July 15, 1958 W. SCHNEIDER 2,843,043

INJECTION PUMPS

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Fig. 1

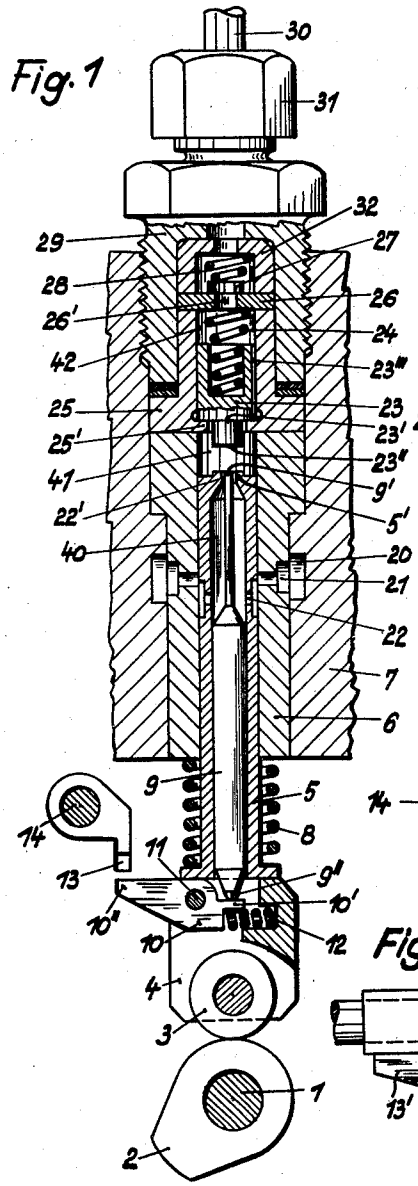


Fig. 2

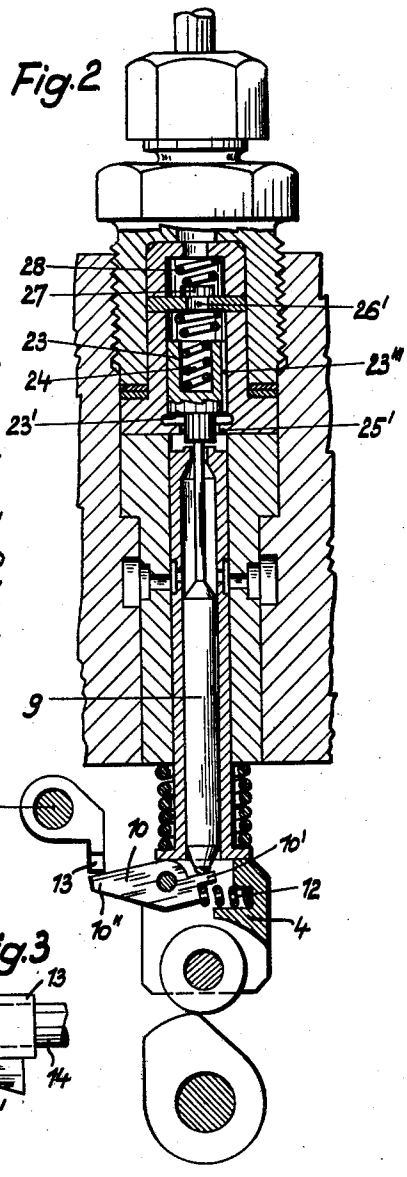


Fig. 3

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INJECTION PUMPS

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5 Claims. (Cl. 103—40)

This invention relates to injection pumps of the pop-controlled type, for internal-combustion engines, which may be diesel engines or Otto engines with fuel injection. The application of the present pumps to other types of internal-combustion engines operating with intermittent fuel injection is also contemplated.

In most injection pumps the quantity of fuel delivered per discharge stroke is controlled by the cooperation of the helical control edge of a working piston with a control edge of the casing at an earlier or later phase of the working stroke, depending on the angular portion of the piston relative to the control edge of the casing, whereby the discharge of fuel into the nozzle is interrupted. That widely used construction is expensive and the control edges are subjected to considerable wear.

The pop control is effected by a member which blocks a connection between the discharge space and a relatively non-pressurized space during the discharge stroke and which is popped open at an adjustable point of time to cause a collapse of the fuel pressure in the nozzle line.

An injection pump has been disclosed whose piston has a fuel passage leading from the pump inlet to the discharge space of the pump and cooperates after a predetermined movement with a closing member which interrupts that passage, whereupon the piston discharges fluid under pressure into the nozzle line. In that construction the quantity of fuel is regulated thereby that the closing member is more or less approached to the pump piston from the outside to cause said interruption to occur at an earlier or later time, depending on the quantity of fuel to be discharged per pump stroke. The adjustment of the closing member requires adjusting means which extend to the outside but which are subjected to the full working pressure of the pump. This involves great sealing difficulties.

The invention provides an improved construction for the last-mentioned type of injection pumps, which comprise a pump casing formed with a pump inlet, a liquid chamber, and an outlet connected to said liquid chamber, a pump piston movably fitted in said liquid chamber and formed with a passage connecting said inlet to said liquid chamber, and a closing member arranged to be engaged and moved by said pump piston in a predetermined phase of movement of said pump piston and to close said passage and enable the pump piston to urge liquid out of said liquid chamber through said outlet during said phase.

More particularly it is an object of the invention to provide an injection pump which combines a long life with a permanent accurate adjustment of the quantity of injected fuel, simplicity of construction and an accurate adjustment of the quantity of liquid discharged per discharge stroke.

These objects are achieved mainly by arranging said closing member entirely in said liquid chamber and providing a stop which is arranged in a stationary relation to the pump casing for locating the closing member in an

initial position in which it is arranged to be engaged by said pump piston at the beginning of said phase.

The closing member consists preferably of a closing piston fitted in said liquid chamber and formed with a passage connecting the parts of said liquid chamber on opposite sides of said closing piston. The stop may consist of a seat provided in said liquid chamber for said closing piston. The pump piston and closing piston may be formed with surfaces arranged to contact each other on a substantial area in said phase of movement of said pump piston. Desirably a spring is arranged to urge the closing piston towards said seat.

The principle of pop control is applied to such pump by arranging the closing member to be lifted from the pump piston, in order to limit the quantity to be injected, by a lifting pin extending axially in said pump piston and arranged for axial movement relative thereto to protrude out of the pump piston at the end thereof faced by said closing member, in combination with a second stop arranged to be moved with said pump piston and in engagement with said lifting pin to cause it to move with said pump piston, and control means arranged to engage said second stop in a final part of said phase of movement and to move through the intermediary of said second stop said pin relative to said pump piston and into engagement with said closing member to disengage the same from said pump piston and open said passage at the end of said phase. The said control member may be adjustable as a control of the internal-combustion engine.

To explain these and additional features of the invention, reference is made to the accompanying drawing, which shows a fuel pump according to the invention in diagrammatical longitudinal sectional views in

Fig. 1, where the movable parts of the pump are shown at the lower dead center, and in

Fig. 2, where said movable parts are shown just before the upper dead center.

Fig. 3 is a side view showing a detail of the control stop.

The casing of the pump may be of conventional type and is only indicated in the drawing. For a multi-cylinder internal-combustion engine a number of individual pumps corresponding to the number of cylinders will be combined. Only a single pump is shown in the drawing.

The camshaft 1 having a working cam 2 acts on the roller 3 of the cam follower 4, which acts in turn on the pump piston 5. The pump piston 5 is guided in a liner 6 fitted in the pump casing 7 and is permanently loaded by a compression spring 8, which urges the piston 5 towards the cam 2. A lifting pin 9 guided in the piston 5 has a reduced end 9′ extending with a clearance in the head 5′ of the piston 5. The lower end 9″ of the pin 9 rests on one arm 10′ of a two-armed lever 10, which is pivoted to the follower 4 by a pivot pin 11 and is held by a spring 12 in the position shown in Fig. 1. A stop 13 carried by a slidable rod 14 is disposed opposite to the end 10″ of the other lever arm.

The pump casing 7 is formed with a fuel inlet duct 20 and the cylinder 6 is formed with a port 21. The piston is formed with a fuel passage 22, which takes the form of a circular ring gap 22′ in the piston head 5′. 23 is a closing member in the form of a piston, which is loaded by a compression spring 24 to have its shoulder 23′ urged against a step 25′ of the stationary insert 25. The spring 24 bears against an abutment plate 26, which has an aperture 26′, which is normally closed by a valve plate 27 loaded by a compression spring 28. 29 is a screw-threaded part which forces the parts 25 and 6 through the intermediary of an insert 32 into the pump casing and carries the discharge line 30 by means of a cap nut 31.

The mode of operation of the pump will be described first. As the piston 5 moves downwardly under the action

of the spring 8, fuel is being fed through the ducts 20, 21, 22 into the space 40, which forms in conjunction with the annular duct 22' a fuel outlet to the discharge space 41. As soon as the cam 2 starts lifting the roller 3 the piston 5 will be lifted too. Then the liquid in the space 41 will be discharged through the ducts 22', 22, 21, 20. Only when the piston 5 has risen sufficiently to cause the lower end 23'' of the closing member 23 to engage the piston head 5' and close the duct 22'—to this end the mutually contacting surfaces are formed as preferably plane sealing faces of substantial area—will the space 41 become a pressure space whose liquid content is now displaced under pressure to flow along the ducts 23''' recessed at the periphery of the closing member 23 into the space 42 and from there through the duct 26' to the valve plate 27 to lift the same and to flow farther through the line 30 to the injection nozzle (not shown). It is apparent that the closing member 23 is fitted entirely in the liquid chamber 41, 42.

The injection will continue as long as the piston 5 is moving upwardly. As soon as the piston has moved beyond its upper dead center the pressure will drop in the pressure space 41 and nozzle line 30. The liquid inflow into the space 41 will be resumed when the piston head 5' has separated from the extension 23'.

The injection can be terminated before the piston has reached its upper dead center when the closing member is popped from the piston to expose the duct 22' and cause the liquid under pressure to flow back through the ducts 22', 22, 21, 20.

This popping of the closing member 23 is the essential feature of the pop control. It is effected according to Fig. 2 by the engagement of the lever arm 10'' with the stop 13 during the upward stroke of the follower 4. Thus the lever 10 is deflected in that sense whereby the lifting pin 9 is lifted to pop open the closing member 23. The time when the lever arm 10'' engages the stop 13 depends on the level of the contact point where the stop 13 is engaged by the lever 10. It is not difficult to provide for an adjustment of that level, in order to obtain a pump for injecting an adjustable quantity. As is apparent from Fig. 3 the part 13 is formed within an inclined surface 13' in the illustrated embodiment. If the rod 14 and with it the part 13 are axially adjusted the injection can be terminated at an earlier or later time.

The invention provides an injection pump which consists entirely of concentrically arranged parts which can be made in a simple manner on the lathe, and is distinguished thereby that the part which is critical for a permanently precise control of the injected quantity may be practically free from wear because the flow-controlling surfaces of parts 23'' and 5' can be plane and designed with large areas. The closing member is accommodated entirely in the interior of the pump and the seal against high liquid pressure needs to be provided only along the long pump piston 5. It is ensured that the closing member 23 will always be located with the highest precision in its position which is critical for a precise control.

I claim:

1. An injection pump of the pop-controlled type for internal-combustion engines, which comprises a pump casing formed with a pump inlet, a liquid chamber, and an outlet connected to said liquid chamber, a pump piston movably fitted in said liquid chamber and formed with a passage connecting said inlet to said liquid chamber, a closing member arranged entirely in said liquid chamber to face one end of said pump piston and to be engaged and moved by said pump piston in a predetermined phase of movement of said pump piston and to close said passage and enable the pump piston to urge liquid out of said liquid chamber through said outlet during said phase, a stop arranged in a stationary relation to the pump casing for locating the closing member in an initial position in which it is arranged to be engaged by said pump piston at the beginning of said phase, a lifting pin extending axially in said pump piston and arranged for axial movement relative thereto to protrude out of said pump piston at the end faced by said closing member, a second stop arranged to be moved with said pump piston and in engagement with said lifting pin to cause it to move with said pump piston, and control means arranged to engage said second stop in a final part of said phase of movement and to move through the intermediary of said second stop said pin relative to said pump piston and into engagement with said closing member to disengage the same from said pump piston and open said passage at the end of said phase.

2. An injection pump as set forth in claim 1, in which said control means is adjustable to vary said final part of said phase of movement.

3. An injection pump of the pop-controlled type for internal-combustion engines, which comprises a pump casing formed with a pump inlet, a liquid chamber, and an outlet connected to said liquid chamber, a pump piston movably fitted in said liquid chamber and formed with a passage connecting said inlet to said liquid chamber, a closing member arranged entirely in said liquid chamber to face one end of said pump piston and to be engaged and moved by said pump piston in a predetermined phase of movement of said pump piston and to close said passage and enable the pump piston to urge liquid out of said liquid chamber through said outlet during said phase, a stop arranged in a stationary relation to the pump casing for locating the closing member in an initial position in which it is arranged to be engaged by said pump piston at the beginning of said phase, a lifting pin extendng axially in said pump piston and arranged for axial movement relative thereto to protrude out of said pump piston at the end faced by said closing member, a cam follower arranged to move the pump piston, a lever pivoted to said cam follower and having two arms, one of which is in engagement with said lifting pin to cause it to move with said pump piston, and a third stop adjustably arranged to engage the other arm of said lever in a final part of said phase of movement and to move through the intermediary of said lever said pin relative to said pump piston and into engagement with said closing member to disengage the same from said pump piston and open said passage at the end of said phase.

4. An injection pump as set forth in claim 3, which comprises means connected to said cam follower and tending to return said lever into an initial position relative to the pump piston for engagement with said lifting pin when the latter does not protrude out of said pump piston at the end faced by said closing member.

5. An injection pump of the pop-controlled type for internal-combustion engines, which comprises a pump casing formed with a pump inlet, a liquid chamber, and an outlet connected to said liquid chamber, a pump piston movably fitted in said liquid chamber and formed with a concentric passage connecting said inlet to said liquid chamber, a closing member arranged entirely in said liquid chamber to face one end of said pump piston and to be engaged and moved by said pump piston in a predetermined phase of movement of said pump piston and to close said passage and enable the pump piston to urge liquid out of said liquid chamber through said outlet during said phase, a stop arranged in a stationary relation to the pump casing for locating the closing member in an initial position in which it is arranged to be engaged by said pump piston at the beginning of said phase, a lifting pin extending concentrically in said passage and axially through said pump piston and arranged for axial movement relative thereto to protrude out of said pump piston at the end faced by said closing member, a second stop arranged to be moved with said pump piston and in engagement with said lifting pin to cause it to move

with said pump piston, and control means arranged to engage said second stop in a final part of said phase of movement and to move through the intermediary of said second stop said pin relative to said pump piston and into engagement with said closing member to disengage the same from said pump piston and open said passage at the end of said phase, said concentric passage and pin being formed to provide for a clearance between them at least when the pin protrudes out of said pump piston at the end faced by said closing member.

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