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PISTON PUMPS FOR THE INJECTION OF FUEL INTO INTERNAL COMBUSTION ENGINES

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Fig.2.

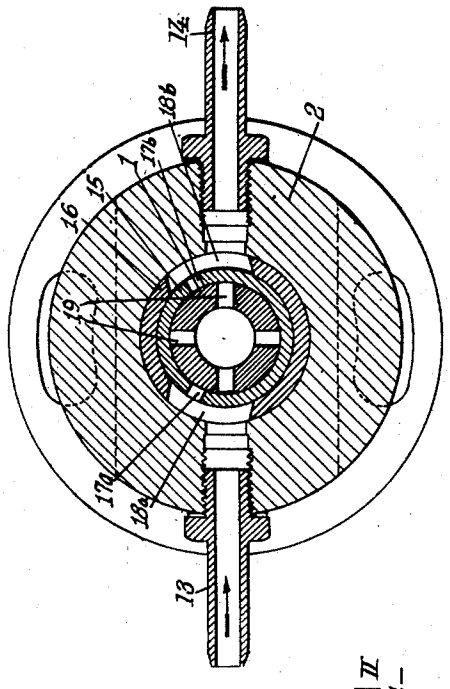


Fig.3

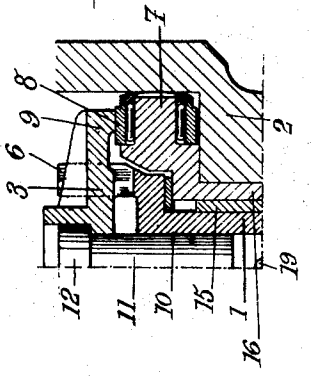
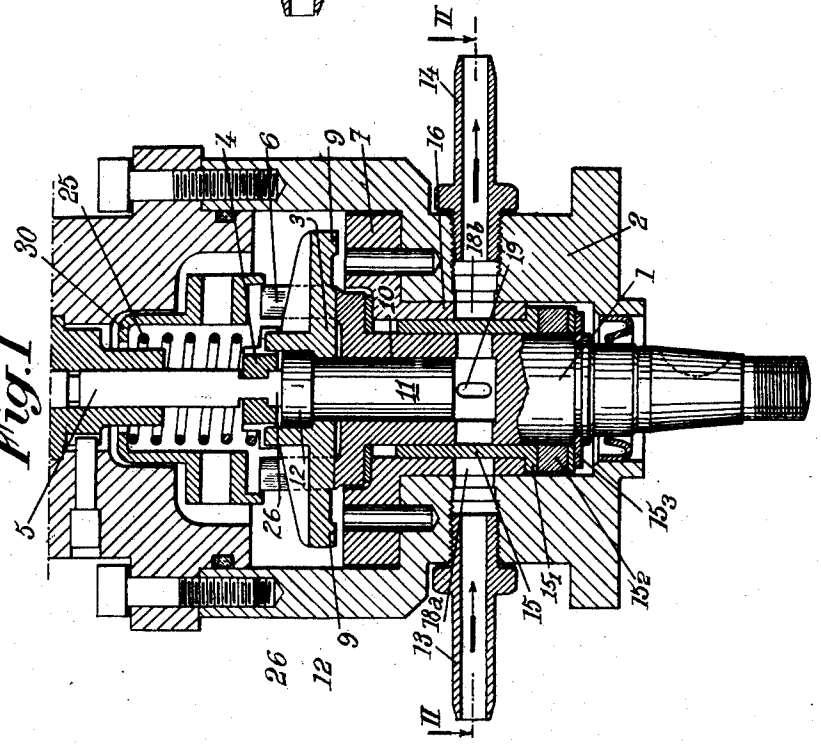


Fig.1



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Fig. 4.

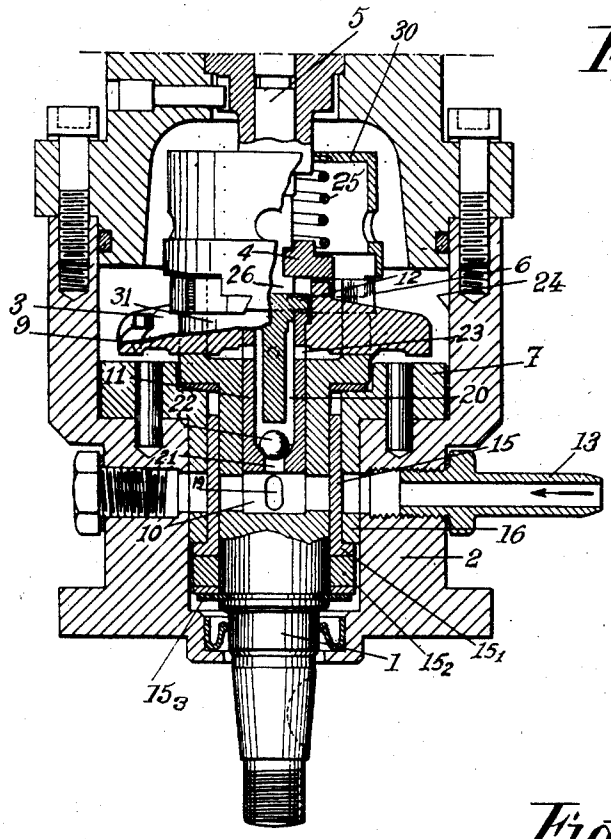


Fig. 5.

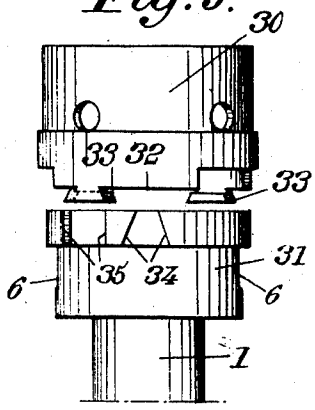
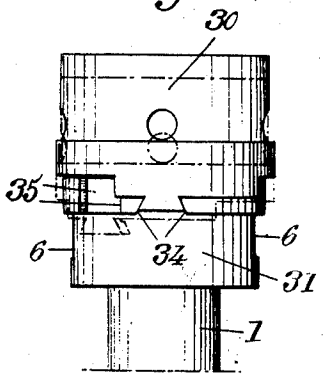


Fig. 6.



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PISTON PUMPS FOR THE INJECTION OF FUEL INTO INTERNAL COMBUSTION ENGINES

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5 Claims. (Cl. 103—5)

The present invention relates to internal combustion engine fuel injection pumps and in particular to pumps of the kind described in the U. S. Patent No. 2,582,535, such pumps including at least one piston driven in rotation by a shaft and simultaneously actuated with a reciprocating motion through means such as a plate or cross-bar cooperating with cams or rollers, the movement of rotation of the piston being arranged to achieve the successive distribution of fuel toward the respective cylinders of the engine.

The chief object of my invention is to provide a fuel feed system of the above mentioned kind which is simpler than those used up to the present time.

According to my invention, such a feed system includes an auxiliary feed pump for feeding fuel to the main pump or injection pump, said auxiliary pump being operatively connected with a driving shaft of the main pump so as to be driven by it, the distributing valve means of the auxiliary pump being controlled by the main pump.

Preferred embodiments 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 an axial part section view of a fuel injection pump made according to the present invention.

Fig. 2 is a cross sectional view on the line II—II of Fig. 1.

Fig. 3 is a part axial section showing some elements of the pump located in an axial plane different from that of Fig. 1.

Fig. 4 is a view similar to Fig. 1 showing a pump made according to a modification.

Figs. 5 and 6 separately show, in elevational view, some elements of the system of Fig. 4.

The fuel injection system illustrated by the drawings includes the following essential elements:

An input or driving shaft 1 rotating in the frame 2 of the system,

A plate or cross-bar 3 connected through any suitable joint 4 with the main piston 5 of the injection pump, this cross-bar being adapted to be driven in rotation by shaft 1, with the possibility of axial displacements, for which purpose I make use of a fork driving system 6 carried by an extension 31 of shaft 1,

And means for ensuring the reciprocating movement of cross-bar 3 and piston 5 from the movement of rotation of shaft 1, such means including for instance rollers, cams or the like carried by a fixed plate 7 (which may be adjustable), such rollers being shown at 8 on Fig. 3, and being adapted to cooperate with suitable surfaces 9 of the cross-bar during the rotation thereof, thus producing a temporary upward movement thereof against the action of resilient means such as a spring 25.

As it is well known, a system of this kind is capable of discharging fuel toward the injectors every time piston 5 reciprocates, the distribution toward the respective injectors of the engine being obtained as a consequence of the rotation of the piston in combination with the provision of suitable ports and conduits.

I incorporate in such a system an auxiliary feed pump (that is to say a pump intended to supply fuel to the inlet ports of the main piston 5), this auxiliary feed pump being disposed along the axis of the main pump, in particular in such manner that the rotation of shaft 1 can be used to achieve at least one of the two liquid inlet and outlet distributing functions, to the auxiliary pump.

In particular, the auxiliary pump may be constituted by the combination of the following elements:

On the one hand, a bore 10 provided in shaft 1,

And on the other hand, a piston 11 slidable in said bore and reciprocated by cross-bar 3.

For instance, in the construction that is shown by the drawings, the joint 4 provided between the main piston 5 and the cross-bar 3 applies the tail 26 of piston 5 by means of a spring 25 against the head 12 of piston 11.

Means must be provided for controlling the inflow of fuel to the auxiliary pump and the discharge of said fuel. Said means are constituted for instance by two series of ports, some of which are movable and provided in the walls of the above mentioned bore, that is to say in the shaft 1, the others being fixed and possibly adjustable and located on the outside of said shaft, the whole of said ports being arranged in such manner that the rotation of shaft 1, combined with the reciprocating movement of cross-bar 4 and piston 11, achieves correct communication with, on the one hand a fuel inlet connected with a suitable tank, and on the other hand a fuel outlet connected with the inlet ports of the main piston.

According to the embodiment illustrated on Fig. 1, and where it is supposed that fuel flows in from a tank through a conduit 13 and flows out through a conduit 14 (leading to the inlet ports of the main piston), the system is arranged as follows:

Shaft 1 is rotatable in a sleeve 15 made of a self-lubricating metal mounted with a force fit (or in any other suitable manner which may for instance permit angular adjustment) in another sleeve 16 rigid with the roller carrying part 7, a shoulder 15_1 forming an abutment in combination with an abutment ring 15_2 and a fixation member 15_3;

Inlet ports 17*a* and discharge ports 17*b* are provided in said sleeve 15 (Fig. 2); passages 18*a* and 18*b* are provided in sleeve 16, these inlet and discharge ports and passages being adapted to be connected respectively with the inlet and discharge conduits 13 and 14;

Finally ports 19, for instance four ports at 90° to one another, are provided in the wall of shaft 1 or of bore 10 so that, account being taken of the location of ports 17*a*, 17*b* with respect to rollers 8 through which cross-bar 3 is given its reciprocating motion, and therefore with respect to piston 11, the desired result is obtained, that is to say coincidence takes place between a port 19 and port 17*a* when piston 11 is moving upwardly and another coincidence takes place between a port 19 and port 17*b* when the piston subsequently moves downwardly (all other distributing means being possible according to my invention).

Fig. 4 shows another embodiment of my invention according to which discharge of the fuel from the auxiliary pump takes place through the inside of piston 11 which is made hollow for this purpose.

In this case, as shown by Fig. 4, the fuel is fed in through a conduit 13 and reaches the inside of the bore 10 through the same ports as above described. But discharge of said fuel takes place through an axial passage 20 provided in piston 11, including an inlet orifice 21 controlled by a ball check valve 22. The fuel discharged through conduit 20 is fed at 23 into the in-

ternal chamber 24 of the pump, from which it reaches the inlet ports of the main piston through any suitable means.

Of course, by providing a check valve such as 22 working in the opposed direction, I might cause the inflow of fuel to take place from chamber 24 and the discharge toward the main piston through a conduit arranged such as 13.

With the arrangement such as above described the mounting of the auxiliary pump is axial, that is to say easy, and all the reactions are also axial, whereby there are no transverse reactions on the piston and the parts cooperating therewith, thus reducing to a minimum the wear and tear and the risks of seizing.

With either of the above described arrangements (Figs. 1 to 3 and Fig. 4) I may provide a mounting such that the spring, for instance 25, which urges the cross-bar against rollers 8, bears, at its end opposed to that cooperating with said cross-bar, against a cup-shaped member 30 rotating together with shaft 1, and therefore connected therewith either directly or indirectly.

In this way I constitute a unit, including shaft 1, cross-bar 3, main piston 5, spring 25 and cup-shaped member 30, which is particularly easy to fit. Furthermore, I dispense with the thrust ball bearing which is generally necessary when spring 25 bears against a fixed portion of the frame.

Figs. 4 to 6 illustrate a particular arrangement for the connection between cup-shaped member 30 and shaft 1, according to which said connection is of the bayonet type. It will be visible on the drawing that the lower edge 32 of the cup-shaped member is provided with catching teeth 33 capable of engaging in bevel openings 34 provided in the outer face of extension 31.

When the parts are to be assembled together, cup-shaped member 30 being engaged on its spring 25 which has previously been fitted in position, said cup-shaped member 30 is pushed back so as to compress spring 25, whereby the teeth 33 pass into the mounting grooves 35 (Fig. 6—position in dot-and-dash lines), after which a slight rotation is imparted to the cup-shaped member so as to bring said teeth opposite openings 34. When spring 25 is then allowed to expand, teeth 33 engage in said openings 34 (position in solid lines).

It should be noted that the arrangement according to my invention further ensures a very good lubrication. In particular, concerning the abutment surfaces 15_1 which must withstand the reaction of spring 25 every time the cross-bar is passing on the rollers 8, they are always moistened by the gas-oil which flows through the auxiliary pump. The same applies to the other rotary areas of the pump.

In a general manner, while I have, in the above description, disclosed what I deem to be practical and efficient embodiments of my invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the accompanying claims.

What I claim is:

1. An internal combustion engine fuel injection system which comprises, in combination, a frame, a pump including a pump body rigid with said frame and a reciprocating piston slidably axially in said pump body, a hollow driving shaft, means for operatively connecting said piston with said shaft to have said piston driven by said shaft, an auxiliary pump for feeding fuel under pressure to said pump body, means for connecting the output of said auxiliary pump with said pump body, the body of said auxiliary pump being constituted by the inside of said hollow shaft, said auxiliary pump having a piston slidable with a reciprocating motion inside said auxiliary pump body constituted by the inside of said shaft, means operatively connected with said main pump piston to have said auxiliary pump piston driven by said main pump piston, and valve means operative by said first mentioned pump for controlling the flow of fuel to said auxiliary pump.

2. A fuel injection system according to claim 1 in which said valve means include a sleeve surrounding said shaft in a fluidtight fashion, said shaft, said sleeve and said frame being provided with cooperating ports for the distribution of fuel to and from the auxiliary pump.

3. A fuel injection system according to claim 1 in which said auxiliary pump piston is hollow so as to form an axial passage for the flow of fuel therethrough, further including a check valve in said axial passage.

4. An internal combustion engine fuel injection system which comprises, in combination, a frame, a pump including a pump body rigid with said frame and a reciprocating piston slidable axially in said pump body, a driving shaft, means for operatively connecting said piston with said shaft to have said piston driven by said shaft, an auxiliary pump for feeding fuel under pressure to said pump body, means for connecting the output of said auxiliary pump with said pump body, a cross-bar rigid with said main pump piston, a plate, cam means carried by said frame for cooperation with the ends of said cross-bar, means for axially connecting said cross-bar with said main pump piston, whereby said cross-bar ensures a reciprocating movement of said main pump piston with respect to said main pump body, a spring for applying said cross-bar against said cam means, said shaft including a cup-shaped member at the end thereof and said spring being interposed between said cup-shaped member and said cross-bar, and valve means operative by said first mentioned pump for controlling the flow of fuel to said auxiliary pump.

5. An internal combustion engine fuel injection system which comprises, in combination, a frame, a pump including a pump body rigid with said frame and a reciprocating piston slidable axially in said pump body, a driving shaft, means for operatively connecting said piston with said shaft to have said piston driven by said shaft, an auxiliary pump for feeding fuel under pressure to said pump body, means for connecting the output of said auxiliary pump with said pump body, a cross-bar rigid with said main pump piston, a plate, cam means carried by said frame for cooperation with the ends of said cross-bar, means for axially connecting said cross-bar with said main pump piston, whereby said cross-bar ensures a reciprocating movement of said main pump piston with respect to said main pump body, a spring for applying said cross-bar against said cam means, said shaft including a cup-shaped member at the end thereof and said spring being interposed between said cup-shaped member and said cross-bar, a bayonet joint connection between said cup-shaped member and said shaft, and valve means operative by said first mentioned pump for controlling the flow of fuel to said auxiliary pump.

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