United States Patent [19]

Parks et al.

[11] **3,915,140**

[45] **Oct. 28, 1975**

[54] **GOVERNOR WITH STABILIZING MEANS**

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[73] Assignee: **Caterpillar Tractor Co.,** Peoria, Ill.

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[52] **U.S. Cl.** ..... **123/140 FG;** 73/522

[51] **Int. Cl.** **F02d 1/04;** F02d 1/06

[58] **Field of Search** .. 123/140 R, 140 FG, 140 MC; 73/522

[56] **References Cited**

UNITED STATES PATENTS

2,656,174	10/1953	Crookston	73/522
2,868,184	1/1959	Moulton	123/140 FG
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FOREIGN PATENTS OR APPLICATIONS

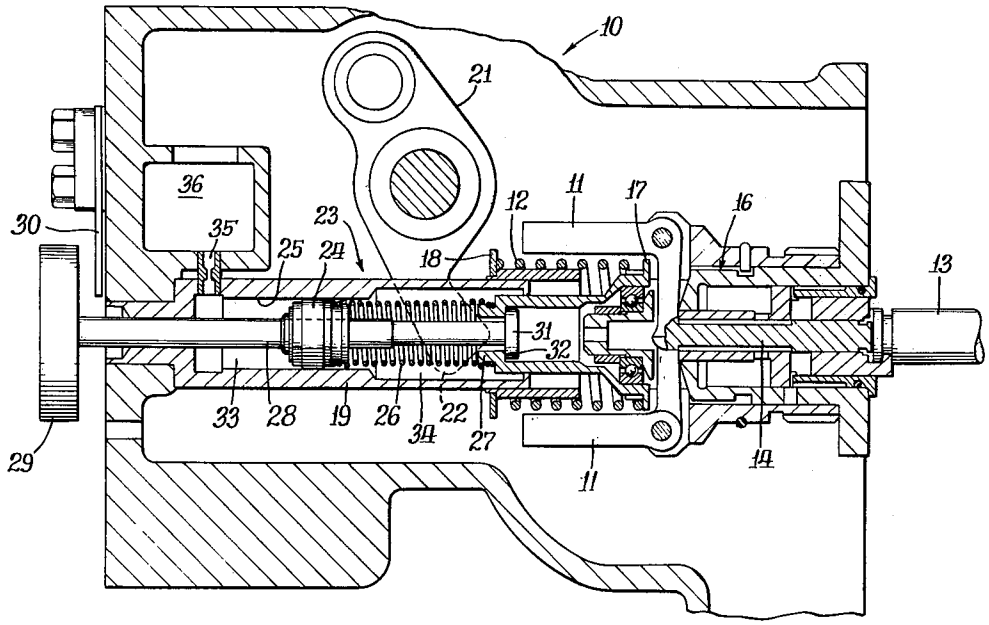
2,064,644	12/1969	Germany	123/140 FG
55,718	1/1939	Denmark	123/140 FG

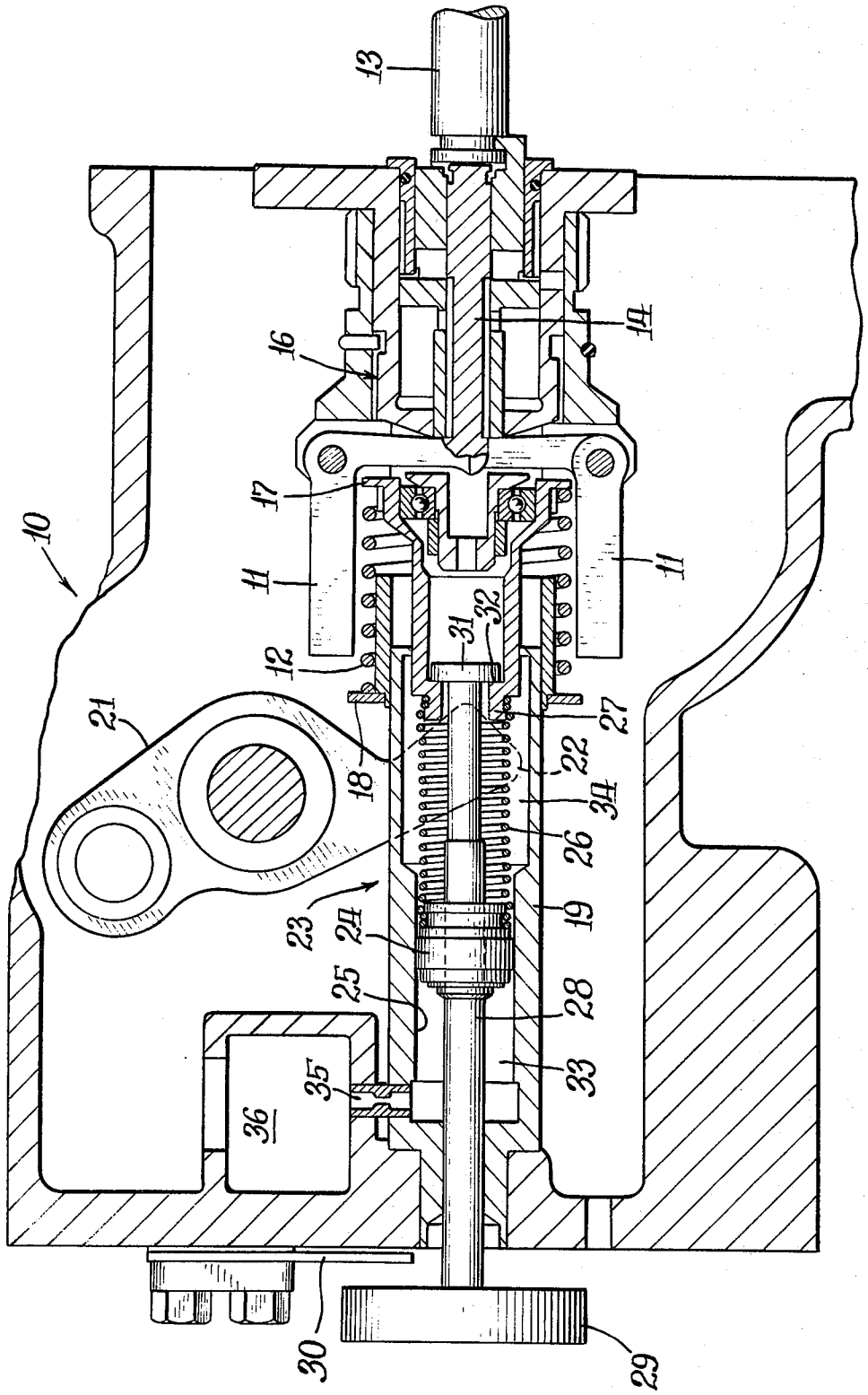
Primary Examiner—Charles J. Myhre
Assistant Examiner—Ronald B. Cox
Attorney, Agent, or Firm—Phillips, Moore, Weissenberger Lempio & Strabala

[57] **ABSTRACT**

A governor mechanism of the type having interacting flyweights and a governor main spring for regulating engine speed includes damping means comprising hydraulically damped piston means interacting with a compression-extension spring member to temporarily, effectively change the spring rate of the main governor spring, and thereby substantially eliminate governor speed droop while maintaining governor stability.

6 Claims, 1 Drawing Figure

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GOVERNOR WITH STABILIZING MEANS

BACKGROUND OF THE INVENTION

This invention relates to means for preventing erratic or surging governor operation of an engine. In particular, this invention relates to governor damping means for preventing surging or erratic operation of the governorcontrolled engine.

Although numerous mechanical and hydromechanical means for preventing surging or erratic engine operation have been proposed for use in conjunction with conventional governors having interacting spring and flyweight regulating means, many of these have proven unsatisfactory, particularly in applications requiring constant engine speed within a low tolerance and with varying engine loads.

For example, in diesel electric set applications, it is very desirable to achieve isochronous, or near isochronous, governing of the engine to insure a constant cycle-per-second output of the generator, typically of about **50** or **60** Hz. Due to an engine's inherent characteristic of losing speed when load is applied, a governor is used to increase the amount of fuel delivered to the engine when this occurs so that a constant engine speed is maintained. However, conventional mechanical and certain hydromechanical governors allow engine speed to drop slightly as engine load increases. This characteristic known as "speed droop" and also described in Application Ser. No. **202,254,** filed Nov. **26, 1971,** now U.S. Pat. No. **3,818,883,** issued June **25, 1974,** to Glassey, is inherent in such governor designs to insure governor stability, and typically results from the use of a relatively high-rate governor spring. Although this characteristic could be altered by employing a lower-rate governor spring which would interact with the flyweights to provide improved engine isochrony, the lower-rate spring tends to increase governor instability, which is detrimental to engine operation. This increase in governor instability with lower-rate springs is primarily due to a more rapid reaction of the springs and flyweights to changes in engine load, which causes an overshoot or undershoot of the correct fuel position of the fuel control member.

Although other damping means have been proposed for stabilizing engine operation without increasing governor instability, such as that described in U.S. Pat. No. **2,984,112,** issued on May **16, 1961** to J. H. Parks and assigned to the assignee hereof, such prior art means have not satisfactorily provided the desired damping function in all applications, particularly those requiring constant engine speed within minimal tolerances.

Therefore, it is desirable to provide improved governor damping means for maintaining a predetermined engine speed within minimal tolerance levels with changes in engine load.

SUMMARY AND OBJECTS OF THE INVENTION

The invention provides damping means for governors of the type having interacting flyweights and a main governor spring for regulating the position of a fuel control member which controls the supply of fuel to the engine and thus regulates the speed thereof. The damping means of this invention include hydraulically-damped piston means interacting with a compression-extension member to increase the spring rate of the main governor spring during transitory adjustments thereof to engine load changes. Thus, a lower-rate governor spring may be employed, and governor speed droop with increased engine load is substantially eliminated without impairing governor stability. Substantially isochronous governing of the engine within minimum tolerances is thereby achieved.

It is an object of this invention to provide governor means for engine operation which prevent surging or erratic operation of the governor-controlled engine.

It is another object of this invention to provide governor means for engine operation including means for preventing uncontrolled adjustment by the governor in response to changes in engine loads.

It is a further object of this invention to provide governor means for enging operation which permit substantially isochronous governing of the engine.

It is an additional object of this invention to provide damping means for a governor of the type having interacting flyweights and a main governor spring which provide a transitory, effective change in the rate of the governor spring during governor adjustment, thus substantially eliminating governor speed droop while maintaining governor stability.

It is yet another object of this invention to provide damping means for a governor which substantially eliminate governor speed droop without impairing governor stability, thereby permitting substantially isochronous engine operation within minimum tolerances.

Other objects and advantages of the invention will be apparent from the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWING

The sole FIGURE is a sectional view of a governor mechanism including the governor damping means of this invention.

DETAILED DESCRIPTION OF THE INVENTION

With reference to the drawing, a governor mechanism generally indicated at **10** includes a pair of flyweights **11** and a main governor spring **12** which interact to control the movement of a fuel pump rack bar **13** through a valve member **14** and a servo-mechanism **16.** The fuel pump rack bar **13** in turn controls the supply of fuel to an associated engine (not shown) according to its position so that a constant engine speed is maintained. Governor spring **12** is disposed between a forward spring seat **17** secured to the valve member **14,** and a rearward spring seat **18** slideably mounted on a guide **19.** Main governor spring **12** is adjusted to provide the desired engine speed by adjusting the position of a bifurcated lever **21,** one arm **22** of which is shown bearing against rearward spring seat **18** to apply the necessary force to the main governor spring.

In the conventional governor mechanism thus described, the interaction of the main governor spring **12** and the flyweights **11** control the position of the fuel pump rack bar **13** through the servo-mechanism **16** in a conventional manner to establish engine speed. When little or no speed droop is desired, however, the conventional governor is susceptible to surging or overcontrolled adjustment of the rack bar during changes in engine load, which thereby results in erratic engine operation.

In order to prevent such undesirable surging when substantially eliminating engine speed droop in the governor mechanism as engine load is increased or decreased, while at the same time maintaining stability, the invention provides damping means generally indi-

cated at 23 for effectively changing the spring rate of main governor spring 12 during governor position changes. The damping means 23 include piston means 24 slideably engaged in a bore 25 of the guide 19, and a compression-extension member in the form of a damping spring 26 secured at opposite ends thereof to the piston 24 and a shoulder 27 of forward spring seat 17, respectively. Piston means 24 is slidable on a shaft 28 which functions in a conventional manner as a governor load control by means of a flange 29 engaging a full load stop 30 and a second flange 31 engaging a shoulder 32 of rearward spring seat 18.

Bore 25 of guide 19 includes chambers 33, 34 formed by the walls of the bore and piston means 24. Guide 19 is provided with an orifice 35 communicating chamber 33 with a reservoir 36 having a source of hydraulic fluid such as engine oil which acts as a damping fluid for the action of the piston.

Oil reservoir 36, at atmospheric pressure provides a continuous fluid supply for chamber 33. Orifice 35 provides a continuous controlled fluid flow between chamber 33 and reservoir 36 as dictated by the piston means motion. The damping of the piston is caused by the lubricnt being forced through the orifice between piston 24 and bore 25. There is lubricant on only one side of piston 24 in chamber 33, the other side of piston 24 including chamber 34 is to drain. In this manner, the piston is enabled to move to the left or right as urged by spring 26, but restricted by the damping action.

To operate the engine at a predetermined speed, the lever 21 is positioned to accordingly preload the governor spring 12. As an increased load is placed on the engine, the forces acting on flyweights 11 decrease, allowing spring 12 to force forward spring seat 17 to the right to a position as illustrated in the figure, thereby actuating servo-mechanism 16 through the valve member 14 and positioning the rack bar 13 to increase the supply of fuel to the engine, all in a conventional manner.

Simultaneously with the decrease in force on flyweights 11, the rightward movement of forward spring seat 17 moves damping spring 26 and attached piston 24 to the right so that the force of the spring 26 is combined with the force of the governor spring 12. These forces together with the resistance of piston 24, causes a temporary spring action which acts like a relatively high spring. Once the governor spring and flyweights are positioned to maintain engine speed with the increased load, spring 26 returns piston 24 to a neutral, or equilibrium position.

When engine load is suddenly decreased, flyweights 11 are moved radially outwardly by centrifugal forces generated by increased engine speed. This outward movement of flyweights 11 moves forward spring seat 17 leftwardly from the position as shown in the Figure to compress main governor spring 12, and reposition rack bar 13 through servo-mechanism 16 to reduce the supply of fuel to the engine. The leftward movement of the forward spring seat 17 simultaneously compresses the damping spring seat 26 against the piston 23. Since the piston 23 is damped by fluid in the chamber 33, however, the piston resists the urging of the damping spring 26, and the spring 26 in additive combination with the governor spring 12 thereby temporarily functions as a high-rate spring. As the force of the main spring 12 approaches the force acting on flyweights 11, the damping spring 26 slowly urges the piston 24 to a position where spring 26 is in a neutral or equilibrium position.

It may therefore be seen that the invention provides improved means for preventing erratic engine operation and for maintaining a constant engine speed within minimum tolerances. While the invention has been described in terms of a specific embodiment, it is apparent that equivalent modifications and embodiments are contemplated by the invention, and no limitations are intended except as specifically pointed out in the appended claims.

We claim:

1. In an engine governor for maintaining a desired engine speed and having a fuel control member for regulating the flow of fuel to an engine, flyweight means for controlling the movement of said fuel control member to position said fuel control member to increase the flow of fuel in response to an increase in engine load, main spring means mounted adjacent to said flyweight means for assisting movement of said fuel control member in a direction to increase flow of fuel, said main spring means having a spring rate, wherein said main spring means comprises a main spring, said governor including a spring seat for said main spring, said flyweight means comprising flyweights for compressing said main spring by said spring seat as engine speed increases, and means for temporarily, effectively changing said spring rate of said main spring means when engine load is suddenly increased or decreased, and thereby maintaining governor stability, said means for changing comprising a damping spring and a hydraulically damped piston for providing a force which subtracts from the force of the main spring during a decrease in engine speed and adds to the force of the main spring during an increase in engine speed, further including a hydraulically damped piston reciprocable within said bore, and said damping spring being fixed to said piston at one end thereof and to said spring seat at the other end thereof, wherein said piston and said bore form a generally cylindrical chamber on the opposite side of said piston from said damping spring, and further including orifice means for communicating said chamber with a hydraulic fluid reservoir and for providing a controlled flow of hydraulic fluid between said chamber and said hydraulic fluid reservoir as dictated by reciprocable motion of said piston, and further including a coaxial shaft attached to said piston extending on the opposite side of said piston and stop means on said shaft for limiting movement of said shaft and thereby said piston.

2. The governor of claim 1 wherein said stop means comprise a flange stop on opposite ends of said shaft.

3. The governor of claim 2 wherein said stop means comprises a full load stop positioned so as to contact one of said flange stops when said piston and shaft move in a first direction.

4. The governor of claim 3 wherein said stop means further comprise a shoulder on said spring seat positioned so as to contact the other of said flange stops when said piston and shaft move in a second direction, opposite to said first direction.

5. The governor of claim 4 wherein said damping spring is a coil spring and the end of said shaft extending on the spring side of said piston extends through said coil spring.

6. The governor of claim 5 wherein said governor includes a housing and said reservoir is defined by said housing.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,915,140
DATED : October 28, 1975
INVENTOR(S) : John H. Parks, et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

column 4, line 35, after "including" insert --a spindle coaxial with said spring seat and having a bore therein,--

Signed and Sealed this

Twenty-first Day of September 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks