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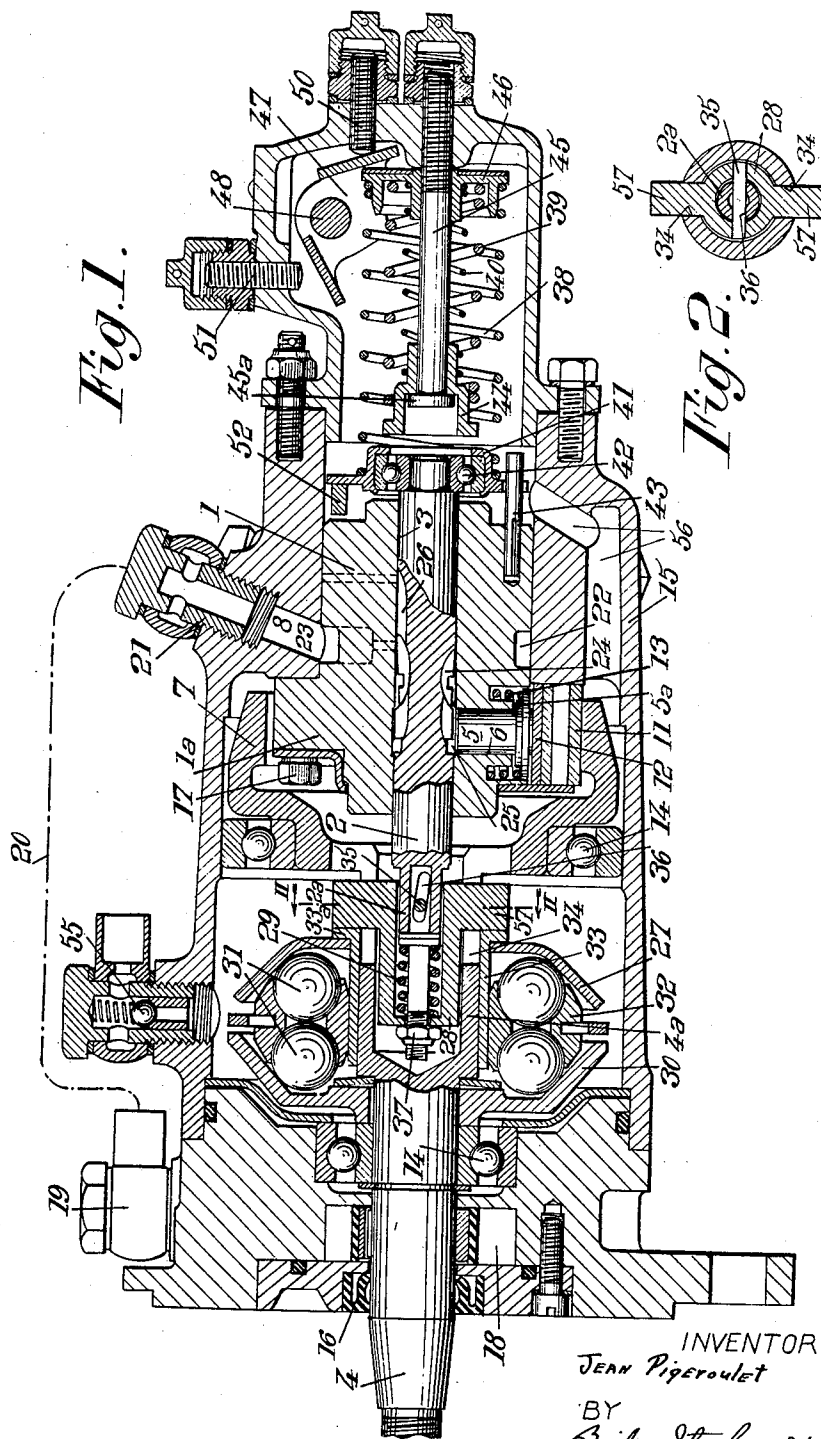


Fig. 1.

Fig. 2.

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COUPLING FOR FUEL INJECTION PUMPS

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4 Claims. (Cl. 64-24)

The present invention relates to fuel injection pumps for multi-cylinder internal combustion engines. The type of pump with which this invention is concerned comprises two elements driven by each other, to wit a shaft driven by the internal combustion engine fed with fuel by the pump and a rotating piece acting as distributor for the pump, these two elements being coupled together by a sleeve comprising on the one hand, outer projections each engaged in a longitudinal groove provided in a portion of one of the above mentioned elements and on the other hand, an inner projection located substantially in the same transverse region as said outer projections and engaged in a longitudinal groove provided in a portion of the other of said elements, at least one of said grooves being oblique with respect to the axis of the shaft so that displacements of the sleeve parallel to this axis produce relative angular displacements between the above mentioned elements and, consequently, vary the relative time of beginning of fuel injection.

The objection of the present invention is to provide a pump of this kind which is capable of working correctly despite a defect of alinement between the shaft and the piece.

For this purpose, according to the present invention, said outer projections extend in a diametral plane of said sleeve perpendicular to that in which said inner projection is located, said inner projection extending diametrically through said sleeve so that it bears symmetrically upon the portion of the element engaged in said sleeve, and said sleeve being mounted with a transverse play with respect to both of said elements.

A preferred embodiment of the present invention will be hereinafter described with reference to the accompanying drawings, given merely by way of example and in which:

FIG. 1 is a longitudinal sectional view of a pump made according to the invention; and

FIG. 2 is a cross-section on the line II—II of FIG. 1.

The pump shown by the drawing comprises a fixed body 1 and a piece 2, acting as a distributing valve and rotating in a cylindrical bore 3, provided in said body, this piece being driven by a coaxial shaft 4, itself driven by the internal combustion engine (not shown) fed with fuel by the pump. Two opposed pump pistons 5, one of which is visible in FIG. 1, are mounted slidable in a cylindrical bore 6 substantially perpendicular to the theoretical axis common to piece 2 and shaft 4. These pistons 5 are actuated by an annular cam 7 comprising a number of inward projections equal to the number of cylinders of the engine to be fed with fuel by the pump (four, for instance). Fixed body 1 is provided with radial distribution channels 8 leading respectively to the fuel injectors (not shown) of the engine, these channels being adapted to communicate with the pump cylindrical bore 6.

Annular cam 7 is carried by shaft 4, and the two pump pistons 5 are mounted in a portion 1a of body 1 engaged in said cam, transverse cylindrical bore 6 extending along a diameter of said body. Cam 7 exerts a centripetal action upon pistons 5, through rollers 11 and shoe members 12, the pistons being urged in the outward direction by springs such as 13 acting upon a flange 5a of each of said pistons.

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Cam 7 is preferably integral with shaft 4, the elements thus formed being mounted on ball bearings 14 in a casing 15. Shaft 4 extends through one end face of this casing, with the interposition of packing means 16. Distributing valve piece 2 is distinct from shaft 4, and coupled therewith by a device which will be hereinafter described, this piece 2 being mounted with a sliding fit in the bore 3 of body 1, which is fixed to casing 15 by means of screws 17.

The feed circuit of the pump bore 6, is made as follows. Shaft 4 carries a feed pump 18, adapted to communicate with two connecting elements 19 and one of which serves to the inlet of fuel and the other to its delivery, these two elements being adapted to have their respective functions exchanged according as shaft 4 is rotating in one direction or the other. The inlet connecting element 19 is in connection with a fuel intake and the delivery connecting element 19 communicates through a pump 20 with another inlet connecting element 21, with the interposition of a filter (not shown). The connecting element 21 is in permanent connection, through a groove 22 provided in the periphery of body 1, with radial holes 23, the number of which is equal to that of the engine cylinders and which open into bore 3 opposite a longitudinal groove 24 provided in distributing piece 2. This groove 24 leads to a peripheral groove 25 provided in piece 2 and in permanent communication with pump bore 6.

The delivery circuit comprises a second longitudinal groove 26 starting from groove 25 and leading to a region opposite distributing channels 8.

It will be understood that injection begins when a radial hole 23 ceases to communicate with groove 26 and that it stops when the next radial hole 23 begins to communicate with groove 24.

A regulating system capable of varying the angular position and possibly the longitudinal position of distributing valve piece 2 with respect to driving shaft 4 is provided. The variation of angular position of piece 2 causes an angular off-setting, with respect to shaft 4, of the period during which no radial hole 23 is in connection with grooves 26 and 24, i.e. a variation of the respective time of beginning of injection. On the other hand, a possible variation of the longitudinal position of said piece 2 causes a variation of the flow-rate per revolution of the pump if care is taken to limit grooves 24 and/or 26 by surfaces oblique with respect to the axis of piece 2, and disposed in the transverse region of radial holes 23. To obtain such a regulation, distributing valve 2 is driven by shaft 4 through a sleeve 28 interposed between the two last mentioned elements. This sleeve 28 comprises on the one hand, opposite external projections 57, each engaged in a groove 34 parallel to the axis of shaft 4 and provided in a portion of said shaft, and on the other hand, an inner projection 35, located substantially in the same transverse region as the outer projections 57 and engaged in an oblique groove 36, provided in the end portion of piece 2. A governor is provided to exert on sleeve 28, against the action of suitable return springs, an axial thrust which varies correspondingly with the speed of shaft 4. Grooves 24 are formed in a tubular portion 4a of shaft 4 located between said shaft proper and cam 7, sleeve 28 being housed in this tubular portion 4a.

According to the present invention, the outer projections 57 and the inner projection 35 extend radially in two directions respectively perpendicular to each other, (as shown by FIG. 2). Furthermore, the inner projection 35 extends from one side to the other of the sleeve so as to pass throughout the portion of piece 2 in which groove 36 is provided, and the whole is arranged in such manner as to leave a transverse play between sleeve 28 and shaft 4 on the one hand, and between sleeve 28 and piece 2 on the other hand.

For this purpose, said inner projection 35 consists of a transverse pin, and groove 36 consists of two helical slots provided symmetrically in the tubular end portion 2a of piece 2.

Furthermore, the above mentioned governor exerts its action through a tubular member 33 coaxial with portion 4a of shaft 4, and fitting slidably thereon. Sleeve 28 is mounted with a slight transverse play in this portion 4a and the projections 57 of said sleeve bear against the smooth surface of a flange 33a of tubular member 33, whereby sleeve 28 can have a limited transverse displacement in the diametral direction of projections 57 and parallelly to itself owing to the fact that it is guided by flange 33a.

A small play is further provided between the inner wall of sleeve 28 and the outer wall of the portion 2a of piece 2, pin 35 being mounted so as not to project beyond said outer wall of part 2a.

The governor above referred to is of the centrifugal type and is made as follows.

Shaft 4 carries fixed thereon a disc 30 provided with recesses adapted to drive in rotation centrifugal masses consisting each of a pair of balls 31, held in a cage 32 which is radially guided, one of the balls of every pair being engaged in a recess of disc 30 and the other one bearing upon the inner face of a cup shaped part 27 carried by tubular member 33.

To be able to vary not only the relative time of injection but also the flow-rate per cycle of the pump in accordance with the speed thereof, a spring 29 is interposed between sleeve 28 and piece 2 and the springs of the governor act not directly upon sleeve 28 but upon piece 2, for instance upon the end thereof that projects from body 1, on the side opposed to that where shaft 4 is mounted.

There may be provided a return spring 38, called "overload" spring, acting normally in a permanent fashion upon distributing valve piece 2, and one or several return springs 39 and 40, called regulating springs, acting upon piece 2 only when the speed of the pump exceeds a given value, i.e., after a preliminary axial displacement of piece 2 from its overload position. Spring 38 bears upon a cup shaped member 41 mounted at the end of piece 2, preferably with the interposition of a ball bearing 42, and which is prevented from rotating by a pin 43, whereas springs 39 and 40 bear upon a second cup shaped member 44, which is slidably mounted upon a rod 45 and the displacement of which toward piece 2 is limited by a shoulder 45a carried by said rod and which determines the flow-rate under full load. As for spring 29 it is housed in sleeve 28, its tension being adjustable by means of a nut 37.

Preferably, spring 29 and the return springs of the governor are adjusted in such manner that the first one yields before the others, i.e. in such manner that the angular position of piece 2 with respect to shaft 4 (determining the beginning of injection) is modified before its relative longitudinal position (flow-rate regulation) is modified.

The usual control means of the internal combustion engine is arranged in such manner as to permit of increasing the compression of return springs 38, 39 and 40.

For this purpose these springs bear, on the side opposed to distributing valve piece 2, upon a cup shaped member 46 operatively connected with control lever 47, which may be actuated from the outside of the casing, through a shaft 48, between two given limit positions by means of adjustable abutments 50 and 51.

Furthermore, in order to make it possible to stop the internal combustion engine by reducing the flow-rate of the pump to zero, there is provided a control capable of displacing distributing valve 2 independently of the action of the centrifugal governor, this control acting upon cup shaped member 41 through an inner lever 52.

The pump comprises a system for circulating fuel in-

side the casing to lubricate the parts of the pump. This system comprises a leak starting from groove 22 and adjustable in such a manner that the groove remains always under pressure, this leak making it possible to fill the portions of the casing disposed on either side of body 1 and connected together by a passage 56, a valve 55, adjusted to a pressure lower than the pressure of operation of groove 22, limiting the pressure in the casing and permitting circulation of the lubricating fuel.

This pump works as follows:

When shaft 4 is rotating, together with its cam 7, pistons 5 are caused to reciprocate in bores 6. During the suction strokes, the fuel under pressure in groove 22 passes through the holes 23 that are opposite grooves 24 and 26, and comes to fill the volume created in bore 6 by the outward movement of pistons 5. During the delivery strokes, fuel is forced into groove 25 and grooves 24 and 26. As long as one of the holes 23 is cleared by groove 26, fuel is discharged through this hole into groove 22, and there is no injection. As soon as distributing valve piece 2, which rotates at the same speed as cam 7, has closed this hole, the fuel delivered by pistons 5 passes through groove 26 and through that of channels 8 which is located opposite this groove, thus reaching the corresponding fuel injector. Injection then takes place, until the groove 24 clears the next hole 23.

The governor determines the angular position corresponding to the beginning of injection and the flow-rate of the pump per cycle thereof in the following manner. During the first portion of the displacement of ball 31 (toward the right of FIG. 1) from the overload position of distributing valve piece 2, cup-shaped member 27 is moved in the same direction, first compressing spring 38 the tension of which is smaller than that of spring 29. Cup-shaped member 41 then comes into contact with cup shaped member 44. As balls 31 keep moving in the same direction, spring 29, the tension of which is smaller than the sum of the tensions of springs 38, 39 and 40 when lever 47 is on its full load abutment 51, is now compressed. Sleeve 28 alone accompanies the axial movement of cup-shaped member 27. Pin 35 thus moves in the double groove 36 of piece 2 which remains fixed in the axial direction, and as this groove is oblique, the angular position of distributing valve piece 2 with respect to shaft 4 is modified, which changes the angular position of the beginning of injection as above explained.

When the amplitude of displacement of cup-shaped member 27 becomes such that the tension of spring 29 is greater than that of the whole of springs 38, 39 and 40, these last mentioned springs are compressed. The axial position of distributing valve piece 2 therefore varies from this time on and, due to the inclination of the surfaces limiting grooves 24 and 26, the flow-rate per revolution of shaft 4 decreases as above explained.

As soon as the internal combustion engine has been started, balls 31 move radially in the outward direction and cup-shaped member 27 moves in such manner that cup-shaped member 41 comes into contact with cup-shaped member 44, which brings regulation springs 39 and 40 into action. Grooves 26 and 34 then determine the beginning and the end of injection according to the load determined by the position of lever 47.

In order to stop this engine it suffices to act onto cup shaped member 41 by means of lever 52.

In the usual case where distributing valve piece 2 is not in accurate alinement with shaft 4 but is however parallel thereto, the device constituted by sleeve 28 and projections 35 and 57 acts as an Oldham joint and, consequently, causes piece 2 to be driven with an instantaneous angular speed always equal to that of shaft 4. Consequently, the amounts of fuel fed on every revolution of shaft 4 toward the respective injectors through channels 8 are exactly equal to one another, which constitutes an extremely important advantage for a fuel injection pump.

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Instead of being of the centrifugal type the governor acting upon sleeve 28 may be of any suitable type, for instance, of the hydraulic type.

What I claim is:

1. In a mechanism comprising two elements consisting of a driving shaft and a rotating piece having its axis parallel to that of said shaft and approximately in line therewith, a device for transmitting the rotation of said shaft to said piece while permitting limited adjustment displacements of said piece with respect to said shaft both in the longitudinal direction and angularly about the axis of rotation of said piece, which device comprises, in combination with said two elements, a sleeve substantially coaxial therewith, outer radial projections carried by said sleeve, and an inner radial projection carried by said sleeve in the same transverse region as said outer projections, one of said elements being provided with longitudinal grooves arranged to accommodate said outer projections respectively, the other of said elements being provided with a longitudinal groove adapted to accommodate said inner projection, at least one of said grooves being oblique with respect to the shaft axis so that relative axial displacements of said sleeve produce relative angular displacements between said shaft and said piece, said radial outer projections extending in a diametral plane of said sleeve perpendicular to that in which said inner radial projection is located, said inner projection extending diametrically through said sleeve so that it bears symmetrically upon the portion of the element engaged in said sleeve, and said sleeve being mounted with a transverse play with respect to both of said elements.

2. In a mechanism comprising a driving shaft and a rotating piece having its axis parallel to that of said shaft and approximately in line therewith, a device for transmitting the rotation of said shaft to said piece while permitting limited adjustment displacements of said piece with respect to said shaft both in the longitudinal direction and angularly about the axis of rotation of said piece, which device comprises, in com-

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bination with said shaft and said piece, a sleeve substantially coaxial therewith, engaged in one end of said shaft and surrounding one end of said piece, two opposed outer projections carried by said sleeve and located in a diametral plane thereof, said shaft being provided with longitudinal grooves adapted to accommodate said outer projections, and an inner projection extending from one side to the other of said sleeve and located in a diametral plane thereof perpendicular to said first mentioned diametral plane, said inner projection being located in the same transverse region as said outer projections, said piece being provided with oblique grooves arranged to accommodate said inner projection so that relative axial displacements of said sleeve produce relative angular displacements between said shaft and said piece, said sleeve being mounted with a transverse play with respect to both said shaft and said piece.

3. A device according to claim 2 wherein said inner projection is a pin extending transversely through said sleeve, the portion of said piece through which said pin passes being tubular and the grooves provided in said piece to accommodate said pin being two helical slots formed opposite each other in said tubular portion.

4. A device according to claim 2, further comprising a tubular member fitting on the outer periphery of said shaft and including a flange located in a plane perpendicular to the axis of said shaft, said outer projections of said sleeve having faces fitting slidably against the surface of said flange whereby said sleeve can move transversely to its axis and parallelly to itself in the direction of the diametral plane of the outer projections.

References Cited in the file of this patent

UNITED STATES PATENTS

1,029,764	Opsahl	June 18, 1912
1,632,223	Fey	June 14, 1927
2,107,070	Fleury	Feb. 1, 1938
2,914,054	Deutschmann	Nov. 24, 1959