GOVERNOR FOR FUEL INJECTION PUMP

INVENTOR.
VERNON D. ROOSA

BY Lindsay, Bautzmann and Hayes
ATTORNEYS
GOVERNOR FOR FUEL INJECTION PUMP
Vernon D. Roosa, % The Hartford Machine Screw Company, P.O. Box 1440, West Hartford, Conn. 06102
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ABSTRACT OF THE DISCLOSURE

A fuel pump governor of the type utilized in fuel injection systems for delivering measured charges of fuel to the nozzles of an associated internal combustion engine. Said governor comprising a gear, one end of which is segmented to provide a plurality of angularly spaced slots around the periphery thereof, a cam member engaging the segments of said gear for rotation therewith, a plurality of weights mounted in said slots for pivotal movement during rotation, whereby said gear and cap members form a cage for guiding the weights in said pivotal movement.

This invention relates to an improved governing means for fuel pumps of the type utilized in fuel injection systems for delivering measured charges of fuel to the nozzles of an associated internal combustion engine.

An object of this invention is to provide an improved governor for fuel pumps of the type referred to which is capable of more effective speed regulation over a wider speed range and which is arranged to be mounted in an improved manner in the fuel pump.

Another object of this invention is to provide a governor which can be mounted in the fuel pump to rotate at a higher speed than the rotor thereof and which is simplified construction whereby it can be fabricated and assembled in an economical and convenient manner.

A more specific object of this invention is to provide a combined governor drive and cage construction.

Other objects will be in part obvious and in part pointed out more in detail hereininafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth, and the scope of the application of which will be indicated in the appended claims.

In the drawings:

FIG. 1 is a longitudinal cross-sectional view, partly broken away, of a fuel injection pump embodying the present invention;

FIG. 2 is an enlarged fragmentary sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a fragmentary sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is an enlarged cross-sectional view taken along line 4—4 of FIG. 1; and

FIG. 5 is an exploded perspective view of the governor assembly of this invention.

Referring now to the drawings in detail, in which like numerals refer to like parts throughout the several figures, a pump exemplifying the present invention is of the type now commercially available for supplying fuel charges to an associated internal combustion engine. The pump comprises an external housing or casing 10 having an axial bore or opening 12 rotatably supporting a pump rotor or distributor 14.

At the right end of the housing 10, as viewed in FIG. 1, there is mounted a vane-type fuel supply or transfer pump 18 driven by the rotor 14 and having an inlet port 16 and a discharge port 17. A diagonal inlet passage 20 delivers fuel to the transfer pump 18 from an inlet pipe 22 which is connected to a fuel supply reservoir. The transfer pump delivers fuel under pressure through an outlet passage 24 in the housing 10 to an air separator 26 from whence the fuel flows through a passage 28 (FIG. 2) in the housing 10 to a longitudinal bore 30 in the housing. A slideable spring biased pressure regulating valve 32 (FIG. 3) is mounted in the bore 30 for regulating the output pressure of the pump 18. Regulating valve 32 delivers fuel to the metering valve 34 at a pressure correlated with the speed of the driving engine through conduit 33 and returns excess fuel to the transfer pump inlet conduit 20 through conduit 35.

The high pressure charge pump generally denoted by the numeral 40 is formed by a transverse bore 42 in rotor 14 in which are slidably mounted a pair of opposed plungers 44. The outer ends of the plungers engage against shoes 46 which are slidably mounted in transverse passages 48 formed by the bifurcated end 47 of a separable drive shaft 60 aligned with bore 42. As shown in FIG. 4, the bifurcated end of drive shaft 60 also provides a pair of flat opposed shoulders which engage complementarily shoulders 45 on the rotor 14 to drive the same.

Surrounding the rotary member 14 is a generally circular or ring-like cam ring 50 preferably constructed of hardened steel which encircles the rotor 14 in the plane of revolution of the plungers 44 and mounted for angular adjustment within an annular bore 49 in the pump housing. The cam has a plurality of pairs of diametrically opposed inwardly extending cam lobes 52 which are adapted to actuate the plungers 44 inwardly simultaneously for discharging fuel from the pump, it being understood that the rollers 43 and the roller shoes 46 are disposed between the plungers 44 and the cam 50 whereby the rollers 43 act as cam followers for translating the cam contour into this reciprocating movement of the plungers 44.

The C-shaped ring 56 secured to the charge pump by a screw fastener 58 (FIG. 4) provides an adjustable outer resilient top for the roll shoes 46. A seal 62 is provided to prevent leakage of fuel into or out of between the shaft 60 and the housing 10.

Upon rotation of the drive shaft 60, the transfer pump 18 and the charge pump 40 are rotated to supply measured charges of fuel under pressure to a plurality of fuel pump outlets 84 having suitable connections with the fuel injection nozzles of an associated engine. During the outward or intake stroke of the plungers 44 fuel is delivered to the charge pump from the metering port 41 by a passage 66 in the housing 10 and a diagonal passage 68 in the rotor 14. During the inward or discharge stroke of the plungers 44 fuel is delivered under high pressure by an axial passage 76 to a pressure-operated delivery valve 77 and a generally radially extending distributor passage 78 adapted for sequential registration with a plurality of angularly spaced radial delivery passages 63 in fluid communication respectively with a plurality of pump outlet passages 84, only one of which is shown for convenience of illustration. It is to be noted that a one-way check valve 68a prevents reverse flow through inlet passage 68 during the discharge stroke of charge pump 40.

As shown in FIG. 4, the housing 10 has a transverse bore 100 in which an automatic injection timing advance plunger 102 is reciprocally mounted. A passage 104 (FIG. 1) delivers regulated transfer pump outlet pressure from air separator 26 to bore 100. In the illustrated design, the plunger 102 includes a pilot valve 105 positioned in a chamber 106, one end of which is in continuous communication with housing passage 108 through passage 108 in plunger 102. A one-way valve is positioned in pilot valve 105 to prevent the reverse flow of fluid through the passage 108 as a result of intermittent pulsations.
tions of force imposed on the plunger 102 due to the operation of the charge pump.

Pilot valve 105 is also provided with an annular land 110 which is axially shiftable over port 111 in the plunger 102. Port 111 communicates through passage 112 to a chamber 113 formed in the end of transverse housing bore 110 to deliver fuel under pressure thereto when annular land 110 of the pilot valve is moved to the left to provide communication between passage 108 and port 111 via annulus 107. Inasmuch as the transfer pump pressure is a function of engine speed, the balanced position assumed by the outer valve is determined by the equilibrium between the forces imposed thereon by the transfer pump pressure and the spring 109, an end of which engages screw 103. This, in turn, determines whether the port 111 communicates with annulus 107 to receive additional fuel from the transfer pump (and hence shift plunger 102 to the left to advance the time of injection) or the port 111 communicates with passage 114 to dump a portion of the fuel trapped in the chamber 113 into the pump housing through passage 114 to permit the plunger 102 to move to the right.

An arm 115 having a cylindrical body 116 mounted in a complement of radial bore 118 in the plunger 102, and an integral head 120 closely received within a bore 101 of the cam ring 50 which serves as a socket therefor connects the plunger 102 and the cam 50. A snap ring 124 seated in an annular groove in the connector 115 prevents excess axial movement of the connector toward the cam ring.

In accordance with this invention, a governor 31 of simplified and improved construction is disposed within a chamber formed in the end cap 140 of the housing 10 as shown in FIG. 1. A driving gear 65 secured to the drive shaft 60 engages the gear 64 to provide a step-up drive for driving the governor. This step-up drive arrangement serves to amplify the speed of the rotation of the governor, by say 21/2 to 4 times, relative to that of the pump to permit the governor to be miniaturized.

An apertured sleeve 142, which projects into the governor chamber, is nonrotatably secured with respect to the housing 10 and provides a stub shaft on which the gear 64 is journaled to support the governor 31 for rotation.

As best seen in FIG. 5, an important feature of this invention is that the governor gear 64 is segmented at one end so that it also serves as the inner cage for the governor 31. The projecting V-shaped gear segments 150, shown as being in number, are spaced apart to form a plurality of rectangular pockets or slots 152, each of which may receive a governor weight 154 having a generally trapezoidal shape. The governor weights 154 are notched at 156 to provide inwardly extending fingers 158. A control member, or metering valve, 34 is slidably mounted for axial movement within the sleeve 142, has a thrust washer 160 at its inner end in engagement with the fingers 158 of the governor weights 154. The governor weights are adapted to pivot on the apex or corners 163 thereof in the outer corner 162 of the cap member 148 which, together with gear 64, serve to form the complete cage assembly for the governor weights. The center of gravity of the weights 154 is at the right of the apex 163, as viewed in FIG. 1, with the result that as the cage formed by the gear 64 and the cap member 148 is rotated, the weights will tend to pivot outwardly responsive to centrifugal force about the apaxes 163 thus applying an axial load through the fingers 158 and the thrust washer 160 to the metering valve 34. The reaction force is transmitted through the apaxes 162 of the cap member 148, the central hub 149 of which engages the thrust washer 146 of the adjusting screw 144 which is threaded into an aperture of the end wall of the governor chamber.

The parallel surfaces of the gear segments 150 defining the rectangular slots 152 serve to positively guide the pivotal movement of the weights 154 and to rotate the same as the gear 64 rotates.

In order to avoid any sticking of the metering valve 34, and to render it sensitive to slight changes in the speed of the governor the valve 34 is positively rotated by the gear 64 through a spider 164, the ends of which are positioned in a pair of the slots 152 of the gear 64. A generally rectangular aperture 166 at the center of the spider 164 engages a rectangular tang 168 on the end of the metering valve 34 to provide driving connection therebetween.

As seen in FIG. 1, the gear 64 is provided with an apertured elongated hub 170 which projects in the direction of the segments 150 to the end of sleeve 142 to improve the stability of the gear 64 on the sleeve 142. Since the hub is an integral part of the gear 64 it further provides a rotatable positive stop to limit the inward radial movement of the weights 154.

As shown in FIG. 5, each of the axially extending segments 150 of the gear 64 have, on their outer surfaces, a pair of gear teeth 172. The inner surface of the cap member 148 provides a plurality of radial inwardly raised radial ribs 174 each having a first portion 176. When the gear 64 and the cap member 148 are assembled to form the cage for the weights 154, the tooth 176 is positioned between the pairs of teeth 172 of one of the segments 150 to provide a positive drive for the cap member 148 from the gear 64 without the need for any additional parts. The number of ribs 174 correspond with the number of gear segments 150 and are angularly spaced apart by slots 178 which are aligned with the slots 152 between the gear segments for receiving the pivot ends of the governor weights 154.

Another feature of this invention is that the distance between diametrically opposed upper surfaces 175 of the ribs 174 is slightly less than the outer diameter of the gear teeth 172 so that the segments 150 must be deflected inwardly a small amount during the assembly of the cap 148 on the gear 64. With this arrangement, the resiliency of the gear segments 150 positively and accurately mounts the cap member concentrically on the governor weights with the gear and frictionally maintains the cap member 148 assembled on the gear 64.

The adjusting screw 144 permits the axial adjustment of the metering valve 34 when the governor is at rest so that the metering port is just fully disposed tooth 176. The passage 190 interconnects the chamber containing spring 29 with the annulus 192 around the opposite end of the metering valve 34 so that fuel in the spring chamber does not affect the axial position of the metering valve 34. The end of the spring 29 engages the metering valve 34 and the right end thereof engages a spool 180 having a central shank 182 surrounded by a light idle control spring 184. The central shank 182 of spool 180 bottoms against washers 188 when the throttle 25 is moved above idle speed and a throttle control member 186 engaging the end of idle control spring through any suitable low friction thrust connection such as washers 188 to accommo-
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5 date the rotation of the spring 29, spool 180 and spring 184 with the metering valve 34.

As will be apparent to persons skilled in the art, various modifications and adaptations of the structure above described will become readily apparent without departure from the spirit and scope of the invention, the scope of which is defined in the appended claims.

I claim:

1. A fuel pump governor comprising a gear, one end of which is segmented to provide a plurality of angularly spaced slots around the periphery thereof, a cap member engaging the segments of said gear for rotation therewith, a plurality of weights mounted selectively in at least some of said slots for pivotable movement during the rotation of the governor whereby said gear and said cap member form a cage for guiding the pivotable movement of said weights.

2. A device as recited in claim 1 wherein said gear has outwardly directed teeth from one end to the other said cap member having inwardly directed teeth to provide a driving connection therebetween.

3. A device as recited in claim 1 wherein the adjacent segments forming said one end of said gear have parallel sides for guiding the weights for radial movement.

4. A device as recited in claim 1 wherein the segments forming said one end of said gear resiliently engage said cap member.

5. A device as recited in claim 1 wherein said gear is provided with a central hub spaced inwardly from said segmented end thereof for limiting the inward movement of the free end of said weights.

6. A device as recited in claim 1 wherein said gear provided with an apertured central hub projecting in the direction of said segmented end, and a stub shaft receive within said aperture for mounting said governor for rotation.

7. A device as recited in claim 2 wherein each gear segment has a pair of teeth for straddling a mating tooth on said cap member.

8. A device as recited in claim 6 wherein a control member extends through an aperture in said stub shaft and is mounted for axial movement in response to the movement of said governor weights.

9. A device as recited in claim 8 wherein a spider having ends disposed in said slots of said gear engages said control member for positively rotating the same.

10. A device as recited in claim 9 in combination with a housing for said governor, and adjustable means on said housing providing a reaction surface for said control member for adjusting the axial position of said control member.

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JAMES J. GILL, Primary Examiner.

ROBERT S. SALZMAN, Assistant Examiner.