by a spring *m* and carrying a closure member *p* which co-operates with a seating *o* in communication by way of a pipe 9 with the servomechanism of the pump. The lever *k* is operable by the diaphragm *i* through a push rod 22. The valve box is connected to the inlet side of the pump (or a sump) by way of the pipe 10. It also communicates with the chamber of the body part *a* through an orifice 23, the chamber of the body part being filled (when the governor is in use) by liquid derived from the pump. The servomechanism is similar to that of Figure 1, and is controlled in like manner by the action on the diaphragm *i* by the liquid contained in the rotor.

The use of a governor as above described is not, however, restricted to the control of a fuel supply pump, as they may be used in other ways for controlling the rate of supply of liquid fuel to an engine in response to the speed of the engine. Thus they may be adapted to control

a fuel throttle or a by-pass in a fuel supply system. Moreover, the governors may be applied to other uses where it is required to produce a controlling or other effect in response to speed, such as the actuation of a switch in an electrical system. Further, subordinate details of construction may be varied to suit different requirements.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A speed-responsive governor of the kind adapted to utilize the centrifugal pressure of a rotating liquid comprising, in combination, a rotary member including at least one liquid-flow passage of spiral form having a plurality of turns to afford inherent damping and consequent stability of action during changes of speed, and a displaceable and spring-loaded member responsive to the centrifugal pressure of the liquid created by the rotary member.

2. A speed responsive governor of the kind adapted to utilize the centrifugal pressure of a rotating liquid comprising, in combination, a rotary member including a plurality of axially spaced liquid-flow passages of spiral form each having a plurality of turns and the spiral passages being alternately of opposite hand, means affording intercommunication between adjacent inner and outer ends of the spiral passages to constitute a single passage which extends alternately inwardly and outwardly, and a displaceable and spring-loaded member responsive to the centrifugal pressure of the liquid created by the rotary member.

3. A governor according to claim 2, comprising a collapsible capsule located within the rotary member and having its interior in communication with the inner end of the single passage, and means for admitting air to the outside of the capsule.

4. A speed responsive governor of the kind adapted to utilize the centrifugal pressure of a rotary liquid comprising, in combination, a rotary member formed to provide two chambers separated by a flexible diaphragm, one of said chambers including a plurality of axially spaced liquid-flow passages of spiral form each having a plurality of turns and the spiral passages being alternately of opposite hand, means affording intercommunication between adjacent inner and outer ends of the spiral passages to constitute a single passage which extends alternately inwardly and outwardly, and spring loading means for the flexible diaphragm which thereby constitutes means responsive to the centrifugal pressure of the liquid created by the rotary member.

5. A speed responsive governor according to claim 4, in which the spiral passages are formed on one side of discs which are grouped in pairs with the passages lying adjacent but separated by partitions.

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