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ADJUSTABLE INJECTION PUMP

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FIG. 1.

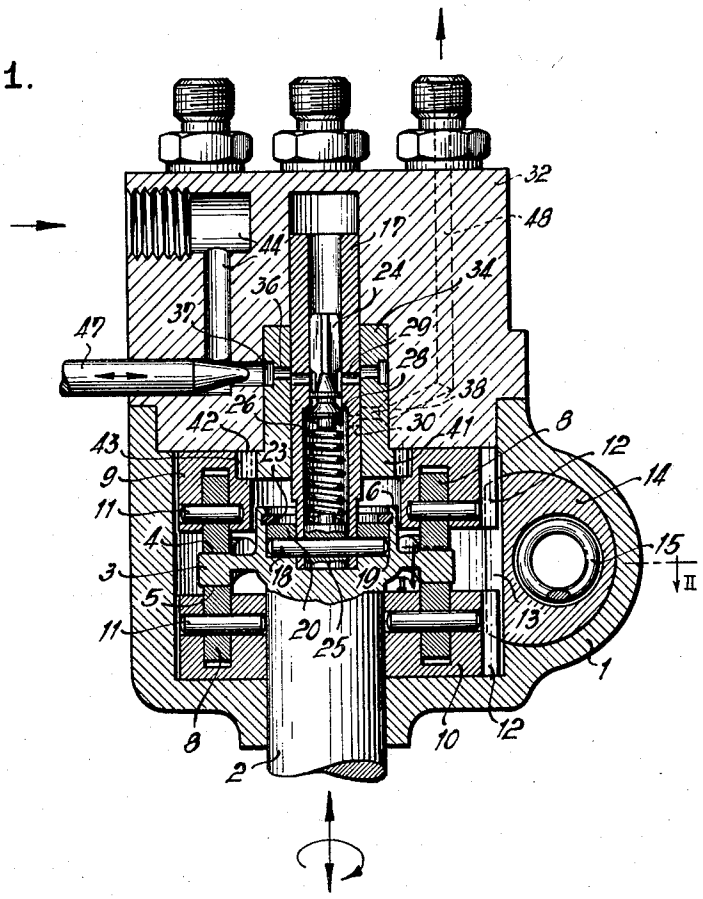
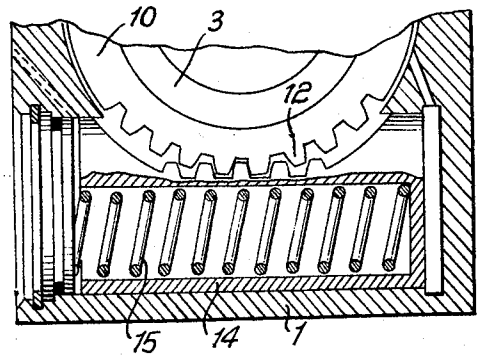


FIG. 2.



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ADJUSTABLE INJECTION PUMP

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6 Claims. (Cl. 123—139)

The present invention relates to injection pumps.

It is conventional in injection pumps to provide a means for regulating the moment at which fuel is supplied to the engine cylinders. This regulating means may be automatic and operates so as to start the delivery of fuel to the cylinders at earlier instance in the operating cycles thereof as the engine speed increases.

However, with such injection pumps there is a disadvantage in that the changing of the moment when fuel supply begins for the several cylinders results in undesirable diminishing of the cross-sectional area of the passages through which the fuel flows into the pump and to the cylinders, so that the amount of fuel supplied by the injection pump to the cylinders is undesirably influenced.

One of the objects of the present invention is to overcome the above drawbacks by providing an injection pump wherein the cross-sections of the paths of flow of the fuel into the pump and to the engine cylinders remain unchanged even though adjustments are made in the moment when fuel supply begins.

Another object of the present invention is to provide a structure composed of simple, rugged elements which operate reliably to accomplish this result.

On the other hand, it may be desirable to change the amount of fuel delivered to the cylinders in a controlled manner. Thus, as was pointed out above, the moment when fuel delivery begins is automatically regulated as the speed of the engine changes. At the same time, the maximum amount of fuel which can be burned in a smoke-free manner by the engine also depends upon the speed thereof. Therefore, it may also be desirable to regulate the maximum possible amount of fuel which can be delivered to the cylinder so that they never receive more fuel than can be burned in a smoke-free manner at the particular speed of the engine, and it is an object of the present invention to control the cross-sections of the paths of flow of fuel into the pump and to the cylinders in a manner which will not permit the cylinders to receive more fuel than can be burned in a smoke-free fashion at the particular speed of the engine.

With the above objects in view, the present invention includes in an injection pump, a combined piston and distributing member which reciprocates and rotates during operation of the pump. This member is hollow and is formed with a discharge passage through which fuel flows during the pressure strokes of the combined pump and distributing member. The cam drive means cooperates with this member to reciprocate the same along its pressure and suction strokes while it rotates, and this cam drives means includes an adjustable element which is turned about the axis of the combined piston and distributing member to adjust the moment when fuel delivery begins to the several cylinders. A sleeve surrounds and engages the outer surface of the combined piston and distributing member, and the latter reciprocates and rotates in this sleeve which is formed with a plurality of passages distributed about the axis of the member and forming parts of the paths of fuel flow into the pump and to the

several cylinders. The discharge passage of the piston member communicates successively with the sleeve passages during operation of the pump. In accordance with the present invention this sleeve of the present invention is connected by a suitable means at least indirectly with the adjusting element of the cam drive to turn about the axis of the piston member when the adjusting element is turned to control the moment of fuel delivery to the several cylinders.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, hwoever, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of a specific embodiment when read in connection with the accompanying drawing, in which:

Fig. 1 shows one possible embodiment of the invention in an axial sectional elevational view; and Figure 2 is a partial sectional view taken along line II—II of Figure 1, viewed in direction of the arrows.

Referring to the drawing, it will be seen that the injection pump includes a housing or housing member 1 in which a drive shaft 2 reciprocates and rotates. This drive shaft 2 is driven in a conventional manner by the engine itself. The drive shaft 2 forms part of a cam drive means which includes a cam ring 3 fixed to the drive shaft 2 and located in the housing 1, and this cam ring 3 is provided at its top and bottom faces, as viewed in the drawing, with wavy annular camming surfaces 4 and 5, respectively. Also, the drive shaft 2 has an upper hollow end portion 6 which serves to receive structure for connecting the combined pumping and distributing member 17 to the shaft 2 for reciprocatory and rotary movement therewith. The cam ring 3 rides along rollers 8 which are respectively supported for rotation by shafts 11 carried by the rings 9 and 10. These rings 9 and 10 form part of the cam drive means, and the cooperation of the cam ring 3 with the rollers 8 of these rings causes the shaft 2 to reciprocate. In addition, the rings 9 and 10 form adjusting elements of the cam drive. By turning these rings about the common axis of elements 2 and 17, the moment when fuel is supplied to the several cylinders of the engine can be regulated. For this purpose each of the rings 9 and 10 is provided, along part of the outer periphery, with axial teeth 12 which mesh with teeth 13 of a piston 14 which extends tangentially with respect to the rings 9 and 10. The coil spring 15 engages the piston 14, as best shown in Fig. 2, to urge the latter in one direction, and the piston 14 is urged, in a conventional manner, in the opposite direction by a liquid under pressure and the pressure of this liquid varies with changes in the speed of the engine, so that in this way the elements 9 and 10 are automatically adjusted to automatical control the moment when fuel supply to several cylinders begins.

The end of the combined pumping and distributing member 17 which extends into the open end 6 of the drive shaft 2 carries a cross pin 18 whose free ends are located in a pair of diametrically opposed recesses 19 of the shaft 2, respectively. A ring 20 is located in the end 6 of the shaft 2 and engages the cross pin 18, while a snap ring 23 in an annular groove of the shaft 2 maintains the ring 20 in the position shown in the drawing so that the pin 18 cannot leave the recesses 19, and in this way the combined pumping and distributing member 17 is connected to the shaft 2 for reciprocatory and rotary movement therewith.

The pumping and distributing member 17 is axially bored so that it is in the form of a tube, and it carries in its interior an axially movable valve member 24 as well as a pin 25 which is pressed fluid-tightly into the interior

of the member 17 adjacent its bottom end, as viewed in the drawing. It will be noted that the pin 18 passes through a bore of the member 25. A coil spring 26 presses at one end against the member 25 and at its opposite end against the valve member 24 to urge the latter to a closed position engaging a valve seat 28 in the form of an annular shoulder in the interior of the tubular member 17. Above this shoulder 28, as viewed in the drawing, the tubular member 17 is formed in its wall with inlet passages 29, and below the shoulder or seat 28 the member 17 is formed in its wall with a discharge passage 30 shown in dotted lines and extending from the interior to the exterior of the member 17. The number of inlet passages 29 is equal to the number of engine cylinders supplied by the injection pump.

The housing 1 carries a pump body 32 in a bore of which the member 17 is partly guided. The member 17 additionally extends through a cylindrical sleeve 34 in which the member 17 reciprocates and rotates, and the sleeve 34 is turnable in pump body 32. The sleeve 34 is provided with a pair of diametrically opposed inlet passages 36 which communicate with an annular groove 37 formed in the exterior surface of the sleeve 34. Furthermore, this sleeve 34 is formed with a plurality of passages 38 equal in number to the number of cylinders of the engine and forming parts of the paths through which the fuel flows to the several cylinders. These passages 38 are distributed about the axis of member 17 whose outer cylindrical surface is surrounded and slidably engaged by the inner cylindrical surface of the sleeve 34. One of the passages 38 is shown in dotted lines in the drawing, and the discharge passage 30 of member 17 successively communicates with the several passages 38 during operation of the pump.

In accordance with the present invention the sleeve 34 of the present invention is interconnected by a suitable means with the adjusting element 9 of the cam drive so that the sleeve 34 turns about the axis of member 17 when the adjusting element 9 turns about this axis. This means in the illustrated example takes the form of a flange 41 provided at the bottom end of sleeve 34, as viewed in the drawing, and having outer projections 42. The annular adjusting means 9 has a portion formed with recesses 43 which respectively receive the projections 42 so that with the illustrated embodiment of the invention the sleeve 34 is connected by projections 42 and recesses 43 directly with the ring 9 for turning movement therewith through the same angle.

The pump body 32 is provided with a fuel inlet passage 44 having a pair of right-angle turning points therein, and at the second of these turning points, a throttling valve member 47 is located. This member 47 is axially shifted by an unillustrated conventional regulator so as to control the cross-section of the passage through which the fuel flows into the pump. The pump body 32 is furthermore provided with a number of discharge passage portions 48 equal in number to the number of cylinders to the engine, and one of these passage portions 48 is shown in dotted lines in the drawing. The several passage portions 48 are respectively in permanent communication with the several passages 38 of the sleeve 34.

The above-described injection pump operates in the following manner:

During a rotation of the drive shaft 2 the latter, as well as the combined pumping and distributing member 17, reciprocate as many times as there are cylinders in the engine which is supplied by the pump. During the outward or suction strokes of member 17 the fuel is sucked into the working chamber of the pump through the inlet passage 44, the annular groove 37, the inlet passages 36, and the inlet passages 29, and during the inward or pressure strokes the increase in the pressure of the fuel in the working chamber of the pump causes the valve 24 to automatically open so that the fuel flows past this valve to the discharge passage 30 of member 17 and from the latter through one of the passages 38 and passage portion 48 to a cylinder.

When, as a result of a changing in the pressure of the liquid acting on the piston 14 due to a change in the speed of the engine the piston 14 shifts, then by cooperation of the teeth 13 with the teeth 12 the adjusting elements 9 and 10 also turn and the turning of the upper adjusting element 9 is transmitted to the sleeve 34. As a result of the simultaneous turning of the sleeve 34 with the ring 9, the operative relationship between inlet passages 29 and 36, on the one hand, and discharge passages 30 and 38, on the other hand, remains unchanged, so that the adjustment of the moment when fuel supply begins will have no effect on the amount of fuel supplied. In other words, with the structure of the invention, there is no change in the cross-section of the path of fuel flow through the inlet and discharge passages of the sleeve 34 and piston 17. In order that there will be no change in the cross-section of the path of fuel flow at the outer surface of the sleeve 34, the latter is provided with the annular groove 37 which communicates with the inlet passages 36, and the outer ends of the discharge passages 38 of the sleeve 34 are flared outwardly so as to be enlarged, as shown in the drawing, and thus there will be no change in the cross-section of the path of fuel flow between discharge passages 38 and the passage portion 48, respectively. In this way, the structure of the invention is capable of regulating the moment when fuel supply begins to the several cylinders without changing the cross-sections of the paths of fuel flow to the cylinders or to the pumping chamber, so that there is no influence on the amount of fuel supplied.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of injection pumps differing from the types described above.

While the invention has been illustrated and described as embodiment in adjustable injection pumps, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In an injection pump, in combination, a reciprocable and rotatable hollow pumping and distributing member formed with an inlet passage through which fuel flows into the pump and with a discharge passage through which fuel flows to an engine cylinder when said member moves along a pressure stroke thereof; cam drive means cooperating with said member for axially reciprocating the same along its pressure and suction strokes during rotation of said member, said cam drive means including an adjusting element turnable about the axis of said member for controlling the moment when fuel supply begins during each pressure stroke of said member; a sleeve surrounding and engaging the outer surface of said member, the latter reciprocating and rotating in said sleeve and said sleeve being formed with a passage forming a part of the path through which the fuel flows into the pump and with a plurality of passages equal in number to the number of engine cylinders and distributed about the axis of said member, and forming parts of the paths through which the fuel flows to the several cylinders of the engine, and said inlet and discharge passages of said member successively communicating with said sleeve passages;

and means operatively connecting said sleeve to said adjusting element of said cam drive means for turning movement about the axis of said member when said adjusting element is turned about said axis.

2. In an injection pump, in combination, a reciprocable and rotatable hollow pumping and distributing member formed with an inlet passage through which fuel flows into the pump and with a discharge passage through which fuel flows to an engine cylinder when said member moves along a pressure stroke thereof; cam drive means cooperating with said member for axially reciprocating the same along its pressure and suction strokes during rotation of said member, said cam drive means including an adjusting element turnable about the axis of said member for controlling the moment when fuel supply begins during each pressure stroke of said member; a sleeve surrounding and engaging the outer surface of said member, the latter reciprocating and rotating in said sleeve and said sleeve being formed with a passage forming a part of the path through which the fuel flows into the pump and with a plurality of passages equal in number to the number of engine cylinders and distributed about the axis of said member, and forming parts of the paths through which the fuel flows to the several cylinders of the engine, and said inlet and discharge passages of said member successively communicating w th said sleeve passages; and means connecting said sleeve directly to said adjusting element for turning movement together therewith through the same angle about the axis of said member.

3. In an injection pump, in combination, a reciprocable and rotatable hollow pumping and distributing member formed with an inlet passage through which fuel flows into the pump and with a discharge passage through which fuel flows to an engine cylinder when said member moves along a pressure stroke thereof; cam drive means cooperating with said member for axially reciprocating the same along its pressure and suction strokes during rotation of said member, said cam drive means including an adjusting element turnable about the axis of said member for controlling the moment when fuel supply begins during each pressure stroke of said member; a sleeve surrounding and engaging the outer surface of said member, the latter reciprocating and rotating in said sleeve and said sleeve being formed with a passage forming a part of the path through which the fuel flows into the pump and with a plurality of passages equal in number to the number of engine cylinders and distributed about the axis of said member, and forming parts of the paths through which the fuel flows to the several cylinders of the engine, and said inlet and discharge passages of said member successively communicating with said sleeve passages, said sleeve having a plurality of projections and said adjusting element having a plurality of recesses respectively receiving said projections, so that said projections and the portion of said adjusting element formed with said recesses form a means connecting said sleeve directly to said adjusting element for turning movement therewith through the same angle about said axis of said pumping and distributing member.

4. In an injection pump, in combination, a tubular cylindrical pumping and distributing member reciprocating along its axis and rotating about its axis during operation of the pump, said tubular member being formed with an inlet passage passing through its wall and through which fuel flows during the suction strokes of said member and with a discharge passage passing through its wall and through which fuel discharges during the pressure strokes of said member; a cam ring fixed to said member for reciprocatory and rotary movement therewith; a cylindrical sleeve surrounding and engaging the outer surface of said tubular member, the latter reciprocating and rotating in said sleeve and said sleeve being formed with a passage forming a part of the path through which the fuel flows into the pump and with a plurality of passages distributed about the axis of said member, equal in number to the number of engine cylinders, and forming parts of the paths through which fuel flows to the engine cylinders, said inlet and discharge passages of said tubular member successively communicating with said passages of said sleeve during rotation of said tubular member; annular means coaxial with said member and cooperating with said cam ring for reciprocating said member during rotation thereof, said annular means being located adjacent said sleeve; adjusting means cooperating with said annular means for changing the angular position thereof to control the moment at which fuel delivery to the several engine cylinders begins; and means operatively connecting said sleeve to said annular means for turning movement about the axis of said tubular member when said annular means is turned by said adjusting means.

5. In an injection pump for a multi-cylinder combustion engine, in combination, a housing member formed with a bore and an inlet passage means through which fuel flows into the pump and a plurality of discharge passage means equal in number to the number of engine cylinders and distributed about the axis of said bore, said inlet passage means and said plurality of discharge passage means communicating with said bore; a hollow pumping and distributing piston arranged reciprocably and rotatably in said bore and being formed with an inlet passage through which fuel flows into the pump when said inlet passage in said piston is at least partly aligned with said inlet passage means in said housing member and when said piston moves along a suction stroke and with a discharge passage through which fuel flows to an engine cylinder when said discharge passage in said piston is at least partly aligned with one of said discharge passage means in said housing member and when said piston moves along a suction stroke; cam drive means cooperating with said piston for axially reciprocating the same along its pressure and suction strokes during rotation of said piston, said cam drive means including an adjusting element turnable about said axis of said piston for controlling the moment when fuel supply begins during each pressure stroke of said piston; a sleeve member located in said bore coaxial with said piston and engaging with the inner surface thereof the outer surface of said piston and with the outer surface thereof the bore surface of said housing member, said sleeve member being formed with a first passage means forming part of the path through which the fuel flows into the pump and with a plurality of second passage means equal in number to the number of said plurality of discharge passage means in said housing member and distributed about the axis of said bore, and forming part of the path through which the fuel flows to the cylinders of the engine, said inlet and discharge passages of said piston successively communicating with said sleeve passage means, said sleeve passage means having at the inner surface of said sleeve member a cross-section substantially matching the cross-sections of said passages of said piston with which they respectively communicate and the passage means in one of said members having at the engaging surface of said members a passage portion extending in circumferential direction a greater distance than the passage means in the other of said members; and means operatively connecting said sleeve member to said adjusting element of said cam drive means for turning movement about said axis of said piston when said adjusting element is turned about said axis.

6. In an injection pump, in combination, a reciprocable and rotatable hollow pumping and distributing member formed with an inlet passage through which fuel flows into the pump and with a discharge passage through which fuel flows to an engine cylinder when said member moves along a pressure stroke thereof; cam drive means cooperating with said member for axially reciprocating the same along its pressure and suction strokes during rotation of said member, said cam drive means including an adjusting element turnable about the axis of said member

for controlling the movement when fuel supply begins during each pressure stroke of said member; a sleeve surrounding and engaging the outer surface of said member, the latter reciprocating and rotating in said sleeve and said sleeve being formed with a passage forming a part of the path through which the fuel flows into the pump and with a plurality of passages equal in number to the number of engine cylinders and distributed about the axis of said member, and forming parts of the paths through which the fuel flows to the several cylinders of the engine, and said inlet and discharge passages of said member successively communicating with said sleeve passages, said passages in said sleeve having at the ends thereof directed toward said pumping and distributing member a cross-section substantially matching the cross-sections of

said inlet and discharge passages with which they respectively communicate and said passages being widened at least in circumferential direction at the other ends thereof; and means operatively connecting said sleeve to said adjusting element of said cam drive means for turning movement about the axis of said member when said adjusting element is turned about said axis.

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