March 21, 1950 D. E. MEITZLER 2,501,074

FUEL PUMP

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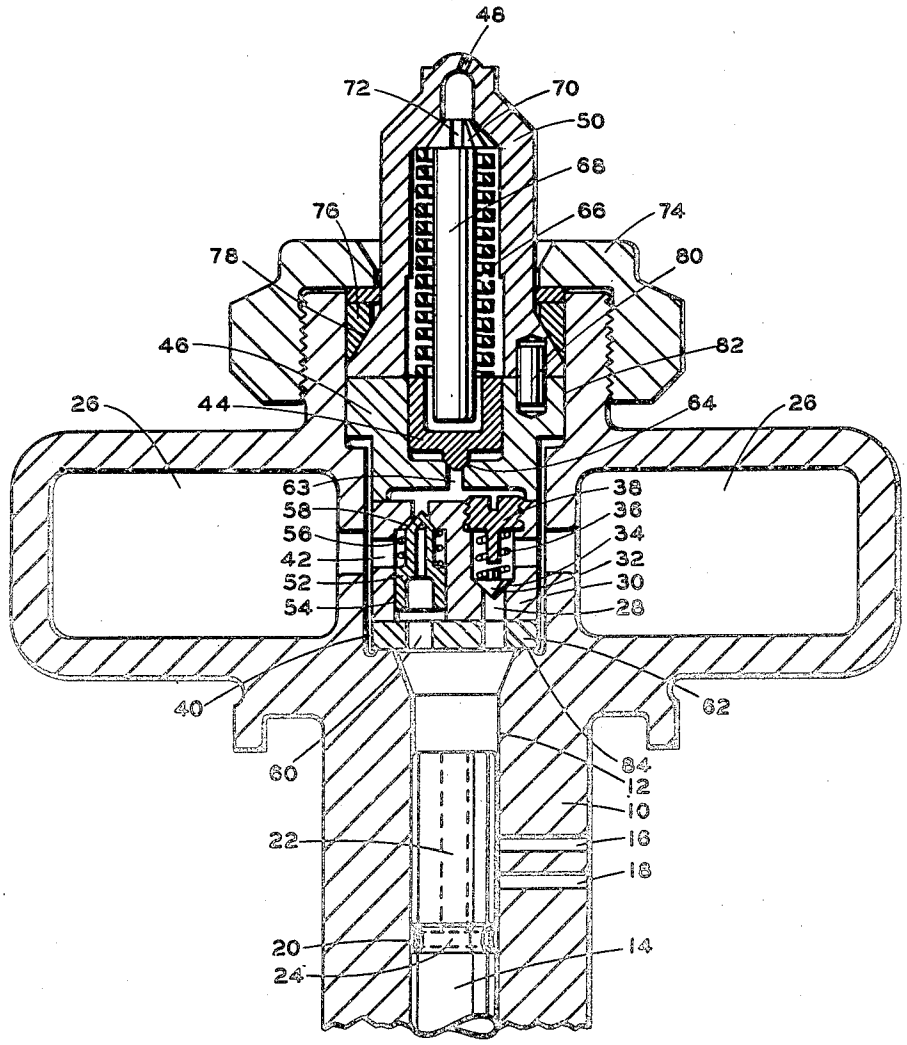


FIG. 1.

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FUEL PUMI

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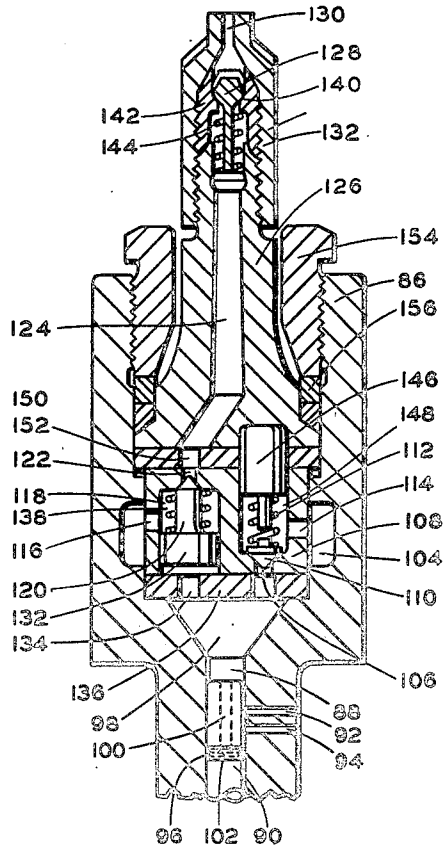


FIG. 2

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FUEL PUMP

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8 Claims. (Cl. 103—154)

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The invention relates to a fuel injection device particularly of the accumulator type in which fuel under pressure is collected in a chamber and is caused to discharge from the chamber by a drop in pressure in the inlet passage for the chamber.

In prior devices a single accumulator valve has been used in controlling the flow of fuel into and out of the accumulator chamber. This valve is normally held by the pressure of fluid in the inlet to the chamber in such a position that fuel will not discharge from the chamber and a drop in pressure in the inlet causes the valve to move for a discharge of fuel. For high speed operation this valve must have the characteristics of rapidly opening and closing and must also provide for a high flow rate in order that the discharge of fuel from the chamber through the nozzle may occur in the desired short space of time. A feature of the invention is the use of two separate valve devices, one of which will control the flow into the chamber and the other will control the discharge from the chamber. By this arrangement it is possible to obtain the desired characteristics in each of the valves.

Another object of the invention is an arrangement by which the valves may be located in a valve body which can be readily machined separate from the ring of the device.

Another feature is the arrangement of the discharge valve so that it is held closed by pressure in the inlet passage for the chambers and is opened by a pressure drop in the inlet passage supplemented by a spring to make the operation more positive.

In addition to the pressure control discharge valve it has been found that a check valve is advantageous in the discharge so that the flow from the chambers will terminate at a predetermined pressure. A feature of the invention is a control for a check valve in the discharge ring which has a limited lift so that its rate of closing may be rapid. Another feature is a control for the lift of both the inlet check valve and the pressure actuated valve.

Other objects and advantages will be apparent from the specification and claims, and from the accompanying drawings which illustrate an embodiment of the invention.

Fig. 1 is a sectional view through the device.

Fig. 2 is a sectional view through a modified form of the device.

As shown in Fig. 1 a casing 10 has a bore 12 in which a plunger 14 reciprocates. An inlet port 16 is uncovered by the plunger during reciprocation for admitting fuel to the bore and a vent port 18 is uncovered by a groove 20 in the plunger for venting the space at the head of the plunger. Groove 20 is connected with the head of the plunger by passages 22 and 24.

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Fuel is accumulated in chambers 26 in the casing being pumped through an inlet passage 28 in a valve body 30. A check valve 32 engages a seat 34 in the passage and is held in position by a spring 36. A plug 38 engages the valve as it opens and limits the extent of valve opening. As shown, valve 32 has an extremely small mass so that it will open and close rapidly. Thus, when the space at the head of the plunger is vented the valve 32 will close quickly and no substantial amount of fuel will flow out of the chambers. The chambers communicate with each other by a cylindrical space 40 surrounding the valve body 30.

Fuel in the chambers discharges through a passage 42 in the valve body and past a check valve 44 in a ring 46 through a discharge passage 48 in a nozzle 50. A pressure actuated valve 52 controls the flow through passage 42.

Valve 52 reciprocates in a bore 54 and is normally moved into open position by a spring 56. The valve has a conical tip engaging a seat 58 and at the other end forms a plunger reciprocating in bore 54. This bore communicates with the space at the end of the pump plunger through a passage 60 in a plate 62 so that pressure at the end of the pump plunger may act on the valve 52 and hold it closed while fuel is being forced under pressure into the chambers.

The ring 46 has a central passage 63 having a seat 64 at its upper end engageable by the check valve 44, the latter being held against the seat by a coil spring 66. A bar 68 having a head 70 with grooves 72 is supported within the spring in a position to limit the opening of valve 44.

The grooves 72 permit fuel to flow past the head and through the discharge passage 48.

Plate 62, valve body 30, ring 46 and nozzle 50 are all clamped within the casing by a clamping ring 74. As shown, this ring engages gaskets 76 resting against a conical surface 78 on the nozzle. The nozzle and the ring 46 are held against relative rotation by a pin 80 and the lower end of ring 46 engages the valve body. By this arrangement, the valve body, with the seats formed therein, and the valves also mounted therein, may be assembled within the casing structure and be held within the casing by the same clamping ring that holds the nozzle.

In operation, with the plunger in the position

shown and moving upwardly on the pumping stroke, fuel continues to be forced into the chambers 26 until passage 18 is uncovered. When this occurs, valve 32 is closed by spring 36 and the drop in the pressure at the head of the plunger resulting from the uncovering of port 18 causes the pressure actuated valve to move down until it engages plate 62, this latter plate limiting the opening of the valve. The pressure actuated valve may be dimensioned to assure an adequate rate of flow from the chambers either by controlling the lift or the seat area.

With the pressure actuated valve open fuel accumulated in the chambers discharges through passage 42 past the check valve 44 which is opened by the fuel pressure and through groove 72 to be discharged through passage 48.

As the plunger begins its downward stroke valve 34 remains seated and fluid connection between the chambers and the space at the head of the plunger is cut off by the plunger part of the pressure actuated valve. After port 16 is uncovered the space at the head of the plunger fills and the plunger begins its upward movement for again forcing fuel into the plungers.

By the arrangement shown, the accurate machine work required on the casing 10 is minimized, being limited to the bore 12, the larger bore 82 which guides the nozzle 50 and ring 46, and the surface 84 with which plate 62 engages.

With reference to Fig. 2, the casing 86 has a bore 88 in which a plunger 90 reciprocates. An inlet port 92 is uncovered by the plunger during reciprocation for admitting fuel to the bore and a vent port 94 is uncovered by a groove 96 in the plunger as the latter reaches the upper end of its stroke for venting the space 98 at the head of the plunger. Groove 96 is connected with the head of a plunger by a passage 100 and a cross passage 102.

Fuel is accumulated in an annular chamber 104 in the casing, being pumped through an inlet passage 106 in valve body 108. A check valve 110 engages a seat in the passage and is held in position by a spring 112. The valve 110 is similar to valve 32 and has an extremely small mass. A lateral port 114 in the valve body 108 connects the check valve with the annular chamber 104.

Fuel from the chamber 104 discharges through a port 116 into a bore 118 in the valve body and past a valve 120 into a passage 122 in the valve body and an aligned passage 124 in the nozzle body 126. A check valve 128 adjacent the end of passage 124 terminates the discharge of fuel through a passage 130 in a nozzle tip 132 when the pressure in passage 124 is reduced to a predetermined amount.

Valve 120 has an integral plunger 132 which is exposed to the pressure in space 98 by a communicating passage 134 in a plate 136 which also limits the lift of valve 120. Thus, with a drop in pressure in space 98 the spring 138 assisted by the pressure within bore 118 moves the plunger 132 down to open valve 120.

Check valve 128 is located adjacent to the passage 130 to minimize the space between the check valve and the end of the passage, thereby reducing the amount of fuel that will dribble from the passage after the check valve closes. As shown, the check valve engages a seat 140 in a ring 142 located within the nozzle tip 132. A coil spring 144 holds the check valve closed and the ring is held in place by the tip which may be threaded to cooperate with corresponding threads on the nozzle body.

In assembly of the device, the plate 136 and the valve body 108 with the valves therein may be placed in position with a pin 146 located in the bore 148 for check valve 110 projecting beyond the end of the bore to index a plate 150 having a passage 152 in line with passage 122 and also to index the nozzle body 126. A threaded clamping ring 154 engages packing 156 for sealing the device and for holding the assembled elements within the casing.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claims.

I claim:

1. A fuel injection system including a pump plunger, a casing having a bore in which the plunger reciprocates, a chamber into which fuel is pumped and in which fuel is accumulated under pressure, a discharge passage from the chamber, a connection from the chamber to the bore, a valve body through which said connection is made and through which the discharge passage extends, said casing having a recess for the valve body, a check valve positioned in said body and located in the connection between the chamber and the bore, and a pressure actuated valve mounted in said valve body and located in the discharge passage, and means for holding said body in the casing.

2. A fuel injection system including a pump plunger, a casing having a bore in which the plunger reciprocates, a chamber into which fuel is pumped and in which fuel is accumulated under pressure, a discharge passage from the chamber, a connection from the chamber to the bore, a valve body through which said connection is made, said casing having a recess for the valve body, a check valve positioned in said body and located in the connection between the chamber and the bore, a pressure actuated valve mounted in said valve body and located in the discharge passage, and means for holding said body in the casing.

3. A fuel injection system including a pump plunger, a casing having a bore in which the plunger reciprocates, a chamber into which fuel is pumped and in which fuel is accumulated under pressure, a discharge passage from the chamber, a connection from the chamber to the bore, a valve body through which said connection is made and through which the discharge passage extends, said casing having a recess for the valve body, a check valve positioned in said body and located in the connection between the chamber and the bore, a pressure actuated valve mounted in said valve body and located in the discharge passage, and means for holding said body in the casing including a ring for holding the valve body in position.

4. A fuel injection system including a casing having an inlet passage, a chamber in which fuel is accumulated under pressure, a connection from said passage to said chamber, a check valve in said connection to prevent flow of fuel from the chamber to the passage, a discharge passage from the chamber, and a pressure actuated valve in said last passage, said pressure actuated valve including a plunger, a cylinder in which the plunger slides, and a connection between said cylinder and said inlet passage to cause said valve to move in response to changes in pressure in said inlet passage.

5. A fuel injection system including a casing

having an inlet passage, a chamber in which fuel is accumulated under pressure, a connection from said passage to said chamber, a check valve in said connection to prevent flow of fuel from the chamber to the passage, a discharge passage from the chamber, and a pressure actuated valve in said passage, said pressure actuated valve including a plunger, a cylinder in which the plunger slides, a connection between said cylinder and said inlet passage to cause said valve to move in response to changes in pressure in said inlet passage, and a spring acting on said pressure actuated valve for opening it.

6. A fuel injection system including a casing having an inlet passage, a chamber in which fuel is accumulated under pressure, a connection from said passage to said chamber, and a discharge passage from the chamber, in combination with a valve body through which said fuel connection is made and through which the discharge passage extends, said casing having a recess for the valve body, a check valve located in the valve body in the connection from the inlet passage to the chamber, a pressure actuated valve located in the discharge passage and positioned in the valve body, and means for holding said body in the casing.

7. A fuel injection system including a casing having an inlet passage, a chamber in which fuel is accumulated under pressure, a connection from said passage to said chamber, and discharge passage from the chamber, in combination with a valve body through which said fuel connections are made, said casing having a recess for the valve body, a check valve located in the valve body in the connection from the inlet passage to the chamber, a pressure actuated valve located in the discharge passage and positioned in the valve body, said valve body having a fluid connection between the inlet passage and the pressure actuated valve to cause said valve to move in response to changes in pressure in said inlet passage, and means for holding said body in the casing.

8. A fuel injection system including a plunger, a casing having a bore in which the plunger reciprocates, a chamber into which fuel is pumped by said plunger and in which fuel is accumulated under pressure by said plunger, a discharge passage from the chamber, and a connection from the chamber to the bore, in combination with a check valve in the connection between the plunger bore and the chamber to permit flow of fuel into the chamber, and a presure actuated valve located in the discharge passage to provide for discharge of fuel therethrough, said pressure actuated valve having associated therewith a plunger, a cylinder within which said plunger is slidable, and a connection from the cylinder to said bore so arranged that pressure from said bore transmitted to said chamber will hold said pressure actuated valve closed and a drop in pressure in said bore will allow the pressure actuated valve to be opened by the pressure in said chamber.

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