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FUEL INJECTION DEVICE

Filed April 26, 1946

Fig. 1.

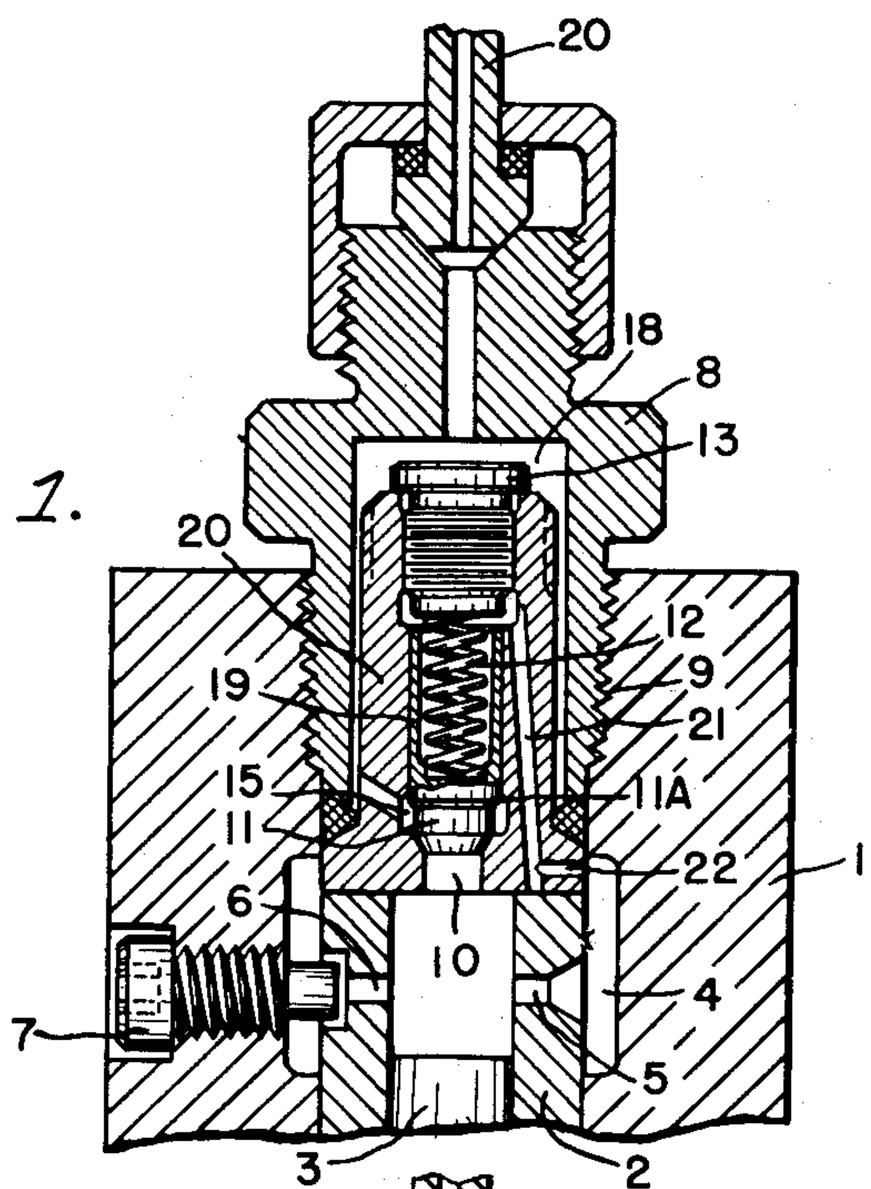
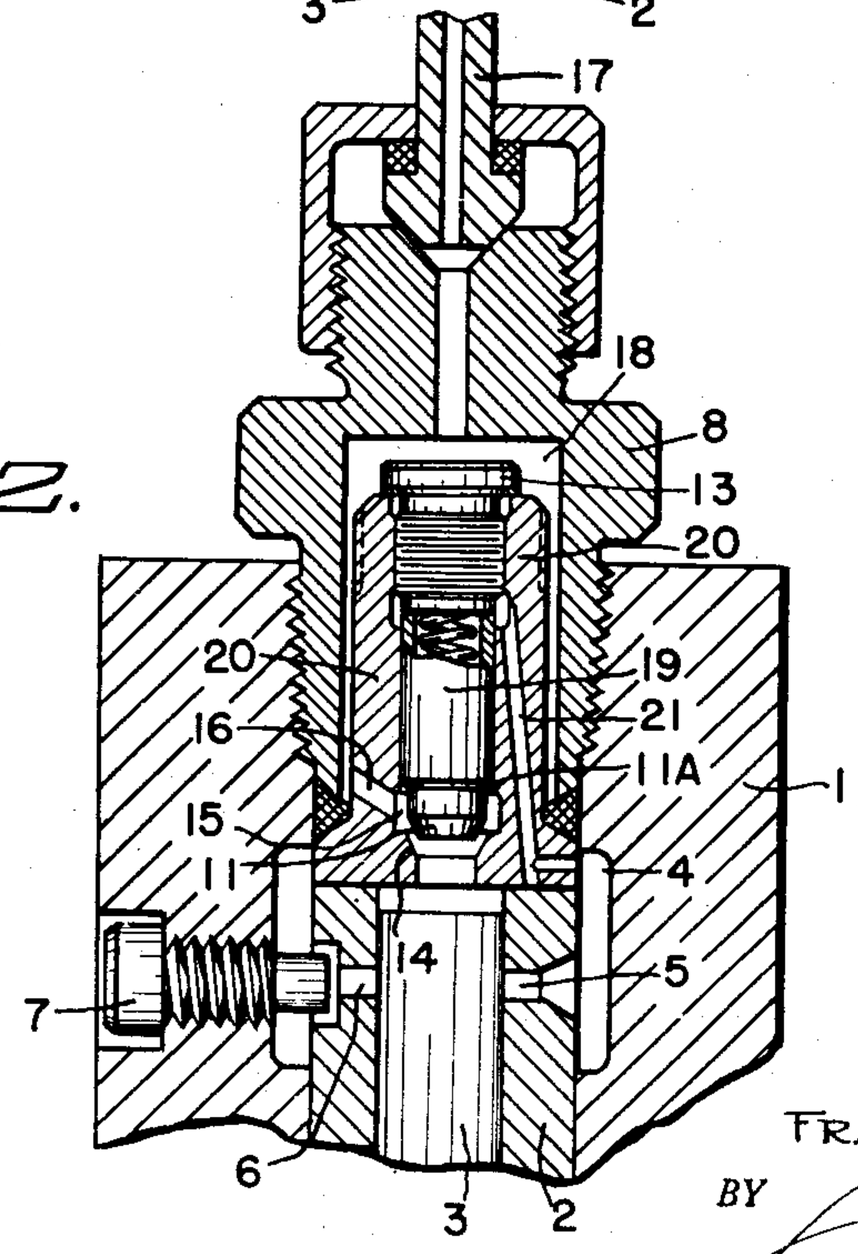


Fig. 2.



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FUEL INJECTION DEVICE

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4 Claims. (Cl. 103—154)

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This invention relates to fuel supply means for internal combustion engines and more particularly to a new and improved delivery valve construction for the fuel injection nozzles of solid fuel injection engines.

An object of the present invention is to provide a new and improved delivery valve having large flow capacity for the fuel injection nozzles of an internal combustion engine.

An object of the invention is to provide a new and improved delivery valve for a fuel injection system which will provide unrestricted fuel flow to the fuel delivery line and also adequate return flow.

Another object of the invention is to provide a new and improved delivery valve that will enable the obtaining of substantially desired residual pressure and which will also enable the maintenance of such pressure to a pre-determined valve regardless of the fuel quantity or the speed of the pump.

Another object of the invention is to provide a new and improved delivery valve for a fuel injection system which will reduce pressure fluctuations in the fuel delivery line and also prevent secondary discharges of fuel through the injection nozzle.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings. It will be understood that many changes may be made in the details of construction and arrangement of parts shown and described, as the preferred form of the invention has been shown by way of illustration only.

Referring to the drawings:

Fig. 1 is a sectional view of a delivery valve constructed according to the invention and with the valve in closed position; and,

Fig. 2 is a view similar to Fig. 1 but showing the valve in open position.

With the prior types of delivery valves of the type of the present invention, when the pump began to deliver fuel through the fuel supply line to the delivery valve, the main valve was raised from its seat to allow fuel to be delivered to the delivery line and the valve remained open until the plunger ceased to deliver fuel at which time the combined action of the main delivery valve spring and the differential in pressure above and below the delivery valve caused the delivery valve to close. When the main valve closed, the secondary valve or reverse flow valve came into action. Should the pressure in the discharge line be higher than the opening pressure of this

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secondary valve, the secondary valve opened and fuel was returned to the pump barrel until the closing pressure of the secondary valve was reached at which time the valve closed.

The difficulty and disadvantage with the construction described above was that the restriction through the reverse flow or secondary valve was so great that the pressure waves arriving at the pump were reflected back toward the nozzle with sufficient strength to cause the nozzle valve to be re-lifted off its seat after having once closed at the end of the injection and this re-lifting of the valve produced what is known as secondary discharge or injection.

The cause of the restriction through the reverse flow valve was inherent in the type of check valve used, that is, the check valve controlling the reverse flow was in series with and interposed between the low pressure receiver, which was the pumping unit, and the high pressure fuel storage, which was the fuel line. Because of this, the pressure urging the fuel through the reverse flow check valve was the difference between the pressure at the valve and the opening pressure of the check valve. For example, if the reverse flow pressure in the reverse flow valve was 1500 pounds per square inch and the opening pressure of the check valve was 1000 pounds per square inch, the effective reverse or lifting pressure would be 500 pounds per square inch. In the construction of the present invention the complete 1500 pounds per square inch pressure is the effective reverse flow or relieving pressure, thus overcoming the inherent disadvantage of such prior constructions.

It is the principal object of the present invention to overcome the disadvantages of the prior type constructions as set forth above.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout the several views, there is shown in Fig. 1 the pump housing 1 having a bore in which is positioned the barrel 2 adapted to receive the pumping plunger 3 which is reciprocably mounted in said barrel 2.

In the pump housing 1 and surrounding the upper end of the barrel 2 is provided the pump supply chamber or sump 4 adapted to receive fuel from a fuel supply tank and to supply fuel to the chamber inside the barrel 2 through the filling port 5. The spill port 6 is provided through the barrel 2 and the adjusting screw 7 is provided to locate the barrel 2 in proper position in the pump housing 1 and also to minimize the velocity of the spill against the wall of the sump 4 adjacent the spill port 6.

The delivery valve body 8 is adapted to be secured to the pump housing 1 by the threaded connection 9 to retain the parts in operative position.

On the pumping stroke of the plunger 3 in the barrel 2, the fuel enters the delivery valve from the pumping unit through the duct 10 and the valve 11 is then lifted off its seat against the spring 12 by the pressure of the incoming fuel against the valve 11 which continues to lift until the valve 11 reaches the stop 13. The fuel then flows through the space between the valve 11 and the seat 14 into the annular chamber 15 and through one or more ducts 16 and to the fuel line 17 through the annular passage 18.

It will be noted that the pressure necessary to raise the valve 11 is relatively low because of the pressure of the said valve 11 on the seat 14 by the combined action of the spring 12 and sump pressure internally of the valve which is balanced by the residual pressure on the differential area 11*a* and the direct sump pressure in the pump barrel acting on the bottom of the valve through the duct 10.

When the fuel delivered by the pump ceases when the plunger 3 reaches the end of its stroke, the pressure in the chamber 15 is the same as that in the discharge line 17. This pressure acts on the annular differential area 11*a* of the valve 11, the differential area 11*a* being determined by the valve diameter and the valve seat diameter. This pressure continues to hold the valve 11 open against the stop 13 until the force exerted against the valve 11 by the pressure of the fuel in the supply duct 10 combined with the pressure against the differential area 11*a* is less than the combined force of the spring 12 and sump pressure internally of the valve 11 at which time the valve 11 is forced back upon its seat 14 where it remains seated until the following cycle or stroke of the plunger 3 when fuel is again delivered through the duct 10 as above described.

If immediately after the valve 11 seats on its seat 14 a pressure wave arrives at the differential area 11*a*, the valve re-opens allowing the full fuel pressure to eject fuel through the space between the valve 11 and seat 14.

In the present construction the spring 12 is positioned within the delivery valve 19 to form a relatively close fit between said valve 19 and the adjacent wall of the seat member 20. In spite of this close fit, fuel leaks through between the parts 19 and 20 and builds up pressure inside the delivery valve member 19 which increases the pressure necessary to operate the delivery valve member 11. In order to relieve this pressure and to return this fuel to the sump 4 of the pump, the ducts 21 and 22 are provided which connect the interior of the valve 19 with the pump sump 4, thereby allowing this fuel leakage to be returned directly to the pump sump during the residual pressure time in the pump, and if the delivery valve 11 is closed on its seat 14 and a pressure surge is received from the nozzle, if the pressure surge is of sufficient pressure, it will automatically lift the valve 11 from its seat and bleed the fuel into the pump chamber.

From the above it will be noted that there are two features of the present invention, namely, that any leakage fuel into the delivery valve 19 can be returned to the pump sump 4 through the ducts 21 and 22 and also should the pressure surge from the nozzle be of sufficient strength, it can be relieved by lifting the valve 11 and bleeding to the pump chamber. Because of this arrangement, it is possible to get practically a constant residual pressure and also reduce pressure waves or surges in the delivery line.

From the foregoing it will be seen that I have provided simple, efficient and economical means for obtaining all of the objects and advantages of the invention.

Having described my invention, I claim:

1. In a device of the character described, a fuel injection pump comprising a barrel having a bore, a plunger in said bore, means for reciprocating said plunger for injecting fuel, a source of fuel supply in communication with said bore and adapted to supply fuel thereto, a fuel delivery outlet and a delivery valve in the fuel path between said pump bore and said outlet, said delivery valve having a bore communicating with said pump bore, a valve member in said valve bore, a seat for said valve member, spring means urging said valve towards said seat, a discharge port communicating with said valve bore, a differential area on said valve member and a fuel passage between said discharge port and said valve bore adjacent said differential area on said valve member whereby said valve member may be urged away from said seat by pressure surges of fuel in said fuel passage to open said valve and allow passage of fuel from said delivery line back to the bore of the fuel injection pump and a second fuel passage communicating with said valve and said source of fuel supply for allowing return of fuel passing said valve member to said source of fuel supply.

2. In a device of the character described, a fuel injection pump comprising a barrel having a bore, a plunger in said bore, means for reciprocating said plunger for injecting fuel, a source of fuel supply in communication with said bore and adapted to supply fuel thereto, a fuel delivery outlet and a delivery valve in the fuel path between said bore and said outlet, said delivery valve having a bore aligned with said pump bore and communicating with said pump bore, a valve member in said valve bore, a seat for said valve member, spring means urging said valve towards said seat, a discharge port communicating with said valve bore, a differential area on said valve member and a fuel passage between said discharge port and said valve bore adjacent said differential area on said valve member whereby said valve member may be urged away from said seat by pressure surges of fuel in said fuel line to open said valve and allow passage of fuel from said delivery line back to the bore of the fuel injection pump and a second fuel passage communicating with said valve and said source of fuel supply for allowing return of fuel passing said valve member to said source of fuel supply.

3. In a device of the character described, a fuel injection pump comprising a barrel having a bore, a plunger in said bore, means for reciprocating said plunger for injecting fuel, a source of fuel supply in communication with said bore and adapted to supply fuel thereto, a fuel delivery outlet and a delivery valve in the fuel path between said pump bore and said outlet, said delivery valve having a bore communicating with said pump bore, a hollow valve member in said valve bore, a seat for said valve member, spring means in said hollow valve and urging said valve towards said seat, a discharge port communicating with said valve bore, a differential area on said valve member and a fuel passage between said discharge port and said valve bore adjacent said differential area on said valve member

whereby said valve member may be urged away from said seat by pressure surges of fuel in said fuel passage to open said valve and allow passage of fuel from said delivery line back to the bore of the fuel injection pump and a second fuel passage communicating with said valve and said source of fuel supply for allowing return of fuel passing said valve member to said source of fuel supply.

4. In a device of the character described, a fuel injection pump comprising a barrel having a bore, a plunger in said bore, means for reciprocating said plunger for injecting fuel, a source of fuel supply in communication with said bore and adapted to supply fuel thereto, a fuel delivery outlet and a delivery valve in the fuel path between said bore and said outlet, said delivery valve having a bore aligned with said pump bore and communicating with said pump bore, a hollow valve member in said valve bore, a seat for said valve member, spring means in said hollow valve and urging said valve towards said seat, a discharge port communicating with said valve bore, a differential area on said valve member and a fuel passage between said discharge port and said valve bore adjacent said differential area on said valve member whereby said valve

member may be urged away from said seat by pressure surges of fuel in said fuel passage to open said valve and allow passage of fuel from said delivery line back to the bore of the fuel injection pump and a second fuel passage communicating with said valve and said source of fuel supply for allowing return of fuel passing said valve member to said source of fuel supply.

FRANK DE LUCA.

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