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ACCUMULATOR PUMP

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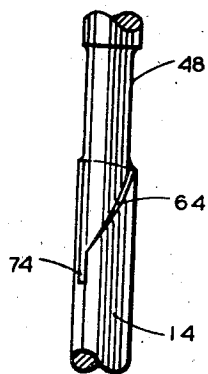


FIG. 3

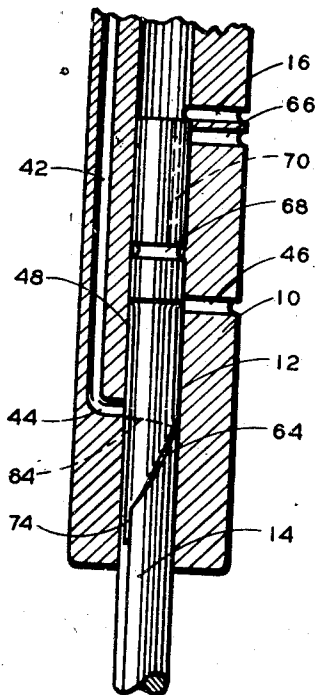


FIG. 2

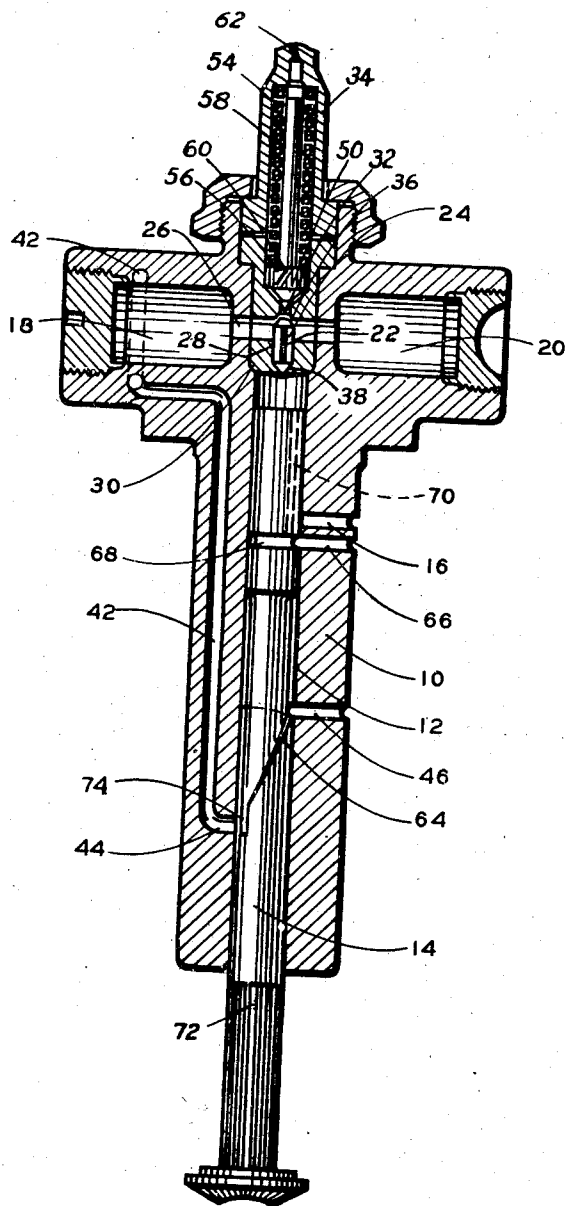


FIG. 1

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ACCUMULATOR PUMP

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10 Claims. (Cl. 103—41)

1 This invention relates to an injection apparatus of the accumulator type.

In accumulator injection apparatus, the chamber in which fuel is accumulated under pressure must be free from gas if the device is to function properly. It is also advantageous to vent the accumulator before starting the apparatus. A feature of this invention is the automatic venting of the chamber during a part of the injection stroke of the pump plunger. Another feature is the venting of the chamber while the apparatus is not operating.

Another feature of this invention is a circulation of fuel through the chamber during a part of the injection stroke and controlling this circulation by the position of the plunger. Thus, a groove in the plunger may connect a passage from the chamber to a discharge passage during a part of the plunger stroke.

Another feature is the adjustment of the quantity of fuel injected on each plunger stroke by turning the plunger to vary the point of the stroke at which the circulation of fuel through the chamber is cut off.

Another feature is the cooling of the apparatus by pumping fuel through the device during a part of the injection stroke.

Another feature is the arrangement of this groove so that by turning the plunger to a predetermined position, fluid connection will be established from the chamber to the discharge passage independently of the longitudinal position of the plunger.

Other objects and advantages will be apparent from the specification and claims and from the accompanying drawing which illustrates what is now considered to be a preferred embodiment of the invention.

Fig. 1 is a sectional view through the fuel injection apparatus.

Fig. 2 is a fragmentary sectional view showing the plunger at the start of the injection stroke.

Fig. 3 is an elevation of a part of the plunger.

The casing 10 has a bore 12 in which is a plunger 14. With the plunger in the position of Fig. 2 before it begins its injection stroke, an inlet port 16 admits fuel to the end of bore 12. During the injection stroke fuel is forced by plunger 14 into accumulator chambers 18 and 20 through a groove 22 in a valve 24 and a cross-passage 26 connecting the accumulator chambers. Valve 24 is slideable in a bore 28 in a ring 30 in the casing.

While fuel is being forced into the accumulator chambers, valve 24 closes a passage 32 which connects cross-passage 26 with the discharge nozzle

2 34. One end of valve 24 is in line with a seat 36 at the end of passage 32 and is held on this seat by pressure of fuel in the other end of the valve during the injection stroke of the plunger. Groove 22 permits a throttled flow of fuel past valve 24 into the chambers. The end of valve 24 remote from seat 36 is conical to engage a seat 38 at the end of bore 28 and communicating with bore 12, said seat closing the end of groove 22.

Air in the accumulator chambers 18 and 20 is vented through a passage 42 in casing 10 which connects with the upper end of chamber 18. The opposite end of the passage forms a port 44 in a bore 12 which, during a part of the plunger stroke, is connected to a relief port 46 by an annular passage 48 formed by a reduced portion of the plunger.

Discharge of fuel through passage 32 to nozzle 34 may be controlled by a check valve 50 held against a seat by a spring 54. When accumulator valve 24 moves to open passage 32, fuel pressure opens the check valve 50 and fuel is discharged past the check valve until the pressure of spring 54 is greater than the pressure differential holding the valve open. The check valve may have an integral plunger 56 slideable in a bore 58 in nozzle 34 and the plunger may have a longitudinal groove 60 for flow of fuel past the plunger. Nozzle 34 has one or more openings 62 for discharge of fuel.

During the pumping stroke of the plunger from the position of Fig. 2 to the position of Fig. 1, the head of the plunger closes inlet port 16 and the movement of the plunger forces fuel into the accumulator chambers and through passage 42 and passage 48 to relief port 46. As the plunger starts its stroke, the pressure of fuel on the end of valve 24 moves this valve against seat 36 to prevent escape of fuel past check valve 50 to the nozzle.

As the plunger continues its movement, an obliquely extending shoulder 64, forming the lower edge of passage 48 and extending substantially the entire circumference of the plunger, closes port 44 and prevents further discharge of fuel from the accumulator chambers. Continued plunger movement raises the pressure of the fuel in the accumulator chambers until a spill port 66 in casing 10 is uncovered by a groove 68 in the plunger. This groove communicates with the end of bore 12 by a longitudinal groove 70, and when port 66 is uncovered, the fuel pressure at the end of the plunger is reduced suddenly causing valve 24 to move endwise to open passage 32 for discharge of fuel from the accumulator chambers through the nozzle and to engage seat 38 to pre-

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vent escape of fuel through groove 22. Accumulator valve 24 is again moved to engage seat 36 when the plunger begins its next pumping stroke.

The quantity of fuel injected on each plunger stroke is controlled by turning plunger 14 to adjust the plunger position at which port 44 is covered by shoulder 64. The earlier the port is covered, the greater the quantity of injected fuel. While port 44 is uncovered, any air bubbles collected in chambers 18 and 20 are forced out passage 42 as fuel is pumped through the chambers. Plunger 14 may be turned by endwise motion of a rack, not shown, engaging teeth 72 on the plunger.

The plunger may be turned angularly to permit complete filling of the apparatus with fuel before starting, independently of the longitudinal position of the plunger. Groove 48 in the plunger has an intersecting longitudinal groove 74 which is aligned with port 44 when groove 70 is aligned with inlet port 16. Fuel from port 16 enters bore 12 through groove 68 and flows past valve 24 to the accumulator chambers. Ports 44 and 46 are in communication and any air bubbles in the chambers are forced out through passage 42 around groove 48 to port 46.

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. Injection apparatus comprising a casing having a bore, a pump plunger reciprocable in the bore, an accumulator chamber into which fuel is pumped by the plunger on the pumping stroke, ports in said cylinder in a position to be covered by the plunger, one of the ports being connected to the chamber and the other being a relief port, and a groove in said plunger connecting said ports during an initial part of the plunger stroke, an active edge of said groove extending obliquely to the axis of the plunger, whereby turning of the plunger varies the point of the plunger stroke at which the connection between the ports is closed.

2. Injection apparatus comprising a casing having a bore, a pump plunger reciprocable in the bore, an accumulator chamber into which fuel is pumped by the plunger on the pumping stroke, ports in said cylinder in a position to be covered by the plunger, one of the ports being connected to the chamber and the other being a relief port, and a groove in said plunger connecting said ports during an initial part of the plunger stroke, an active edge of said groove extending obliquely to the axis of the plunger, and means for turning the plunger in the bore for adjusting the point in the plunger movement in which the active edge of said groove closes the connection between the ports.

3. Injection apparatus comprising a casing having a bore, a pump plunger reciprocable in the bore, an accumulator chamber into which fuel is pumped by the plunger on the pumping stroke, ports in said cylinder in a position to be covered by the plunger, one of the ports being connected to the chamber and the other being a relief port, and a groove in said plunger connecting said ports during a part of the plunger stroke to cause a flow of fuel through the chamber, an active edge of said groove extending obliquely to the axis of the plunger, said active edge closing the connection between the ports during the pumping stroke of the plunger, thereby cutting off the flow of fuel through the chamber.

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4. Injection apparatus comprising a casing having a bore, a pump plunger reciprocable in the bore, an accumulator chamber, a passage connecting the end of the cylinder to the chamber through which fluid is pumped from the cylinder to said chamber, an inlet port in said cylinder adapted to be covered and uncovered by the plunger during its movement, opposed ports intersecting said bore and connected to a vent and to the accumulator chamber respectively, and a groove in said plunger connecting said opposed ports during an initial part of the plunger stroke, said groove and opposed ports being so arranged that the plunger covers the inlet port on the pumping stroke before the connection between the opposed ports is cut off.

5. Injection apparatus comprising a casing having a bore, a pump plunger reciprocating in the bore, an accumulator chamber, a passage connecting the end of the bore to the chamber through which fluid is pumped from the bore to said chamber, inlet and discharge ports intersecting said bore and adapted to be covered and uncovered by the plunger during its movement, opposed ports intersecting said bore and connected to a vent and to the accumulator chamber respectively, and a groove in said plunger connecting said opposed ports during an initial part of the plunger stroke, an active edge of said groove extending obliquely to the axis of the plunger, and means for turning the plunger within the cylinder for adjusting the point at which the connection between the opposed ports is cut off.

6. Injection apparatus including a casing having a bore, a pump plunger reciprocating in said bore, an accumulator chamber connected with said bore and into which fuel is forced under pressure by said plunger on the pumping stroke, a vent port in said casing, and a port connected to the accumulator chamber, said ports intersecting said bore in a position to be covered by the plunger, said plunger having a groove adapted, during an initial part of the pumping stroke of the plunger, for establishing connection between said ports to cause fuel to flow through the chamber during the first part of the stroke, an active edge of said groove extending obliquely to the axis of the plunger for adjusting the point at which said connection is cut off by turning the plunger.

7. Injection apparatus including a casing having a bore, a plunger movable in said bore, an accumulator chamber communicating with said bore, inlet and outlet ports in said casing adapted to be covered and uncovered by the plunger during its stroke, a groove in said plunger and a passage from the end of said plunger to the groove, said groove and passage connecting the end of the plunger to the outlet port, opposed ports in said casing connected to a vent and to the accumulator chamber respectively, said plunger having a groove connecting said opposed ports during a part of the plunger stroke.

8. Injection apparatus including a casing having a bore, a plunger movable in said bore, an accumulator chamber communicating with said bore, inlet and outlet ports in said casing adapted to be covered and uncovered by the plunger during its stroke, a groove in said plunger and a passage from the end of said plunger to the groove, said groove and passage connecting the end of the plunger to the outlet port, opposed ports in said casing connected to a vent and to the accumulator chamber respectively, said plunger having a groove connecting said opposed

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ports during a part of the plunger stroke, an active edge of said groove extending obliquely to the axis of said plunger.

9. Injection apparatus including a casing having a bore, a plunger movable in said bore, an accumulator chamber communicating with said bore, inlet and outlet ports in said casing adapted to be covered and uncovered by the plunger during its stroke, a groove in said plunger and a passage from the end of said plunger to the groove, said groove and passage connecting the end of the plunger to the outlet port, opposed ports in said casing connected to a vent and to the accumulator chamber respectively, said plunger having a groove connecting said opposed ports during a part of the plunger stroke, the groove connecting said opposed ports being wide enough at one point in its periphery to establish connection between said opposed ports when in a predetermined angular position independently of the position of the plunger longitudinally in the bore.

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10. Injection apparatus including a casing having a bore, a plunger movable in said bore, an accumulator chamber communicating with said bore, inlet and outlet ports in said casing adapted to be covered and uncovered by the plunger during its stroke, a groove in said plunger, a passage in the surface of said plunger extending from the end of the plunger to said groove, opposed ports in said casing connected to a vent and to the accumulator chamber respectively, a second groove in said plunger connecting said opposed ports during a part of the plunger stroke, said second groove being wide enough for a portion of its periphery to establish connection between said opposed ports in one predetermined angular position of the plunger independently of the position of the plunger longitudinally of the bore, said plunger in said predetermined angular position aligning the passage in said plunger with the inlet port.

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