

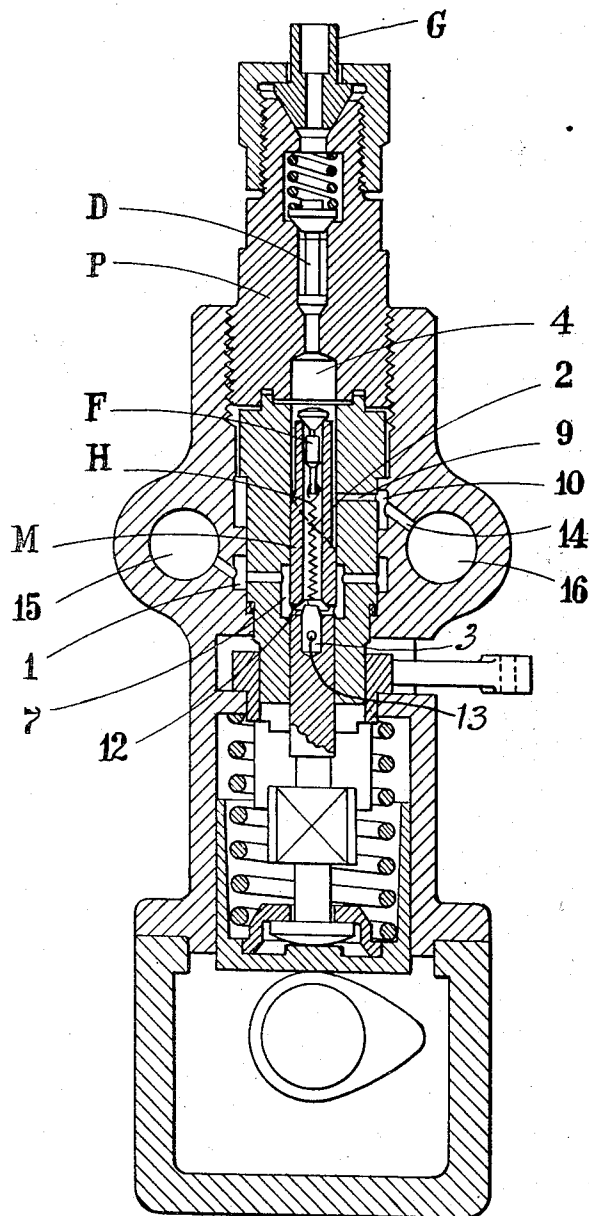
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FUEL PUMP FOR INTERNAL COMBUSTION ENGINES

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FUEL PUMP FOR INTERNAL COMBUSTION
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3 Claims. (Cl. 103—41)

This invention relates to fuel pumps for internal combustion engines of the kind wherein the regulation is effected by an angular adjustment of the pump plunger which causes a return flow of liquid over an inclined shoulder on the plunger or on the surrounding barrel or both.

Pumps of this kind have the advantage of working without back pressure on the regulating mechanism. In many cases, however, particularly when volatile fuel is used, the recoil of the liquid on opening the return flow is liable to produce gas bubbles either directly by the pressure or by the heat generated thereby.

In particular the invention relates to a fuel injection pump for light oil internal combustion engines with external ignition and in such engines considerable disturbance is produced when towards the end of the delivery stroke of the pump plunger communication is suddenly made between the pump chamber and the return passage for the fuel. According to the present invention this disadvantage is overcome and an arrangement provided for satisfactory pump operation at all frequencies by maintaining the end of the injection constant and regulating the feed by varying the beginning of the injection, the fuel return passage being open and in communication with the pump chamber during the initial portion only of the working stroke of the plunger during which period the returning liquid is led through a separate passage into a separate space and conduit to the supply, the fuel return passage being then closed and maintained closed throughout the remainder of the working stroke of the plunger.

The pump chamber has an inlet for the fuel and a return outlet therefor, and the pump plunger operates with constant stroke, it being angularly displaceable in known manner relative to the plunger guide. The effective stroke of the plunger commences with the closing of the fuel return outlet, and this is brought about by the inclined shoulder on the plunger or on the surrounding barrel or both at a point of the working stroke determined by the angular displacement of the plunger.

It is possible in this manner to compel the returning fuel to pass only through the fuel return passage and not through the fuel inlet passage. The latter would, in the case of light fuel, disturb the filling of the pump chamber considerably although not to the same extent as it does in known pumps by the recoil of the highly compressed fuel in the pump chamber at the

end of the working stroke of the plunger.

The invention is illustrated in the single figure of the accompanying drawing, this figure being a vertical view, partly in section, of a preferred embodiment of the invention.

The pump plunger M is hollow and closed at the top by a valve F. The plunger has four suction apertures 12 and 13 of which two are always in communication with aperture 7. The two apertures 13 are covered at the instant illustrated but are, opened when the plunger lifts. As illustrated in the drawing, the apertures 12 and 13 are located near the lower end of the plunger and extend radially of the plunger to permit fuel to pass through said apertures and through the hollow plunger. The external diameter of the upper portion of the plunger, as viewed in the drawing, i. e., that portion adjacent the head of the pump chamber, is reduced with respect to the external diameter of the remainder of the plunger to provide an annular space between said reduced portion and the wall defining the pump chamber, this annular space constituting a passage extending between the pump chamber 4 and the fuel return passage 9 when the plunger is moving through the initial portion of its working stroke. The reduced portion terminates in an annular shoulder 2, preferably inclined with respect to the longitudinal axis of the plunger. During the initial portion of the working stroke of the plunger the pump chamber is in communication with the fuel return passage 9 through the annular space above referred to, but as the plunger completes the initial portion of its working stroke, the annular shoulder moves past the fuel return passage 9, and that portion of the plunger below the annular shoulder 2 maintains the said fuel return passage closed during the remainder of the working stroke of the plunger. The shoulder 2 is preferably inclined upwardly with respect to the longitudinal axis of the plunger and as the plunger is angularly displaceable within the pump chamber, the angular position of said shoulder with respect to the fuel return passage 9 will determine the point in the stroke of the plunger at which said fuel passage 9 will be cut off from communication with the pump chamber through the annular space above said annular shoulder. The fuel is forced by gravity or by a pump through a channel 15 and flows through annular passages 1 and 7, through an inlet 12, through the plunger and past the valve F into the pump chamber 4. While the fuel return outlet 9 is clear, i. e., while the annular

shoulder 2 is below the inner end of said fuel return passage 9, the fuel flows further through the passages 9, 10, and 14 into the fuel return channel 16 for return to the fuel supply. Thus the pump chamber 4 will at no time be subjected to vacuum but will be swept by a continuous massive band of liquid. From this band the required quantity of liquid will be forced by the inclined shoulder 2 on the plunger M past the delivery valve D in the casing P and through the pressure pipe G into the engine. This happens during the inward stroke of the plunger when the inclined shoulder 2 closes the fuel return outlet 9 and after the inlets 12 have been closed by passing beyond the reach of the passage 7 while at the same time when the plunger lifts, the two apertures 13 which have hitherto been closed are opened and brought into communication with passage 7.

The valve F is urged toward closed position by a light spring H, and when closed cuts off communication between the hollow space in the plunger and the pump chamber 4. Referring to the operation of the valve F, it will be noted that as long as the annular space above the inclined shoulder 2 on the plunger permits fuel to flow from the pump chamber 4 through the fuel return passage 9, the valve F is opened against the tension of the light spring H to permit the flow of fuel through the hollow plunger and into the pump chamber 4. After the fuel return passage 9 has been cut off from communication with the pump chamber 4 by the travel of the inclined shoulder 2 past the inner end of said passage 9, the valve F is closed by the pressure of the fuel in the pump chamber aided by the action of the light spring H, to thus cut off communication between the hollow space in the plunger and the pump chamber 4.

After the closing of the fuel return passage 9 and the closing of the valve F, the plunger completes its working stroke and forces the fuel remaining in the pump chamber past the valve D and through the delivery passage G to the engine. It will thus be seen that the effective working stroke of the plunger begins at the time of closing of the fuel return passage by the plunger, which closing is effected by the movement of the inclined shoulder 2 past the inner end of the fuel return passage 9, and that the point of closing of the fuel return passage 9 during the stroke of the plunger, is determined by the angular displacement of the plunger with respect to the fuel return passage 9.

By passing fuel through the pump chamber in a closed stream before the plunger commences its active stroke, the filling of the chamber 4 with massive, cool fuel is, even at the highest rate of movement, reliably ensured.

I claim:

1. In a fuel injection pump for internal combustion engines, in combination: a hollow plunger reciprocable in a casing having a pump chamber, a fuel inlet passage in communication with the hollow space in the plunger, a fuel return passage and a fuel delivery passage in said casing; and a spring loaded valve carried by the end of the plunger adapted when open to place the inlet passage in communication through the hollow space in the plunger with the delivery passage and with the return passage through said pump chamber, said plunger controlling the fuel return passage to maintain said passage in communication with the pump chamber during the initial portion of the working stroke of the plunger

er and to close said fuel return passage at low pressure to cut off communication between said fuel return passage and said pump chamber and to maintain said fuel return passage closed during the remainder of the working stroke of the plunger, the said valve closing after the closing of the fuel return passage, to cut off communication through the hollow space of the plunger between the fuel inlet passage and the pump chamber, completion of the working stroke of the plunger, after the closing of said fuel return passage and said valve, forcing the fuel from the pump chamber through the delivery passage.

2. In a fuel injection pump for internal combustion engines, in combination, a hollow plunger reciprocable in a casing having a pump chamber; a fuel inlet passage in communication with the hollow space in the plunger; a fuel delivery passage extending from said pump chamber; a fuel return passage leading from said pump chamber through the side wall thereof at a point intermediate the ends of said chamber; and a spring loaded valve carried by the end of the plunger adapted when open to place the inlet passage in communication through the hollow space in the plunger with the pump chamber, the external diameter of that portion of the plunger adjacent the head of the pump chamber being reduced with respect to the external diameter of the remainder of the plunger to provide an annular space between said reduced portion and the wall defining the pump chamber, said annular space constituting a passage extending between the pump chamber and the fuel return passage when said plunger is moving through the initial portion of its working stroke and said reduced portion terminating in an annular shoulder intermediate the ends of the plunger, said plunger controlling the fuel return passage to maintain the same in communication with the pump chamber through said annular space during the initial portion of the working stroke of said plunger, said plunger closing said communication at low pressure after said annular shoulder has moved past the fuel return passage and maintaining said fuel return passage closed during the remainder of the working stroke of the plunger, the said valve, after the closing of the fuel return passage, closing to cut off communication through the hollow space of the plunger between the fuel inlet passage and the pump chamber, completion of the working stroke of the plunger, after the closing of the fuel return passage and the valve, forcing the fuel from the pump chamber through the delivery passage.

3. In a fuel injection pump for internal combustion engines, in combination, a casing having a pump chamber therein; a fuel delivery passage extending from said pump chamber; a hollow plunger reciprocable within said pump chamber, said plunger having its upper end reduced in diameter to provide an annular space between said reduced portion and the wall defining the pump chamber, said reduced portion terminating in an annular shoulder inclined with respect to the longitudinal axis of said plunger, and said plunger having at its lower end a plurality of suction apertures at least one of which is always in communication with the hollow space in the plunger; a fuel inlet in the casing near the lower end of the plunger and always in communication with at least one of the apertures in said lower end of said plunger; a fuel return passage leading from said pump chamber through the side

5 wall thereof at a point between the fuel inlet passage and the upper end of the plunger; a spring loaded valve carried by the upper end of the plunger adapted when open to place the inlet passage in communication through at least one of the apertures and through the hollow space in the plunger with the pump chamber and, when closed, to cut off said communication, the annular space between the reduced portion of the plunger and the wall defining the pump chamber constituting a passage extending between the pump chamber and the fuel return passage when the plunger is moving through the initial portion of its working stroke and when 10 any portion of the inclined annular shoulder is positioned below said fuel return passage, said plunger controlling the fuel return passage to maintain the same in communication with the pump chamber through said annular space during the initial portion of the working stroke of said plunger, said plunger closing said communi-

cation at low pressure after said inclined annular shoulder has moved upwardly past the fuel return passage and maintaining said fuel return passage closed during the remainder of the working stroke of the plunger, the said valve, 5 after the closing of the fuel return passage, closing to cut off communication through the hollow space of the plunger between said fuel inlet passage and said pump chamber, completion of the working stroke of the plunger, after the closing of the fuel return passage and valve, forcing the fuel from the pump chamber through the delivery passage; and means for angularly displacing said plunger within the pump chamber to vary the position of the inclined annular edge on the plunger with respect to the fuel return passage to regulate the point of closing of said fuel return passage by said plunger during the stroke of said plunger. 10 15

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