Feb. 7, 1950 D. E. MEITZLER 2,496,804

FUEL INJECTION DEVICE

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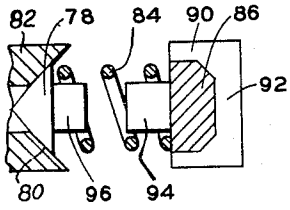


FIG. 4.

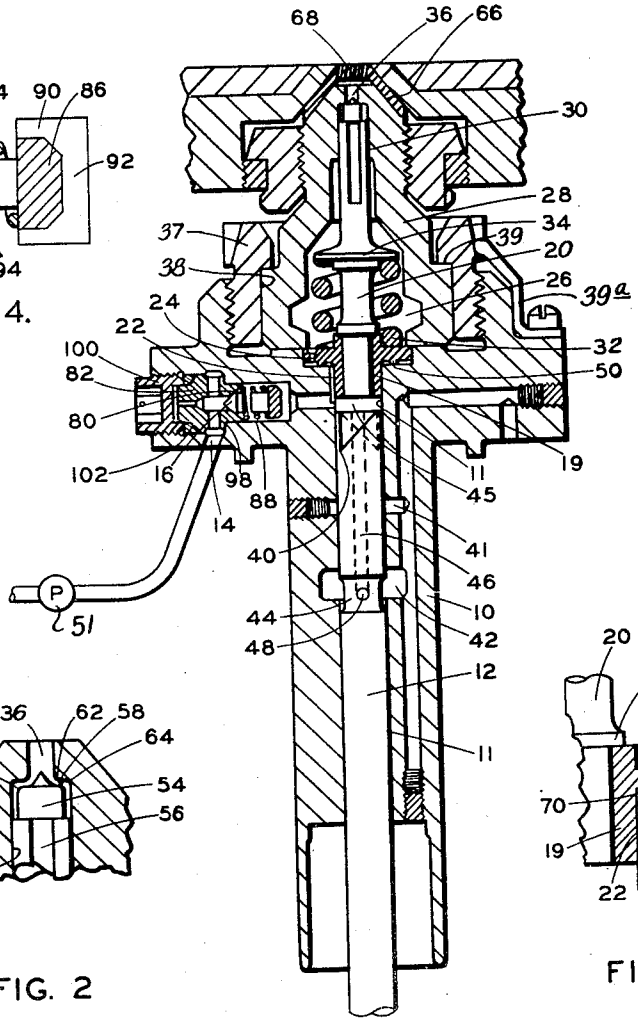


FIG. 1

FIG. 2

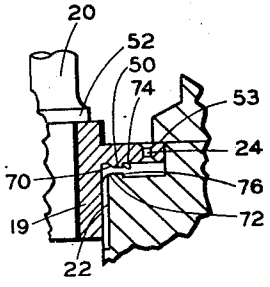


FIG. 3

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FUEL INJECTION DEVICE

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Application January 16, 1945, Serial No. 573,110

6 Claims. (Cl. 103—41)

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This invention relates to a fuel injection device of the accumulator type.

In this type of injection device, where the pressures are high in order to obtain a short duration of injection and also to obtain the desired quantity of injected fuel the parts of the device are under extremely high stresses. A feature of the invention is an arrangement for holding the nozzle tip to the body without overstressing the parts and with the nozzle tip in alignment with the main part of the device.

Another feature is the arrangement of the needle which acts as check valve to terminate the injection in such a way as to provide for the delivery of a large quantity of fuel during each injection without the necessity for having the parts too large. Another feature is an arrangement of the needle valve coil spring such that the flow of fuel through the needle tends to move the spring in a direction to hold the spring against the needle to limit bouncing of the spring away from the needle when the needle valve is opened. In accordance with this feature of the invention the needle flange with which the spring engages is made of small enough dimensions so that it will not be affected by the flow of fuel.

In this type of injection system fuel is forced into an accumulator chamber during the movement of the pump plunger and when the pressure at the end of the plunger drops, the passage from the plunger to the accumulator chamber is closed and the passage from this chamber to the nozzle is opened. A feature of the invention is an arrangement of the flow passage for the fuel between the plunger and the accumulator chamber so that fuel may flow readily into this chamber but will not flow readily in the opposite direction. Another feature is the arrangement of the discharge passage from this chamber to facilitate said discharge of fuel.

A feature of the invention is an injection pump so arranged that fuel may flow through the pump during a substantial part of the pump cycle.

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 injection system.

Fig. 2 is a fragmentary sectional view on a larger scale showing the construction of the needle tip and the associated nozzle.

Fig. 3 is a fragmentary sectional view showing the particular arrangement of the passage between the pump and the accumulator chamber.

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Fig. 4 is a fragmentary sectional view of the check valve for the fuel inlet.

The pump includes a casing 10 having a bore 11 in which a plunger 12 reciprocates. Fuel enters a port 14 and flows past a check valve 16 into the end of the bore 11 in which the plunger is located. A cuff 19 fits in the end of the bore 11 and receives the end of a needle or plunger 20. Grooves 22 (see Fig. 3) permit fuel to flow past the cuff, the fuel passing through one or more openings 24 in the cuff into a chamber 26. This chamber is formed in a nozzle body 28 which has a bore 30 receiving the end of the needle 20 remote from the cuff. A coil spring 32 surrounding the needle holds the cuff against the end of casing 10 and engages with a flange 34 on the needle to move the needle into a position to close the discharge passage 36 in the nozzle. The floating cuff is claimed in detail in a copending Meitzler application, Serial No. 573,109, filed January 16, 1945, now abandoned.

Nozzle body 28 is held on the casing 10 by a threaded ring 37 engaging the casing. The inner surface 38 of the ring pilots the nozzle and a shoulder 39 on the ring holds the nozzle endwise in position. By this arrangement alignment of bore 30 with bore 11 is facilitated. A lock 39a may hold the ring 37 against turning after assembly.

The plunger has a helical slot 40 which, during its reciprocation, covers a discharge port 41 in the casing and thereby controls the quantity of fuel delivered to the accumulator chamber for each reciprocation of the plunger by angular adjustment of the plunger. A vent passage 42 in the casing communicates with an annular groove 44 in the plunger when the latter approaches the end of its pumping stroke to permit fuel in the space 45 at the end of the plunger to flow through a central passage 46 in the plunger and a cross passage 48 into the vent passage 42.

With the plunger in the position shown, the first motion of the plunger is downward causing fuel to enter the bore 11 (space 45) past the check valve 16. During the downward stroke of the plunger the needle and cuff are in the position shown in Fig. 1 in which an annular rib 50 on the cuff forms a seat to prevent fluid communication between the end of bore 18 and the chamber 26. Near the end of the downward stroke of the plunger the helical groove 40 uncovers port 41 to establish fluid connection between this port and the bore 11. If the pressure is high enough on inlet port 14, fuel will flow through the bore 11 and cool the pump, fuel being supplied by a source

represented by a pump 51, connected to inlet passage 14. With the inlet port uncovered during the entire plunger stroke, fuel enters space 45 as soon as the plunger begins its down-stroke. This prevents the creation of a vacuum which occurs when the filling port is covered by the plunger during a part of its stroke and thus prevents the hammering caused by the sudden filling of the pump chamber.

As the plunger begins its upward stroke, fuel discharges through port 41 until this port is closed by the edge of the groove 40. As the plunger continues its upward movement fuel is discharged through groove 22 past rib 50 and through openings 24 into the accumulator chamber 26. At this time, the cuff is in the position shown in Fig. 3, there being clearance normally provided between the upper end of the cuff and a shoulder 52 on the needle 20 and also clearance between the cuff and a shoulder 53 on the nozzle. The plunger continues its upward movement, forcing fuel under pressure into the accumulator chamber until groove 44 communicates with passage 42. When this occurs, the pressure in space 45 at the end of the pump plunger drops, permitting the cuff to move downward under the action of spring 32 so that the rib 50 seats, thereby sealing off the accumulator chamber. At this time, the pressure differential on the needle 20 causes it to move down to open the passage at the upper end of the needle and permit discharge of fuel through passage 36 and into the engine cylinder. To obtain this pressure differential the needle has a reduced portion 54, Fig. 2, at its upper end communicating with the accumulator chamber by a slot 56.

The end of the needle, as shown in Fig. 2, normally engages a seat 58 surrounding passage 36 in the nozzle tip, and, when the needle moves down, the end of the needle moves away from the seat for flow of fuel out of the nozzle. Thus, the injection occurs when the pressure at the end of the pump plunger drops as a result of the venting of the space 45 into passage 42. Shoulder 52 on the needle engages with cuff 19 to limit the opening movement of the needle.

In order to facilitate the flow of fuel from the nozzle without using a large size nozzle the corners 60 of the reduced portion 54 on the needle 20 are rounded and the inner end of passage 36 adjacent seat 58 may be rounded as at 62. The corner 64 at the upper end of the bore 30 is also rounded so that the path for the flow of fluid around the end of the needle is free from sharp corners which would interfere with the flow of fuel.

It may be noted that a separate nozzle tip 66 is mounted on the end of the nozzle 28 and has a number of passages 68 which gives the desired pattern to the fuel spray entering the engine cylinder. This arrangement of the separate tip is claimed in the copending application of Maitzler, Serial No. 573,111, filed January 16, 1945.

In order to facilitate the flow of fuel into the accumulator chamber the leading edge of rib 50, Fig. 3, has a rounded corner 70 and the corner 72 of the casing adjacent to the rib 50 is similarly rounded. The flow of fuel into the accumulator chamber is thus unimpeded by sharp corners. On the other hand, the trailing edge of the rib 50 has a sharp corner 74 and a cooperating shoulder formed in the casing 72 has an opposed sharp corner 76. By this arrangement, the reverse flow of fuel from the accumulator chamber back into the bore 11 is impeded and there will be substantially less loss of fuel by reverse flow during the time that the cuff is moving downward to close the connection between the bore 11 and the accumulator chamber.

As shown in Fig. 4 the check valve past which fuel enters the bore 11 includes a valve cone 78 engaging a seat 80 in a plug 82. A spring 84 normally holds the valve cone seated, the end of the spring remote from the cone engaging a support 86 which fits in a bore 88, Fig. 1, and which has slots 90 and 92 to permit fuel to pass around the support and into the casing bore 11. A projecting lug 94 on the support 86 and a cooperating lug 96 on the cone 78 limit the amount that the cone 78 may move in opening the valve.

The assembly of the inlet check valve provides a tight seal both for the high pressure in the pump space 45 and the lower inlet pressure in passage 14. As shown, the plug 82 has a shoulder 98 engaging a lapped seat in casing 10 for sealing against the high pressure in space 45. A cap 100 holds plug 82 in position and clamps a gasket 102 in position to seal against the low pressure in passage 14.

The spring 32 which holds the cuff and the needle both seated is nearly as large in diameter as the part of the accumulator chamber in which the endmost spring coil is located so that as fuel flows between the periphery of the spring and the wall of the chamber during discharge of fuel from the chamber the motion of the fuel tends to move the spring upwardly in a direction to hold the spring against the flange 34. The spring provides a restriction between the main part of the chamber and the discharge passage so that a substantial pressure differential will develop which will tend to hold the spring against the flange. The flange 34 is preferably somewhat smaller in diameter than the outside diameter of the spring so that the flow of fuel past the periphery of this flange will not be seriously restricted and will not act to cause the needle to be moved into closed position. This limits bouncing of the spring from the needle flange, when, during the opening movement of the needle, shoulder 52 engages cuff 19 and stops the needle.

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. In an injection device, a nozzle body having a discharge passage, and a seat surrounding the inlet end of said passage, and a plunger having a valve surface engaging said seat, a flange on said plunger, a spring engaging said flange and holding the valve surface against the seat, a chamber in which fuel is accumulated and from which fuel discharges through the discharge passage, said spring being located in said chamber, the spring being constructed to occupy enough of the area of the chamber adjacent the end coils which engage the flange to restrict the flow of fuel and cause the pressure resulting from the restriction to urge the spring against the flange, the greater part of the chamber volume being located on the upstream side of the restriction provided by the spring.

2. In an injection device, a nozzle body having a chamber in which fuel is accumulated, and an outlet passage for the chamber, an inlet passage for the chamber, a seat surrounding said inlet

passage, and a valve engaging said seat, said valve having a stem fitting in the passage and forming a guide for said valve, the wall of said inlet passage having grooves providing for fuel flow past said stem, said valve having an integral rib forming the seat engaging surface, said rib and the cooperating seat being constructed to provide curved surfaces for guiding the flow of fuel into the chamber, and being also constructed to provide sharp corners on the downstream side of the rib to restrict reverse flow.

3. In an injection device, a nozzle body having an accumulator chamber and a discharge passage for the chamber, an inlet passage for the chamber having a valve seat, a valve engaging the seat, a needle in said chamber having a valve surface engaging the discharge passage, a spring acting on said needle and valve for holding both of said passages closed, the end of said needle remote from the discharge passage being exposed to the pressure within the inlet passage whereby a drop in pressure in this passage will cause the needle to move to open the dicharge passage, the surface of the nozzle body forming the discharge passage, and the cooperating needle surfaces being curved to facilitate flow of fuel from the chamber into the discharge passage.

4. In an injection device, a nozzle body having a discharge passage, and a bore communicating with said passage, a needle fitting in and guided by said bore, a casing providing an inlet passage for the nozzle body, an inlet valve in said inlet passage, said valve having a bore in which the needle is guided, and means for clamping the nozzle body to the casing including a ring threaded to the casing and having a cylindrical guiding surface, said nozzle body having a cooperating guiding surface engaging with the guiding surface on the ring.

5. In an injection device, a nozzle body having a discharge passage, and a bore communicating with said passage, a needle fitting in and guided by said bore, a casing providing an inlet passage for the nozzle body, an inlet valve in said inlet passage, said valve having a bore in which the needle is guided, and means for clamping the nozzle body to the casing including a ring threaded to the casing and having a cylindrical guiding

surface, said nozzle body having a cooperating guiding surface engaging with the guiding surface on the ring, said ring and nozzle body having cooperating shoulders by which the nozzle body is held securely against the casing.

6. In an injection device, a pump casing having a bore, a plunger in said bore, an inlet passage communicating with said bore at a point beyond the end of the plunger stroke, a check valve in said passage, a discharge port for said bore in a position to be covered by said plunger during a part of its reciprocation, means for supplying fuel to the inlet passage at a pressure high enough to open the check valve and force fuel through the bore while the discharge port is uncovered, and a helical groove in said plunger adapted, upon turning the plunger, for covering the discharge port earlier or later in the piston stroke for controlling the quantity of fuel pumped on each stroke of the plunger.

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