Feb. 5, 1952 J. SELIBER 2,584,745

PILOT INJECTION NOZZLE

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Fig. 1.

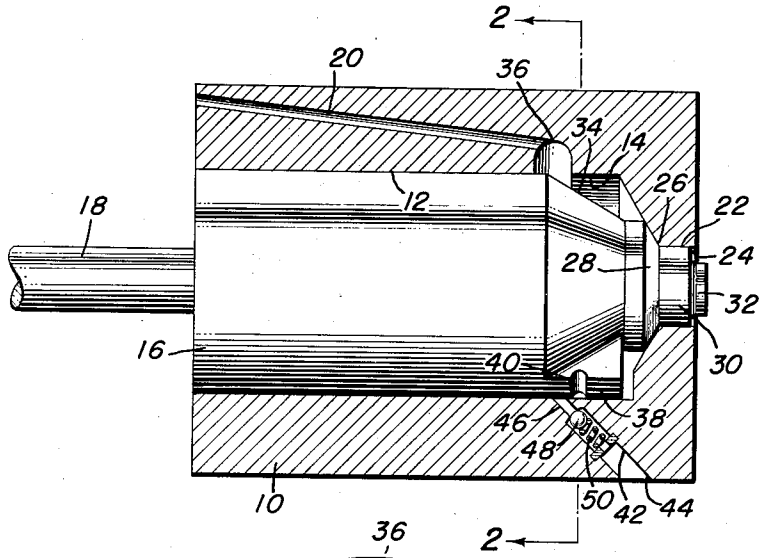


Fig. 2.

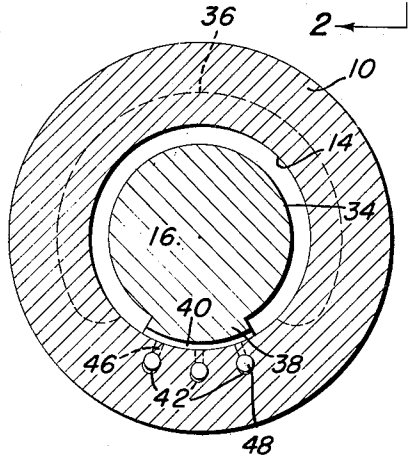
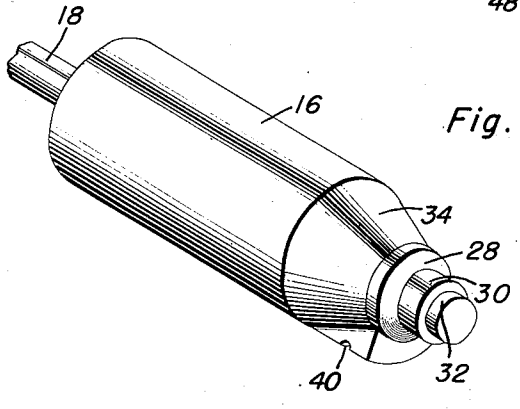


Fig. 3.



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PILOT INJECTION NOZZLE

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1 Claim. (Cl. 299—107.5)

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This invention comprises novel and useful improvements in a pilot injection nozzle and more specifically pertains to a fuel injection nozzle suitable for use with compression ignition internal combustion engines.

The principal object of this invention is to provide a fuel injection nozzle of the fluid pressure operated type wherein a pilot injection in a predetermined direction is effected in advance of the main injection into the combustion chamber of an internal combustion engine in a simple and efficient manner, and in a compact and dependable construction.

An important feature of the invention resides in the provision of a fuel injector body having a chamber and an injection plunger slidable or reciprocable therein, together with a central and axially disposed main injection orifice having a port opening into the chamber and controlled by an axial, pintle valve on the plunger, and one or more pilot injection nozzles communicating with ports opening into the chamber and disposed at a predetermined angle and direction with respect to the main injection orifice, together with a pilot injection control valve carried by the plunger.

Yet another feature of the invention comprehends the provision of main and pilot injection ports in an injection nozzle wherein the injection controlling valves upon the plunger are so arranged as to effect a pilot injection in advance of the main injection and which may also be terminated in advance of the initiation of the main injection.

A still further feature of the invention includes the provision of non-return valves in the passages connecting the pilot ports with the pilot orifices which valves are spring closed and are opened in response to the imposition of a predetermined pressure of the injection fluid thereon but which serve the dual functions of preventing return flow through the pilot orifices into the chamber and further prevent discharge of fluid from the chamber through the pilot orifices upon the return or closing stroke of the plunger.

These, together with various ancillary features and objects of the invention which will later become apparent as the following description proceeds, are attained by this device, a preferred embodiment of which has been illustrated by way of example only in the accompanying drawings, wherein:

Figure 1 is a vertical longitudinal central view through a preferred embodiment of the injection nozzle constructed in accordance with the principles of this invention;

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Figure 2 is a vertical transverse sectional view taken substantially upon the plane of the section line 2—2 of Figure 1 and showing in particular the location and construction of the pilot discharge ports and their control valve; and

Figure 3 is a perspective view of the improved injection plunger including the principles of the invention.

Referring first to Figure 1, the numeral 10 indicates a hollow body which is provided with a cylindrical, central, axial bore 12 therein to form a chamber 14, this bore slidably receiving an injection plunger 16 having an actuating stem 18 secured thereto.

In accordance with a conventional type of fuel injection nozzle for internal combustion engines, the plunger 16 may be urged inwardly of the bore 12 and into the chamber 14 into valve closing position which is the normal or rest position of the device, through the agency of spring means with which the stem 18 is customarily provided, the latter forming no part of the present invention and hence not being illustrated, although it may be noted they are customarily of the pressure adjustable type.

The nozzle body 10 is provided with an injection fluid inlet passage 20 which extends from any suitable source of fluid under pressure, such as the fuel injection pump, not shown, whereby the injection fluid is supplied to the chamber 14 which fluid further by means of its pressure pulsations constitutes the operating means for actuating the injection plunger 16 against its spring loaded stem 18, to permit and effect a controlled injection of fluid into the combustion chamber the internal combustion engine with which this injector may be associated.

The injector nozzle 10 is provided at its extremity with a main injection passage 22, terminating in an injection orifice 24, and the end of this passage is counterbored or tapered as at 26 to provide a valve port or seat which may be engaged by a correspondingly tapered frusto-conical surface 28 on the end of the plunger 16 whereby the flow of fluid through the passage 22 may be controlled.

Forwardly of the valve 28 the plunger 16 is provided with a cylindrical portion 30 which is slidable and snugly receivable in the passage 22 for restricting and substantially preventing flow or fluid therefrom even when the valve 28 is lifted from the seat 26 as set forth hereinafter. At its extremity, the plunger 16 terminates in a diametrically reduced cylindrical extension or pintle 32 which operates in conjunction with

the orifice 24 to create a tubular or conical spray therefrom by means of the fluid introduced through the passage 20 when the plunger is moved outwardly of the chamber 14 on its injection stroke.

Rearwardly of the valve portion 28, the plunger 16 is provided with a conical surface 34 which together with the walls of the chamber 14 defines a fluid receiving space in the plunger body 10. This space is continuously in communication with the passage 20 as by means of an arcuate recess 36 in the walls of the chamber 14, see Figure 2, the surface 34 being so proportioned that in all positions of the plunger 16 free access is had between passage 20, recess 36 and the chamber 14.

Extending circumferentially, a projection 38 is formed upon the surface 34 to constitute a longitudinal continuation of the circumference of the plunger 16, this projection having a sliding engagement with the bore 12. This projection constitutes a valve member for the pilot orifices as set forth hereinafter.

Formed circumferentially in the projection 38, and substantially midway between the ends thereof, is an arcuate channel or groove 40 whose ends are thus in continuous communication with the chamber 14 as will be understood by reference to Figures 1 and 2. Extending through the wall of the body 10 at any desired angle with respect to the longitudinal axis of the main discharge orifice 24 and of the nozzle 10, are a plurality of passageways 42, whose outer ends constitute pilot injection orifices 44, and whose inner ends 46 constitute pilot injection orifice ports communicating with the interior of the chamber 14 and controlled by the above mentioned pilot valve 38. There may be any desired number of these passages 42, three being shown by way of example in Figure 2. These passages are provided with valve seats against which non-return check valves such as the balls 48 are resiliently urged to valve closing position as by springs 50, these springs being suitably seated and retained in the walls of the passages 42.

The arrangement is such that during the longitudinal sliding movement of the plunger 16, the ports 46 are covered by the valving projection 38, until such time as the valve groove 40 is in registry therewith, at which time a pilot discharge or spray of fluid may be injected through the pilot orifices as set forth hereinafter.

The operation of the device is as follows: With the parts in the position shown in Figure 1, it will be understood that the chamber 14 is continuously and at all times filled with fluid for injection into the combustion chamber. When now an impulse is transmitted from the fuel injection pump, not shown, through the passage 20, the force of this impulse as applied to the inner surface 34 of the plunger 16, forces the plunger and its stem 18 outwardly of the chamber, against the opposition of the plunger closing spring, not shown, and at this time the plunger 28 leaves its seat 26. However, during this initiation of the opening movement of the valve members and the injection stroke of the injection plunger 16, the cylindrical portion 30 is still received within the passage 22, to effectively throttle or prevent a discharge of fluid through the main orifice 24. As the plunger 16 continues to move outwardly in the chamber 14, the pilot valve passage 40 now aligns with the pilot ports 46 to place the latter in direct communication with the pressure in the chamber 14, whereupon this pressure fluid opens the valves 48 against the resistance of their closing springs 50 and effects a pilot dicharge through the orifices 44.

Upon further outward movement of the plunger 16, registration of the passage 40 with the ports 46 is cut off by the solid portion of the valving projection 38, and thereafter the end of the valve member is withdrawn from the passage 22, permitting a discharge of fluid from the chamber 14, through the passage 22 and about the pintle valve 32 from the main orifice 24. This latter discharge or main injection of the nozzle continues until such time as the fluid pressure supplied by the fuel pump is cut off by any suitable means such for example as by a bypass of the pump or the like.

Upon the cessation of this injecting pressure from the fuel pump, the pressure in the chamber 14 decreases, whereupon the plunger return spring on the plunger stem 18 drives the plunger 16 inwardly of the chamber 14. The first step of this inward movement results in the throttling of the passage 22 by the re-introduction thereinto of the portion 30 of the plunger, and thereafter the passage 40 of the valve projection 38 again registers with the ports 46. However, during this return registration, the pressure in the chamber 14 has now dropped since the latter is no longer subjected to the injection pressure of the fuel pump from the passage 20, and it is contemplated that the pressure of the springs 50 will be such that the pressure of the closing spring or return spring of the plunger 16 and of the pressure prevailing in the chamber 14 will be insufficient to open the valves 48. Consequently there is no further discharge from the pilot orifices 44. Further inward movement of the plunger results in the solid portion of the valve projection 38 again covering the ports 46, and finally the valve 28 is again seated upon the seat 26.

It should be here noted that a number of variations within the principles above set forth, are possible. Thus, although it may in some instances be found preferable to have the plurality of pilot ports 46 simultaneously in registration with the discharge groove 40 in the valve projection 38, it is also possible to space one or more of the ports 46 so that they register successively or sequentially with the discharge passage 40. Thus, a series of pilot sprays or a prolongation of the pilot injection may be effected.

Further, if desired the proportions and positions of the ports and valve members may be so arranged as to cause an overlapping in the pilot and main injections.

As will be readily understood by those skilled in the art, various advantages attend the employment of a pilot spray in advance of the main injection. By means of this device, this pilot spray can be effected in predetermined time to relation in advance to the main spray, and in a predetermined direction with respect to the direction of the main injection, all by the same mechanism. Further, by a very simple construction return flow through the pilot injection orifice, ports and passages is prevented so that flow occurs only during the injection stroke of the injection plunger.

The check valves 48 serve a dual function in that they cause a quick cut off of the injection through the pilot orifices as soon as the pressure behind the check valve is cut off or reduced, as well as to prevent an undesired injection from these passages when the latter are

again placed in communication with the chamber 14 by the re-registration of the passage 40 therewith on the return stroke of the plunger 16. Further, the check valves 48 prevent a return flow from the combustion chamber of the engine back through these passages, and thus protect the latter as well as the chamber 14 from any undesired back flow which might tend to carbonize, or clog up the passages and chambers.

From the foregoing, it is felt that the manner of constructing and operating the device will be readily understood and further explanation is believed to be unnecessary.

However, since numerous changes will readily occur to those skilled in the art after a consideration of the foregoing specification and drawings, it is not desired to limit the invention to the exact construction shown and described, but all suitable modifications and equivalents may be resorted, falling within the scope of the appended claim.

Having described the invention, what is claimed as new is:

An injection nozzle having a chamber and a plunger reciprocable therein, said chamber having a main discharge orifice at one end and a pilot discharge orifice spaced axially of said

chamber from said main orifice, axially spaced main and pilot valves on said plunger cooperating with said orifices, the axial distance between the valves being less than the axial distances between the orifices whereby upon the injection stroke of the plunger the pilot orifice will be opened and closed prior to the closing of the main orifice, said pilot valve including a circumferentially extended, radial projection on said plunger slidably engaging said pilot orifice, a circumferential groove in said projection registrable with said pilot orifice and continuously communicating with the interior of said chamber, non-return valves in said pilot orifice.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,042,076	Breuer	Oct. 22, 1912
1,833,080	Kenworthy	Nov. 24, 1931
2,235,365	Grumbt	Mar. 18, 1941