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CAPSULATED FUEL INJECTION NOZZLE

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FIG. 1.

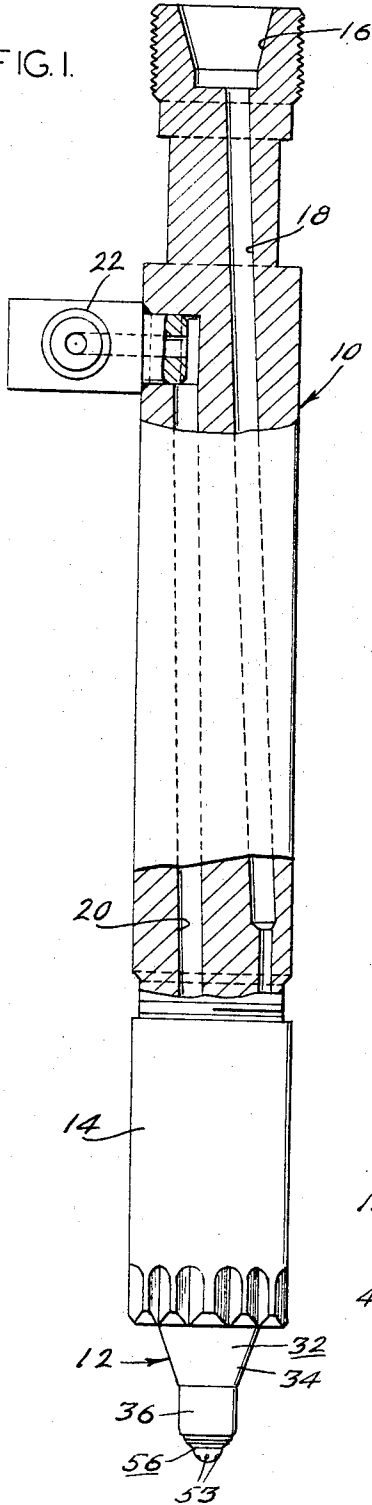


FIG. 2.

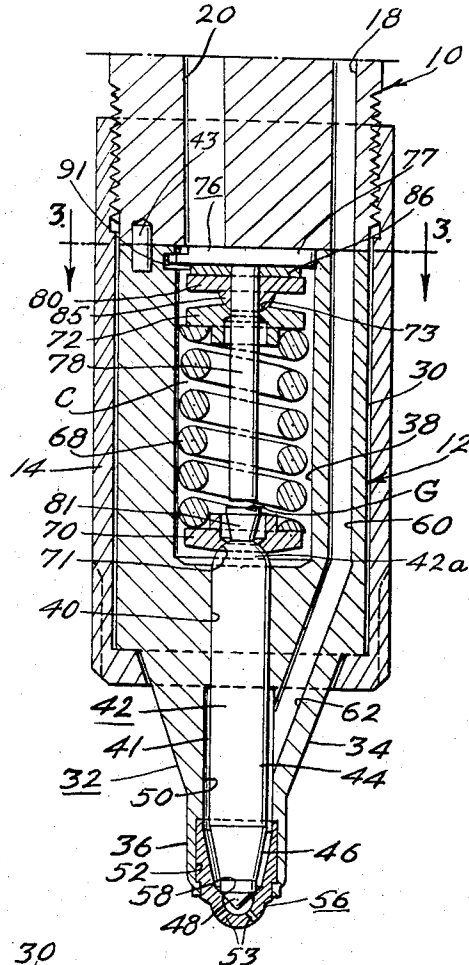
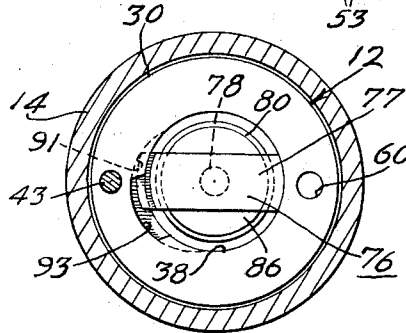


FIG. 3.



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CAPSULATED FUEL INJECTION NOZZLE

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ABSTRACT OF THE DISCLOSURE

A capsulated nozzle for fuel injection nozzle assemblies comprising a cylindrical body portion, an elongated shank of reduced cross section projecting from one axial end of the body portion terminating at its free end in a nozzle tip having at least one discharge orifice therein. The body portion has an enlarged upper axial bore defining a spring chamber and a second lower axial bore having a lower enlarged portion in the shank defining a fuel chamber. A valve member having a nozzle is mounted in the second axial bore which in the closed position seats against an inner conical seat in the nozzle tip portion. A valve actuator assembly normally maintains the valve member in a closed position and includes a compression spring disposed between an upper and lower spring seat and a valve lift stop member for preloading said compression spring and determining the valve lift. The valve lift stop member is detachably secured to the body portion of the nozzle by means of a bar-like bead portion engageable in a groove in a wall of the spring chamber and has a rod depending from the head portion spaced from the inner terminal end of the valve member in the closed position to determine valve lift.

The present invention relates to fuel injection nozzles for internal combustion engines. More particularly, the present invention relates to a compact, unitized capsulated fuel injection nozzle assembly.

Conventional fuel injection nozzle assemblies generally comprise an elongated holder and a nozzle mounted at one end of the holder by means of a cap nut. The nozzle usually consists of a generally cylindrical body portion and an elongated shank of reduced cross section depending from the body portion and a valve member mounted in an axial bore extending lengthwise of the nozzle. The valve is normally biased to a position closing the spray orifices in the free end of the nozzle tip by means of a biasing spring. In some of these assemblies an elongated generally cylindrical valve stop spacer is mounted between the holder and the nozzle by means of the cap nut. The valve stop spacer has an axial chamber therein in which is mounted the biasing spring for the valve element of the valve nozzle. The biasing spring assembly includes a lower spring seat, an upper spring seat and pressure adjusting shims between the upper seat and the lower axial end face of the holder. These shims are used to provide the necessary adjustment for setting the bias of the spring for the valve element to adjust or set opening pressure of the valve.

These conventional assemblies are comparatively expensive to manufacture because of the plurality of parts which have to be precision made. Further, the elements of the assembly have to be installed in a proper sequence and thus they are difficult and time consuming to assemble properly. Notwithstanding the above, it is extremely difficult to accurately set the spring to provide the desired biasing force for proper operation of the valve member and to accurately assemble the parts to provide the desired valve lift. Additionally, it has been found that in these assemblies there is a certain amount of side thrust on the valve member which tends to introduce valve sticking and in some cases effects normal operation of the

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valve. Moreover, the confronting mating surfaces of the holder, valve stop spacer and nozzle must be lap finished which, of course, is a machining operation which adds to the expense of the overall assembly. Even if these mating surfaces are highly machined, there is still the danger of leakage in the fuel injection nozzle assembly.

In view of the above, the present invention is designed to provide a more simplified fuel injection nozzle assembly which is easy and economical to make and assemble and which provides several functional advantages over the prior assemblies discussed above.

In accordance with the present invention, the nozzle is attached directly to the holder and includes an axial bore in the body portion defining a spring chamber. The biasing assembly for the valve element includes a lower spring seat having a spherical surface against which the spherical inner terminal end of the valve seats, somewhat in the nature of a ball and socket arrangement, an upper spring seat also having a spherical surface within which a valve spring spacer seats. The parts such as the biasing spring, and spring seats are easily assembled in the spring chamber and are retained in assembled relation by means of a valve lift stop element having a head portion detachably secured to the valve body portion and a depending rod disposed centrally of the spring and spaced a predetermined distance from the upper end of the valve to set the valve lift. This arrangement provides a more compact unit and eliminates the number of mating flat surfaces of conventional nozzle assemblies discussed above. The unit is more compact by reason of the fact that all of the actuating elements for the valve are contained in the nozzle and may be pre-assembled to provide the desired valve lift and spring biasing force prior to assembly to the holder. Thus, the entire assembly is much easier to install initially and the nozzle is much simpler to replace when necessary. Furthermore, in the present instance a separate spray tip insert is provided in the nozzle tip whereby the angular fuel passage in the nozzle may be drilled from the nozzle tip end which greatly simplifies formation of the fuel passageway in the nozzle assembly. Additionally, side thrust on the valve is minimized by providing spherical seats on the upper and lower spring guide elements and a mating spherical contact surface on the valve element. It has also been found that in this assembly the spring rate may be adjusted much more simply.

With the foregoing in mind, an object of the present invention is to provide a fuel injection nozzle assembly which is of comparatively simplified construction so that it is easy to manufacture and assemble.

A further object of the present invention is to provide a fuel injection nozzle assembly characterized by novel features of construction and arrangement whereby the side thrust on the valve element is minimized and the spring setting for biasing the valve element may be set precisely before assembly of the nozzle to the holder.

Still another object of the present invention is to provide a capsulized comparatively compact nozzle unit which houses the biasing assembly for the valve element which may be readily assembled and disassembled to the holder for ease of installation and replacement when necessary.

These and other objects of the present invention and the various features and details of the operation and construction thereof are hereinafter more fully set forth with reference to the accompanying drawing, wherein:

FIG. 1 is a side elevational view partly in section of a nozzle and holder assembly in accordance with the present invention;

FIG. 2 is an enlarged longitudinal sectional view through the nozzle showing the internal construction thereof; and

FIG. 3 is a sectional view taken on lines 3—3 of FIG. 2.

Referring now to the drawing, there is shown in FIG. 1 a holder and nozzle assembly in accordance with the present invention. The assembly, as illustrated, comprises an elongated generally cylindrical holder 10 and a nozzle 12 mounted at one end of the holder by means of a cap nut 14. The terminal end of the holder opposite the nozzle is provided with a port 16 to receive a fitting and a line connecting the assembly to a fuel supply source and has an axially extending fuel passage 18 to deliver fuel from the supply source to the nozzle. The holder 10 also has an axially extending channel 20 for leakoff fuel which at its upper terminal end communicates with a fitting 22 for connecting the leakoff channel 20 back to the fuel supply source.

In accordance with the present invention there is provided a compact unitized nozzle assembly which is characterized by novel features of construction and arrangement so that it may be easily assembled and disassembled to the holder. The nozzle assembly, as best illustrated in FIG. 2, comprises a generally cylindrical body portion 30 and a nozzle shank 32 depending from the lower axial end of the body portion. In the present instance, the nozzle shank 32 has a downwardly converging frusto-conical section 34 and a generally cylindrical tip portion 36. The frusto-conical section 34 of the nozzle body provides additional strength and minimizes distortion. The body portion 30 has an axial bore 38 extending inwardly from its inner end which defines a spring chamber C and a lower bore section 40 of smaller cross section within which a valve member 42 is mounted. The valve member 42 has a generally cylindrical main body portion 44, and a tapered downwardly converging frusto-conical forward end 46 which terminates in a pointed tip 48. If desired, the valve member 42 may be provided with a double cone seat in lieu of the projected valve seat diameter shown in FIG. 2 to provide a more streamline flow of fuel past the valve seat. In the present instance, the lower bore section 40 is enlarged as at 50 to provide an annular space or fuel chamber 41 for flow of fuel to the nozzle tip and is counter-bored as at 52 to receive a spray tip insert 56 having an inner conical seat 58 against which the tip of the valve element seats and a plurality of discharge orifices 53 through which fuel is discharged. The insert 56 has a tapered side wall generally parallel to the wall of the forward section 46 of the valve element and spaced therefrom to define an annular tapered forward section of the fuel chamber 41 adjacent the tip end of the nozzle assembly. The insert 56 may be secured in the outer free end of the nozzle shank 32 with an epoxy-type sealant and the free end of the nozzle shank 32 may be roll crimped to secure the tip in place.

An axially extending fuel passage 60 is provided in the nozzle body, which, in the assembled relation, registers with the passage 18, the passageway 60 having an angled leg portion 62 which communicates with the fuel chamber 41. The fuel passage 18 in the holder and fuel passageway 60 in the nozzle are maintained in alignment in the present instance by means of a dowel 43 which is press fitted in the holder and has a clearance fit in the mating hole in the nozzle body 12. It is noted that by this arrangement, the angular leg 62 of the fuel passage may be drilled from the nozzle tip end prior to assembly of the tip insert 56. Accordingly, in the operation of the fuel injection nozzle, fuel from the port 16 passes through the passage 18 through the passageway 60 and the angular leg 62 into the fuel chamber. Fuel pressure build up against the bias of the spring in the spring chamber now raises the valve element to permit discharge of fuel through the orifices in the nozzle tip. It is noted that by providing an angled fuel passage and a slightly tapered forward section of the fuel chamber, flow of fuel through the nozzle is laminar, minimizing side thrust on the valve element to provide a more reliable operation of the nozzle assembly.

A valve actuator assembly normally biasing the valve to a closed position is mounted in the spring chamber C which, as best illustrated in FIG. 2, includes a compression spring

68 mounted between a lower spring seat 70 and an upper spring seat 72. The lower spring seat 70 is an annular member having a circumferential arcuate inner face portion 71 conforming to and engaging the rounded semi-spherical head 42a at the inner end of the valve member. The upper spring seat 72 is also an annular member having a circumferential arcuate inner face portion 73 within which a disc-like valve spring spacer 80 having a ball-like projection 85 seats. This arrangement minimizes side thrust on the valve member from the spring 68.

The spring 68 is preloaded between the seats by means including a valve lift stop member 76 having a head portion 77 adapted to be secured to the nozzle body 30 and a depending rod 78 which is aligned axially with the valve element and in the closed position of the valve member has its lower terminal end spaced from a tapered stem 81 projecting from and formed integrally with the head of the valve to provide a gap G which determines the valve lift. In the present instance, the head 77 of the valve lift stop 76 is in the form of a bar having a greater length than the diameter of the spring chamber C which is adapted to engage in a groove 91 in the upper side wall of the spring chamber to secure the parts of the actuator assembly in place, the groove having a cutaway 93 to receive the bar.

The capsulated compact nozzle assembly described above is easy to assemble and may be completely assembled with a preset valve lift gap and spring biasing force prior to assembly to the holder. For example, in manufacturing the assembly, the passageway 60 may be simply drilled from the upper axial end of the nozzle body 30 and the angular leg 62 may be drilled from the open front end of the nozzle tip portion. Thereafter, the tip insert 56 may be press fitted in the counterbored opening 52 in the forward end of the nozzle tip and the valve member 42 positioned in the axial bore. The lower spring seat 70 is then positioned over the upper end of the valve element and thereafter, the spring is assembled. The upper spring seat 70 and spacers 80 and 86 are then positioned over the upper end of the spring and then the valve lift stop 76 is inserted into the spring chamber with the bar in registry with the cutaway 93. The bar is then depressed to align it with the groove 91 and then rotated to lock the parts in place. In this position the gap G and spring bias are set. The nozzle is then positioned over the end of the holder and secured thereto by the cap nut. By this arrangement, the nozzle is easy to replace if necessary.

While a particular embodiment of the present invention has been illustrated and described herein, it is not intended to limit the invention and changes and modifications may be made therein within the scope of the following claims.

I claim:

1. A capsulated nozzle for a fuel injection nozzle assembly comprising a cylindrical body portion an elongated shank of reduced cross section projecting from one axial end of said body portion terminating at its free end in a nozzle tip portion having at least one discharge orifice therein, an enlarged upper axial bore extending inwardly from the axial end face of the nozzle body portion opposite said shank defining a spring chamber, means defining a second lower axial bore coaxially of said spring chamber having a lower enlarged portion in the shank defining a fuel chamber, a valve member mounted in said second axial bore, the nozzle tip having an inner conical seat against which the lower tip of the valve member seats in the closed position, a valve actuator assembly in said spring chamber including a compression spring disposed between an upper and a lower spring seat and a valve lift stop member for preloading said compression spring and determining the valve lift, said valve member actuatable upwardly against the bias of said compression spring upon build up of fuel pressure in said fuel chamber to permit discharge of fuel through said discharge orifice, said valve lift stop member comprising a transverse bar-like head portion and a rod depending from the head portion confronting the inner end of the valve member and spaced therefrom in the closed position providing a

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gap determining valve lift, said head portion being of a length greater than the diameter of the spring chamber and having an end engageable in a groove in the wall of the spring chamber to secure the elements of the actuator assembly in place, said groove having a cutaway 5 to receive the bar-like head portion.

2. A nozzle as claimed in claim 1 wherein said inner end of the valve member has a rounded semi-spherical head and the lower spring seat is provided with a circumferential arcuate inner face portion conforming to and engaging the rounded semi-spherical head of the valve member. 10

3. A nozzle as claimed in claim 2 including a disc-like spacer between the head portion of the valve lift stop member and the upper spring seat, said spacer having a 15

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ball-like projection which seats in a circumferentially extending arcuate face portion of the upper spring seat thereby to minimize side thrust on the valve from the spring.

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