

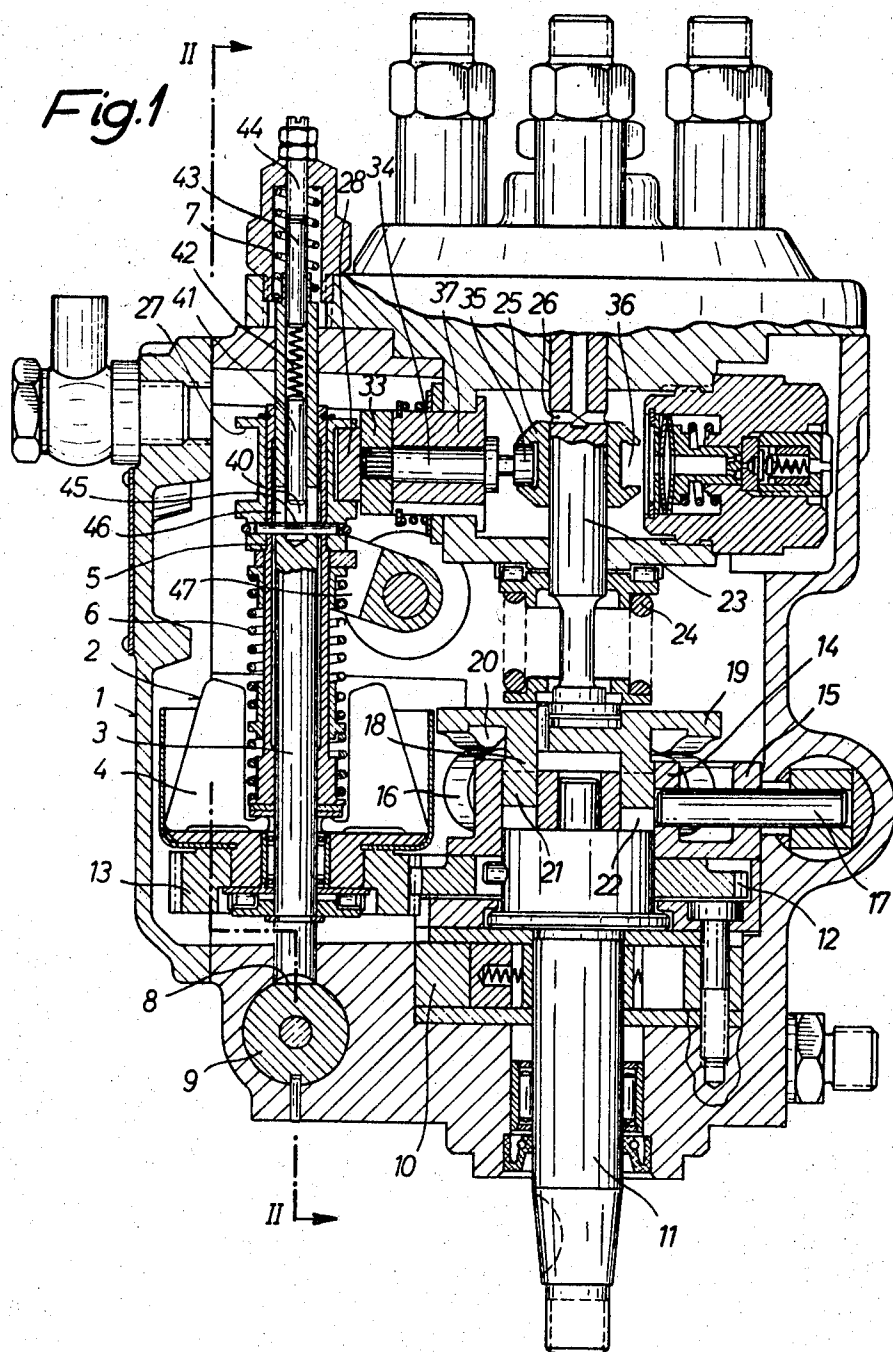
May 13, 1969

R. KLEEGERGER
FUEL INJECTION PUMP

3,443,554

Filed April 6, 1967

Sheet 1 of 3



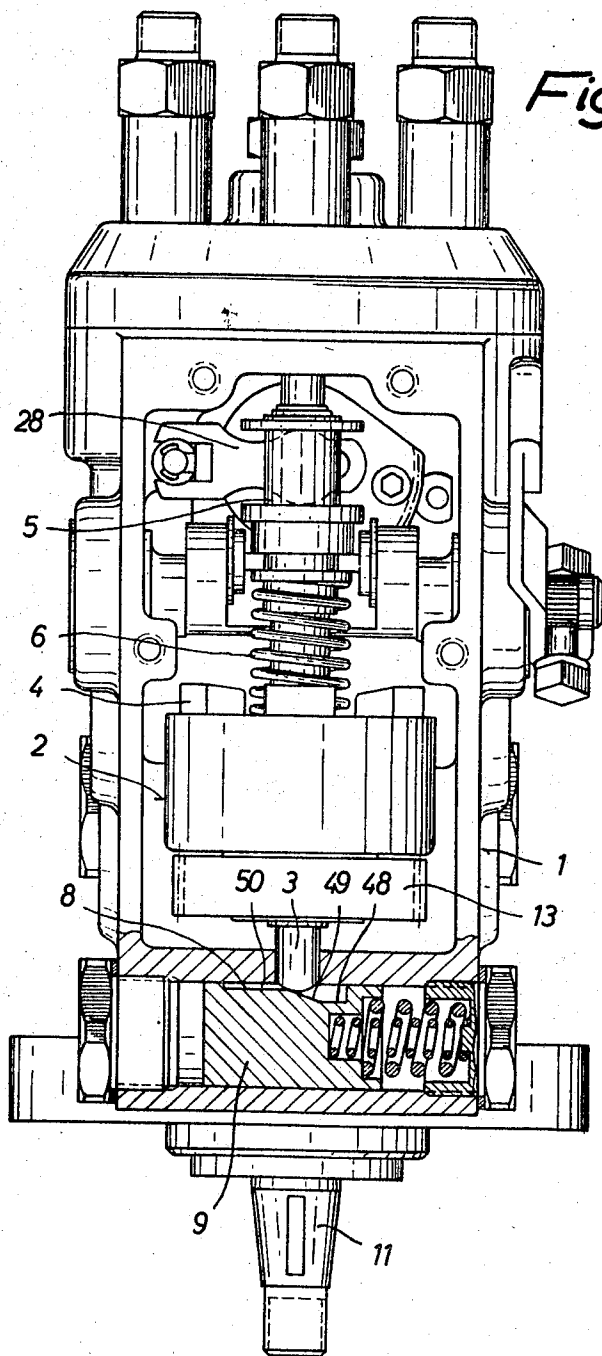
May 13, 1969

R. KLEEGERGER
FUEL INJECTION PUMP

3,443,554

Filed April 6, 1967

Sheet 2 of 3



May 13, 1969

R. KLEEBERGER
FUEL INJECTION PUMP

3,443,554

Filed April 6, 1967

Sheet 3 of 3

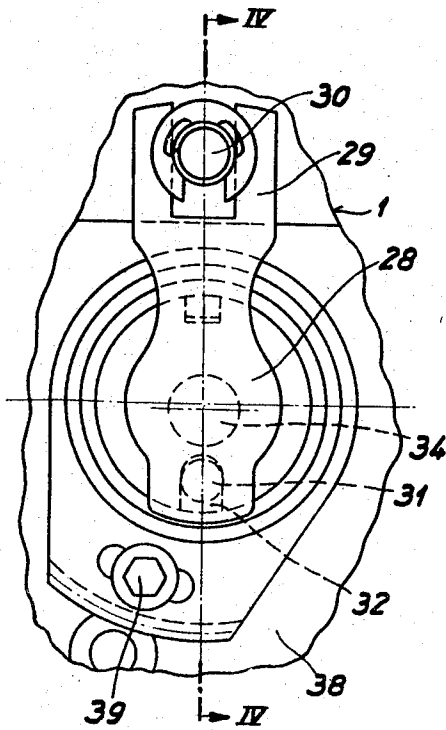


Fig. 3

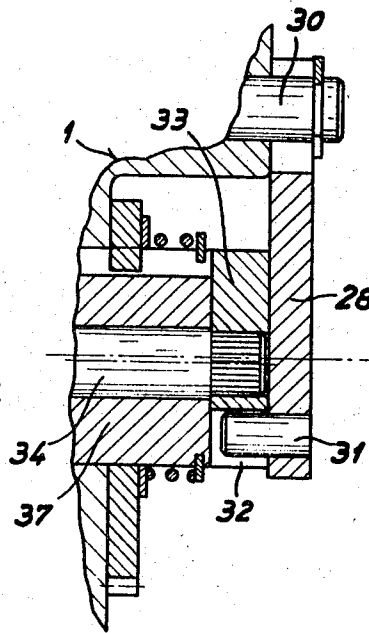


Fig. 4

1

2

3,443,554

FUEL INJECTION PUMP

Rudolf Kleeberger, Munich, Germany, assignor to
Kugelfischer Georg Schafer & Co., Schweinfurt,
Germany

Filed Apr. 6, 1967, Ser. No. 628,951

Int. Cl. F02d 1/04

U.S. Cl. 123—140

10 Claims

ABSTRACT OF THE DISCLOSURE

A fuel injection pump for internal combustion engines in which the position of a delivery regulating member is controlled by two simultaneously acting speed responsive devices. One of the devices being a centrifugal governor and the other being a hydraulic adjusting piston, the axial position of which is determined by the speed-dependent delivery pressure of an engine driven fuel feed pump.

The present invention relates to a fuel injection pump, in particular to a distributor-type injection pump for multicylinder fuel injection internal combustion engines in which the position of the delivery regulating member is determined by two simultaneously acting speed-responsive members, one of which is a centrifugal governor and the other is a hydraulic piston, the axial position of which is determined by the speed-dependent delivery pressure of an engine-driven fuel feed pump.

In a known pump of the above-mentioned type, the matching of the delivery of the fuel injection pump to the fuel requirement characteristics of the engine is achieved by adjusting the delivery stroke of the pump, the basic stroke length being set by the centrifugal governor acting through a stroke-adjusting member, with a correcting factor superimposed on the stroke by adjustment of the pivotal axis of the stroke-adjusting member which is formed as a rocking arm. This adjustment of the pivotal axis is achieved by a follower engaging a cam surface and a pivoted lever of which the pivotal axis is rigidly connected to the eccentrically mounted spindle of the stroke-adjusting member. The position of this cam surface is controlled by the speed-dependent hydraulic piston mentioned earlier.

An object of the invention is to provide an injection pump controlled by simple and compact means. This object is achieved by the invention by providing a spindle of the centrifugal governor which is displaceable in an axial direction by hydraulic means. In this manner the delivery regulating member is adjusted via a linkage common to both speed-responsive members so that a substantial simplification of the overall assembly is achieved.

According to a further feature of the invention, the cam surface can be formed directly on the external surface of the piston and can be shaped to take into account the fuel delivery under starting conditions, fuel requirement characteristics of the engine and the speed-delivery characteristic of the pump. By forming the cam surface, known in itself, directly on the piston instead of on a separate cam member connected to the piston, a further economy in space is possible in comparison with known constructions.

According to a still further feature of the invention, the spindle of the centrifugal governor can directly engage the cam surface of the piston. The direct engagement of the cam surface results both in economy of parts and also in an almost backlash-free transmission of the control parameters to the injection pump piston.

According to a further feature of the invention, a control collar which is acted on by the centrifugal governor can be coupled through a lever and eccentric linkage to

a known axially displaceable control sleeve which is mounted on the pump piston and forms the fuel delivery-regulating member. This linkage can be formed by a lever pivotally mounted in the housing of the pump with one end engaging in an annular groove in the control collar and with its other end acting to turn a shaft having disposed on it an eccentric pin engaging in an annular groove in the control sleeve. The shaft can be eccentrically mounted in a bearing bush which in its turn is rotatably mounted in the pump housing and is capable of being angularly adjusted and then locked in position.

According to a further feature of the invention, the control collar can, during idling, cooperate with a known damping device. For this purpose, a piston can be provided in the spindle of the centrifugal governor. This piston engages a compression spring which is axially displaceable and the control collar acts on the piston through a pin rigidly secured to it and passing through a slit in the spindle.

The means for accomplishing the foregoing objects and other features, which will be apparent to those skilled in the art, are set forth in the following specification and claims, and are illustrated in the accompanying drawings dealing with a basic embodiment of the present invention.

Reference is made now to the drawings in which:

FIG. 1 shows a partial section, longitudinal view of the inventive single-piston distributor type injection pump;

FIG. 2 is a plan view, partially in section, taken along line II—II in FIG. 1;

FIG. 3 is an enlarged view of the linkage between the control collar and the control sleeve; and

FIG. 4 is a section view taken along line IV—IV in FIG. 3.

A known centrifugal governor 2 is rotatably mounted on a spindle 3 in a housing 1 and comprises fly weights 4, a control collar 5, and a control spring 6, the loading of which is adjustable. The spindle 3 is axially displaceable against the action of a spring 7. The end of the spindle which is remote from the spring engages a cam surface 8 which is formed directly on the external surface of a control piston 9. This piston is arranged at the same level as the spindle 3 and perpendicular to it. The axial position of the piston is determined by the speed-dependent delivery pressure of a fuel feed pump 10.

The fuel feed pump 10 is driven from the engine via a shaft 11. The shaft 11 also has secured to it a pinion 12 which meshes with a pinion 13 mounted on the hub of the centrifugal governor 2. That end of the shaft 11 which is disposed within the pump housing is rotatably mounted in a bush 14 carrying a concentric ring 15 with four rollers 16 mounted to rotate about radially extending axes in the intervening annular space. The bush is secured against rotation with respect to the housing 1 by means of a pin 17. The bush 14 is engaged by the hub 18 of a reciprocating disk 19. The disk 19 has an undulating cam face 20 which engages the rollers 16 so that, as the disk 19 rotates, it reciprocates axially with respect to the bush 14. The disk 19 is driven from the shaft 11, to which it is mechanically connected by means of keys 21 engaging in corresponding notches 22 in the end of the shaft 11.

A distributor-type piston 23 is secured to the disk 19, and a spring 24 maintains contact between the disk and the rollers 16 to cause the suction stroke of the piston. A control sleeve 25 is slidably and rotatably mounted on the piston 23 and, according to its position on the piston, covers to a greater or lesser extent a spill port 26 and thereby determines the quantity of fuel delivered on each stroke of the piston.

The position of the control sleeve in relation to the spill port is determined by the position of the control collar 5, to which it is connected through a lever and

eccentric linkage. For this purpose the control collar 5 has an annular groove 27 engaged by a lever 28 having a forked end 29 by which the lever is pivotally mounted on a pin 30 secured to the housing (see FIGS. 3 and 4). At its other end the lever 28 has a pin 31 engaging a radial slot 32 in a disk 33 which is secured to one end of a shaft 34. The other end of the shaft 34 carries an eccentrically disposed pin 35 engaging in an annular groove 36 in the control sleeve 25. The shaft 34 is guided eccentrically in a bearing bush 37 which in turn is rotatably mounted in the pump housing 1. To allow accurate adjustment of the relative positions of the control collar and the control sleeve, this bush 37 is connected to a toothed segment 38 which can be rotated by an appropriate key and then locked in position by a screw 39.

To provide damping of the movement of the governor under idling and light-load conditions and thereby to prevent hunting, the spindle 3 has a bore 40 extending into one end thereof (from its right-hand end as shown in FIG. 1). A piston 41 is mounted in the bore 40 engaging a compression spring 42 which is axially displaceable by an adjusting screw 44 through an intermediate pin 43. The control collar 5 carries a pin 45 guided in a longitudinal slot 46 and passing transversely through the spindle so that displacement of the control collar is transmitted to the piston 41. The control collar is displaceable by means of a regulating lever 47 to adjust the desired running speed.

The manner of operation of the device will now be explained. The control collar 5 is brought to a desired setting by means of the regulating lever 47 thereby setting and adjusting spring 6 to a predetermined loading. If the engine speed rises, the centrifugal weights 4 move outwards as soon as the centrifugal force overcomes the force of spring 6. This causes displacement of the control collar 5 which in its turn moves the control sleeve 25 via the lever 28 and the eccentric shaft linkage 34, 35. The displacement of the sleeve 25 causes the spill port 26 to be uncovered earlier in the stroke, so that a smaller quantity of fuel is fed to the cylinders of the engine.

The regulating action of the centrifugal governor is modified by a further control movement serving to match the delivery characteristic of the pump to the fuel requirement curve of the engine. This second control movement is produced by axial displacement of the spindle 3 of the centrifugal governor, which is spring biased against the cam surface 8 of the control piston 9. The cam surface 8 has a recessed portion 48 (see FIG. 2) allowing adjustment to the starting delivery setting, which is substantially higher than the full load setting. Even before idling speed is reached, the delivery used for starting is cut back by a steeply rising portion 49 of the cam surface. A portion 50 is shaped to take into account the progressively reduced fuel needs and the simultaneously rising fuel delivered with increasing engine speed. Axial movement of the control piston 9 by the action of the delivery pressure of the fuel feed pump 10 displaces the spindle 3 together with the centrifugal governor and the control collar 5 thus adjusting the control sleeve 25 appropriately via the lever 28 and the eccentric linkage 34, 35.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof.

What is claimed is:

1. A fuel injection pump for internal combustion engines comprising a casing, a fuel feed pump mounted within said casing, means operatively connecting said pump to said engine to drive the former, a fuel delivery regulating member, two simultaneously acting speed responsive devices controlling said regulating member, one of said devices being a centrifugal governor rotatably mounted on a spindle and causing a first control movement for the fuel delivery regulating member and the other device being a hydraulic adjusting piston the axial position of which is determined by the speed-dependent

delivery pressure of said fuel feed pump, the spindle of the centrifugal governor being axially displaceable by said hydraulic adjusting piston in superposing a second control movement to the first one for controlling the regulating member.

2. A fuel injection pump for internal combustion engines comprising a casing, a fuel feed pump mounted within said casing, means operatively connecting said pump to said engine to drive the former, a fuel delivery regulating member, two simultaneously acting speed responsive devices controlling said regulating member, one of said devices being a centrifugal governor and the other being a hydraulic adjusting piston the axial position of which is determined by the speed-dependent delivery pressure of said fuel feed pump, a cam surface formed on the outer surface of said hydraulic adjusting piston, the profile of said cam being so shaped as to take into account the starting fuel delivery requirements, the normal fuel requirements, and the delivery characteristics of the pump.

3. A fuel injection pump according to claim 2 in which said centrifugal governor comprises a spindle, fly weights, an axially displaceable adjusting sleeve and an adjustable load control spring mounted on said spindle, one end of said spindle bearing directly against said cam surface.

4. A fuel injection pump according to claim 3 in which said centrifugal governor further comprises a control collar, linkage means operatively connecting said control collar to the fuel delivery regulating member, said linkage comprises a lever pivotally mounted on said casing, one end of said lever engaging in an annular groove in said control collar, a shaft having a radial slot in one end thereof, the other end of said lever engaging in said slot, a pin eccentrically disposed on the other end of said shaft, said pin engaging in an annular groove of a control sleeve axially displaceable on the delivery piston of said injection pump to regulate the fuel delivery thereby.

5. A fuel injecting pump according to claim 2 in which said shaft is mounted eccentrically in a bearing bush which is in turn rotatably mounted in said housing, means for angularly adjusting said bush and locking same to thereby adjust the relative positions of the control sleeve and control collar.

6. A fuel injection pump according to claim 4 in which said centrifugal governor further comprises a damping device, said damping device tending to resist hunting during idling.

7. A fuel injection pump according to claim 6 in which said damping device comprises a bore in the spindle of said governor, a piston movably mounted in said bore, an axially displaceable spring mounted in said bore and acting against said piston, and pin means secured to said control collar and passing through slots in said spindle and traversing said bore, said governor acting on said piston through engagement of said pin therewith.

8. A fuel injection pump according to claim 2 in which said fuel delivery regulating member comprises an axially displaceable control sleeve mounted on a delivery piston of said injection pump to regulate the fuel delivery thereby.

9. A fuel injection pump for internal combustion engines comprising a housing, a fuel feed pump mounted within said housing and operatively connected to be driven by said engine, fuel delivery regulating means, two simultaneously acting speed responsive means operatively connected to conjunctively control said fuel delivery regulating means, one of said devices being a centrifugal governor and the other being a hydraulic adjusting piston the axial position of which is determined by the speed-dependent delivery pressure of said fuel feed pump, said fuel feed pump including a delivery piston having a spill port means therein, said fuel delivery regulating member comprising an axially displaceable control sleeve movable to progressively cover said port, said centrifugal governor comprising a spindle rotatably mounted in said housing, fly weights, an adjusting sleeve, one end of said spindle bearing against

5

said cam surface, a damping device bearing against the other end of said spindle, linkage means operatively connecting said control sleeve and said control collar, said linkage means including adjustable eccentric means whereby the relative displacement between said control sleeve and control collar may be adjusted.

10. A fuel injection pump according to claim 9 in which said centrifugal governor comprises a spindle rotatably mounted in said housing, fly weights, an adjusting sleeve, and an adjustable load control spring mounted on said spindle, one end of said spindle bearing against said cam surface, a damping device bearing against the other end of said spindle.

5

10

6

References Cited

UNITED STATES PATENTS

2,765,741	10/1956	Hogeman	103—37
2,869,529	1/1959	Oxenfurt et al.	123—140
3,096,716	7/1963	Chmura	123—140 X
3,159,152	12/1964	Reiners	123—140
3,247,799	4/1966	Roosa et al.	103—11
3,288,124	11/1966	Roosa	123—140

WILLIAM L. FREEH, *Primary Examiner.*

U.S. Cl. X.R.

103—37