

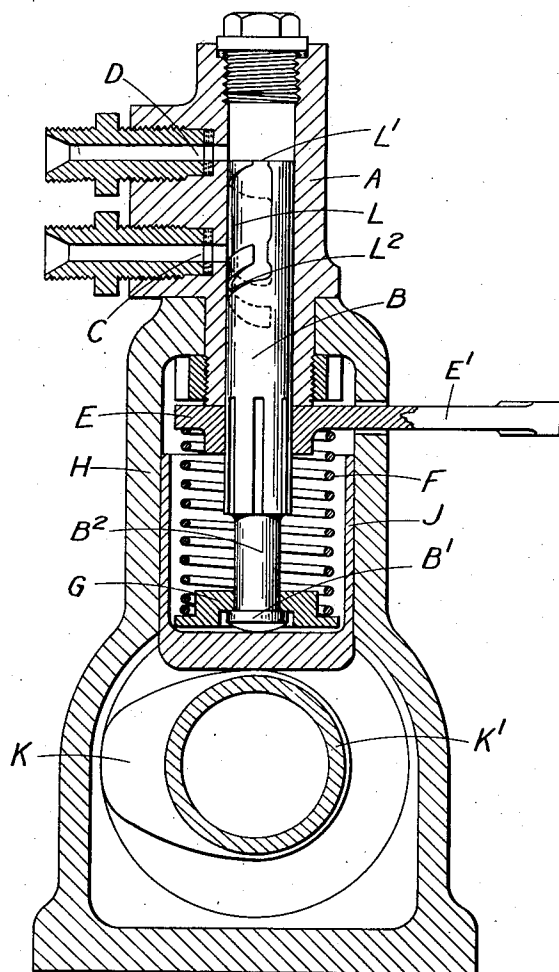
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LIQUID FUEL INJECTION PUMP FOR INTERNAL COMBUSTION ENGINES

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LIQUID FUEL INJECTION PUMP FOR INTERNAL COMBUSTION ENGINES

Application filed October 5, 1931, Serial No. 567,069, and in Great Britain November 7, 1930.

This invention relates to an improvement in or modification of fuel pumps of the kind forming the subject of prior United States patent application Serial No. 556,928 of 1931.

5 The above prior United States patent application relates to fuel injection pumps of the kind having one or more relief or inlet ports which are so controlled by the pump plunger or by a separate valve as to render
10 inoperative the earlier and later portions of each plunger delivery stroke and, according to the invention forming the subject of the above patent application, a fuel pump of this kind is provided with means for positively
15 closing the fuel delivery passage at the moment when or immediately after the relief or inlet port is opened to terminate the operative part of the delivery stroke.

20 According to the present invention a fuel pump of the kind forming the subject of the above patent application is not only provided with means for positively closing the fuel delivery passage at or immediately after the
25 moment when the relief or inlet port is opened to terminate the delivery period, but also with means for re-opening the delivery passage immediately after closing it so as to relieve the pressure therein.

30 The invention is particularly applicable to fuel injection pumps in which the pump piston acts both as a plunger and as the valve controlling the inlet or relief port or ports in the cylinder wall and, in this case, the delivery port is preferably also arranged in the
35 cylinder wall and the piston so formed as to close the delivery port positively as or immediately after it opens the relief port to terminate the effective portion of the delivery stroke and also to form communication between the delivery port and a relief port
40 immediately after positively closing the delivery port.

45 In liquid fuel injection pumps wherein the pump plunger acts also as a valve, it is usual to provide a relief groove in the cylinder or piston having a helical or like inclined edge so that by varying the relative rotational positions of the cylinder and piston, the moment
50 in the plunger delivery stroke at which the relief port is brought into communication

with the pump pressure chamber can be varied so as to vary the quantity of fuel delivered. When the present invention is applied to such a construction the piston or its cylinder is conveniently provided, not only
55 with a main relief groove and a delivery groove provided with helical or like inclined edges so that the quantity of fuel injected can be varied by relative rotation between the plunger and the cylinder while ensuring that
60 the delivery passage will always be closed positively immediately after the relief passage is opened to terminate the delivery period, but also with a subsidiary relief groove having a helical or like inclined edge so as
65 to establish communication between the delivery passage and a relief or inlet passage, immediately after the relief passage has been positively closed, irrespective of the relative rotational positions of the cylinder and
70 plunger.

The invention may be carried into practice in various ways but one construction according to this invention is illustrated somewhat
75 diagrammatically in sectional elevation by way of example in the accompanying drawing.

In the construction illustrated the pump comprises a cylinder A containing a piston B and having a delivery port C and a combined inlet and relief port D in its circumferential wall. The lower end of the plunger is splined and is surrounded by an internally splined member E so that while the plunger can slide through the member E the rotational position of the plunger relatively to the cylinder can be varied by rocking the member E by means of an arm E¹ thereon. Bearing on the member E is the upper end of a spring F the lower end of which acts on a collar G which rests on a head B¹ formed on a projection B² of the plunger B so that the spring tends always to force the plunger out of the cylinder. The cylinder A is supported by a casing H in which slides a guide member J arranged concentrically with and acting on the head B¹ of the projection B² of the plunger, the lower face of this guide member bearing on a cam K on a camshaft K¹. It will thus be seen that as the camshaft K¹ ro-
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tates the plunger B will be caused to reciprocate within the cylinder A while by moving the member E by means of the arm E¹ the rotational position of the plunger relatively to the cylinder can be varied.

Formed in the circumferential wall of the plunger is a helical groove L, acting both as a delivery groove and as a relief groove and communicating with the pressure chamber of the pump through a slot L¹ and with a subsidiary helical relief groove L² also formed in the circumferential wall of the plunger B.

The arrangement is such that the plunger, on the suction stroke, draws in fuel through the combined inlet and relief port D. During the initial part of the delivery stroke of the plunger the port D is uncovered by the piston so that during this portion of the delivery stroke fuel is returned to the inlet passage through the combined inlet and relief port. After the plunger has moved a certain distance on its delivery stroke it covers the port D so that flow of fuel through this port is stopped and fuel is forced through the slot L¹ and groove L and thence through the delivery port C which, during this period, communicates with the groove L. Such delivery continues until the upper edge of the groove L uncovers the port D and the arrangement is such that as, or immediately after the port D is uncovered by the upper edge of the groove L, the lower edge of this groove closes the delivery port C so that at the moment when or immediately after communication is reestablished between the pressure chamber of the pump and the relief port, communication between this pressure chamber and the delivery port is cut off.

Immediately after the delivery port C has been positively closed by the lower edge of the combined relief and delivery groove L, it is re-opened by the upper edge of the subsidiary relief groove L² so as to bring the delivery passage C into communication through the groove L² and groove L with the combined inlet and relief passage, whereby the pressure in the delivery passage is relieved.

It will be seen that by rocking the plunger by means of the lever E¹, the length of the effective portion of the delivery stroke during which the port D is closed and hence the quantity of fuel injected, can be varied, but that at all rotational settings of the plunger, not only will the delivery port C be closed positively by the lower edge of the groove L at the moment when or immediately after the relief port D is re-opened to terminate the effective portion of the delivery stroke, but the delivery port C will be re-opened by the upper edge of the groove L² immediately after being so closed.

It is to be understood that the construction illustrated is given by way of example only and that the means for positively closing the delivery passage at or immediately after the

moment when the relief port is opened to terminate the effective part of the delivery stroke and for re-opening the delivery passage immediately after it has been so closed as well as other details of construction may be varied without departing from this invention. Further, the invention may be applied to fuel injection pumps in which a separate valve controlling inlet or relief ports is operated in timed relation to the piston to render inoperative the earlier and later portions of each plunger delivery stroke.

What I claim as my invention and desire to secure by Letters Patent is:—

1. A liquid fuel injection pump for internal combustion engines including in combination a cylinder having a fuel delivery passage and at least one relief port, a plunger adapted to reciprocate within the cylinder, a part acting as a valve to open a relief port during the earlier and later parts of each delivery stroke to render such parts of the stroke inoperative so that fuel is only delivered through the delivery passage during an intermediate operative part of each delivery stroke, means for positively closing the fuel delivery passage as the relief passage is opened to terminate the delivery period, and means for reopening the delivery passage immediately after closing it so as to relieve the pressure therein.

2. A liquid fuel injection pump for internal combustion engines, including in combination a cylinder having a fuel delivery passage and at least one relief port, a plunger adapted to reciprocate within the cylinder and so formed as to act as a valve which opens a relief port during the earlier and later parts of each delivery stroke to render such parts of the stroke inoperative so that fuel is only delivered through the delivery passage during an intermediate operative part of each delivery stroke, means for positively closing the fuel delivery passage as the relief passage is opened to terminate the delivery period, and means for opening the delivery passage immediately after closing it so as to relieve the pressure therein.

3. A liquid fuel injection pump for internal combustion engines, including in combination a cylinder having a fuel delivery passage and at least one relief port, a plunger adapted to reciprocate within the cylinder and so formed as to act as a valve which not only opens a relief port during the earlier and later parts of each delivery stroke to render such parts of the stroke inoperative so that fuel is only delivered through the delivery passage during an intermediate operative part of each delivery stroke, but also as a valve for positively closing the fuel delivery passage as the relief port is opened to terminate the delivery period and for reopening the fuel delivery passage immediately after closing it for the purpose set forth.

4. A liquid fuel injection pump for internal combustion engines including in combination a cylinder having a relief passage and at least one relief port, a plunger adapted to reciprocate within the cylinder and so formed as to act as a valve to open a relief port during the earlier part of each delivery stroke and having at least one groove therein communicating with the pressure chamber of the pump and provided on the one hand with an edge which uncovers a relief port during the later part of each delivery stroke so that fuel is only delivered through the delivery passage during an intermediate operative part of each delivery stroke, and on the other hand with a second edge which covers the delivery passage as the relief groove comes into communication with the relief port, the said first edge and the said second edge being formed correspondingly helical, while a third similar helical edge uncovers the delivery port immediately after it has been covered by the said second edge, and means for causing relative rotation between the pump plunger and the cylinder whereby the quantity of fuel delivered on each delivery stroke can be varied while maintaining correct timing between the opening of the relief port and the closing and reopening of the delivery passage at the end of the delivery period.

5. A liquid fuel injection pump for internal combustion engines including in combination a cylinder having a fuel delivery passage and at least one relief port, a plunger adapted to reciprocate within the cylinder, a reciprocating cylindrical part acting as a valve not only to open a relief port during the earlier and later parts of each delivery stroke, the edge of the valve which opens the relief port during the later part of each delivery stroke being inclined to the direction of movement of the reciprocating part, but also having correspondingly helical edges one of which closes the delivery passage as the reciprocating member opens the relief port to terminate the effective part of the delivery period while the other reopens the delivery passage immediately after the said first helical edge has closed it, and means for rotating the valve so as to vary the quantity of fuel injected by the pump on each delivery stroke while maintaining correct relative timing between the opening of the relief port, the closing of the delivery passage and the reopening of the delivery passage.

6. A liquid fuel injection pump for internal combustion engines including in combination a cylinder having a delivery passage and at least one relief port, and a plunger adapted to reciprocate within the cylinder and so formed as to act as a valve to open a relief port during the earlier part of each delivery stroke, one of such parts having on the one hand a main relief groove therein

which comes into communication with a relief port during the later part of each delivery stroke so that fuel is only delivered through the delivery passage during an intermediate operative part of each delivery stroke and on the other hand a delivery groove which communicates with a delivery passage in the other part during at least such intermediate part of the delivery stroke but has an edge which covers the delivery passage as the relief groove comes into communication with the relief port, and a further subsidiary relief groove an edge of which uncovers the delivery passage immediately after it has been covered by the edge of the delivery groove, the edge on the main relief groove which uncovers the relief port, the edge of the delivery groove which covers the delivery port, and the edge of the subsidiary relief groove which uncovers this delivery port being formed correspondingly helical, and means for producing relative rotation between the pump plunger and the cylinder whereby the quantity of fuel delivered on each delivery stroke can be varied while maintaining correct relative timing between the opening of the relief port and the closing and reopening of the delivery passage.

In testimony whereof I have signed my name to this specification.

GEORGE SHAKESPEARE WILKINSON.

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