A test model of the present valve system in the delivery stage of a fuel injection pump proved capable of providing dependable operation of the pump under cyclic feed conditions (up to 250 cu. mm. per cycle); high pump capacity with the values of the valve opening being as small as up to 1.5 mm.; complete interchangeability of component parts of the same type; and stable and uniform (within 3 percent) feed of the fuel to the cylinders.

Additional objects and advantages of the invention will become more readily apparent to persons skilled in the art from the following detailed specification and annexed drawings and in which drawings:

Fig. 1 is a view in longitudinal section of an embodiment of the valve system of the delivery stage with openings provided in the delivery valve and in the seat of the check valve;

Fig. 2 is a view in longitudinal section of an embodiment of the valve system of the delivery stage with openings provided in the delivery valve and in the check valve;

Fig. 3 is a view in longitudinal section of an embodiment of the valve system of the delivery stage with openings made sequentially; and

Fig. 4 is a view taken along the line IV—IV of Fig. 3 the view looking but in the direction of the arrows.

The valve system of the delivery stage, according to the invention, comprises a seat 1 (Fig. 1) for a delivery valve 2 arranged in a bore 3 of a head or body 4 of a pump above an opening 5 serving to pass the fuel delivered by the high-pressure stage to a fuel-injection nozzle (the high-pressure stage and the fuel injection nozzle being not shown in the drawing). The bore 1 is prested to the bottom of the seat 3 through a gasket 6 by a high-pressure fuel pipe union 7.

An axial passage 8 formed in the seat 1 is a continuation of the opening 5 in the head and upper end face 9 of the seat 1 is engaged by the delivery valve 2 due to the action of a spring 10 biased between a shoulder in the union 7 and the valve 2 at the moment when the fuel delivery to the fuel-injection nozzle is discontinued. Hence, free transfer of fuel in the opposite direction is prevented.

Bearing against the delivery valve 2 is one end of a cylinder 11 of a check valve 12, and by virtue of a spring 13 located within the cylinder, the valve 12 closes an opening 14 provided in end 15 of the cylinder. The opening 14 serves to transfer the fuel from the delivery fuel line (not shown in the drawing) to the pump after the delivery process effected by the delivery section has been discontinued. The cross-section of the opening 14 determines the moment when the check valve 12 starts to open. In the delivery valve 2 in the path of the reverse flow of the fuel (from the fuel-injection nozzle to the fuel-pump), there is provided a throttle opening having a cross-section smaller than that of the opening 14.

The opening 16 serves to reduce the velocity of the reverse flow of the fuel, thus diminishing the pressure impact affecting the check valve 12 and stabilizing the relief of the fuel line (complementing the effect produced by the check valve 15). At the moment when the pump is started, the fuel passing through opening 5 (Fig. 1) and passage and contacts the delivery valve 2 and, having overcome the resistance of the spring 10, forces the delivery valve 2 slightly in an upward direction. Then the fuel fills the space above the valve in the union 7 and passes into a high-pressure fuel line connected to the fuel-injection nozzle.

At the moment when the fuel supply is arrested, the delivery valve 2, under the action of the spring 10, is rapidly forced onto the seat 1, opening check valve 12, and the fuel entering through the opening 14 starts to
pass through the throttle opening 16 into the space above the plunger of the pump (not shown in the drawing), until a pre-determined pressure is developed in the space above the valve. The throttle opening 16 damps the stream of fuel, thus contributing to the damping action of the check valve 12 with respect to wave oscillations arising in the fuel line and increasing stability and dependability of its operation.

It will be noted that in the embodiments illustrated in FIGS. 2 and 3 corresponding components bear the same reference numbers as in FIG. 1.

In certain situations it is expedient that a check valve 12a (FIG. 2) provided with a spring 13a be arranged in a passage 8a provided in the seat 1 of the delivery valve 2 which, in turn, serves as a seat for the check valve 12a closing the throttle opening 16.

In some situations it may be advisable for the throttle opening 16 (FIG. 3) and the opening 14, which determines the moment at which the check valve 12a commences to open, be formed sequentially in the delivery valve 2 and be in communication with each other. The check valve 12a is provided with a cylindrical portion 18 which serves as a guide for the spring 13a and the upper guide portion of a non-return valve 17 having grooves 19 (FIG. 4) for passing the fuel.

We claim:

1. A valve system for the delivery stage of a fuel injection pump for internal combustion engines, comprising: A body having a bore therein; spring-loaded delivery and check valves located in the bore; one of said valves having a recess passing fuel to said check valve to cause opening thereof; said delivery valve having a throttle opening along its longitudinal axis in the path of fuel flow from a delivery fuel line to the pump with said check valve in an open position; said recess and opening being coaxial and the cross section of said throttle opening being smaller than the cross section of the recess passing fuel to said check valve to effect opening of the check valve.

2. A valve system for the delivery stage of a fuel injection pump for internal combustion engines, comprising: A body having a bore therein; a valve seat within said bore; a spring-loaded delivery valve within said bore for cooperation with said seat; a spring-loaded check valve within said bore axially spaced from said delivery valve; said check valve including a cylinder having a closed end and a flanged end; said flanged end resting on said delivery valve; said closed end having an opening for delivering fuel; said opening being coaxial with the throttle opening; a seat provided about said opening; a check valve within said cylinder; a spring biased between the check valve and the delivery valve for pressing said check valve against its seat; and a second spring means surrounding the cylinder biased between a shoulder within the bore and said flanged end of said cylinder for pressing said delivery valve against its seat.

4. The valve system as claimed in claim 1 in which said bore is provided with means defining a valve seat for said delivery valve; said valve seat having a flat support surface; said delivery valve having a flat support surface resting on said valve seat flat support surface; and said check valve being arranged within said valve seat defining means.

5. The valve system as claimed in claim 4 in which said recess in said check valve is next to said throttle opening.

6. The valve system as claimed in claim 4 in which said recess is provided at the end of said throttle opening next to the check valve.

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