

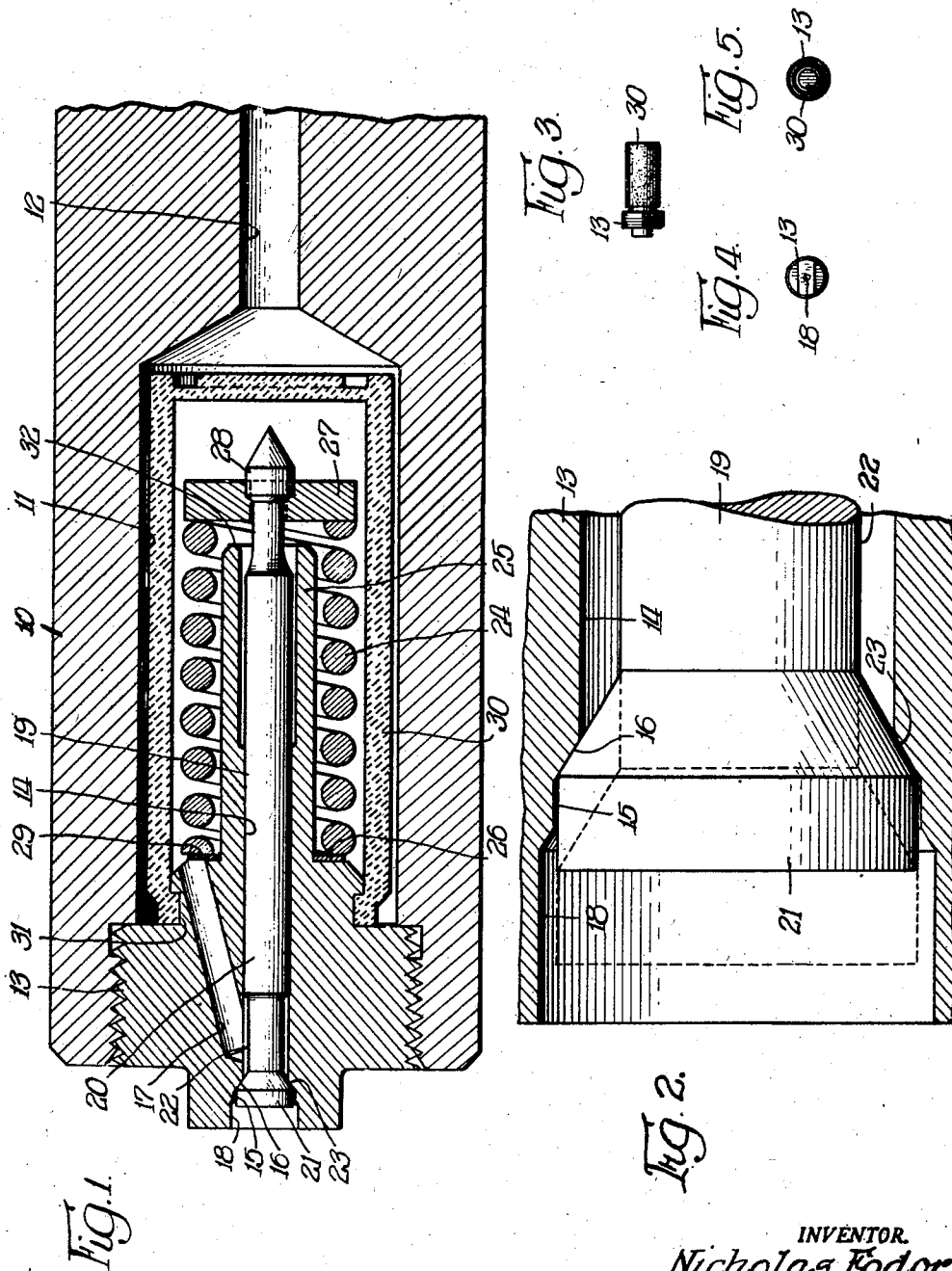
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FUEL INJECTOR

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FUEL INJECTOR

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The present invention is concerned with high pressure liquid fuel injectors for internal combustion engines of the Diesel type.

With such injectors best operating results are obtained by initially retarding the rate of delivery of each metered charge and thereafter increasing the rate. Various ways of accomplishing this have been proposed but for the most part they have involved machining operations which are extremely difficult if not impossible to perform in quantity production because of the minuteness and accurate proportioning of certain of the parts entering into the construction of the nozzle.

The purpose of this invention is to provide, in a fuel injector, an improved nozzle which has the above described two-stage operating characteristic and yet because of the simplicity of the machining operations required for its design is comparatively easy and inexpensive to manufacture.

Other objects and advantages of the invention will be evident to those skilled in the art upon a full understanding of the construction, arrangement and operation of the improved nozzle.

One embodiment of the invention is presented herein by way of illustration, but it will of course be understood that the invention is susceptible of being incorporated in other structurally modified forms coming equally within the spirit of the invention and the scope of the appended claims.

In the accompanying drawing:

Fig. 1 is a greatly enlarged longitudinal section through the front end of an injector, showing a nozzle constructed in accordance with the invention;

Fig. 2 is a still further enlarged longitudinal section through the fuel delivery passage in the nozzle; and

Figs. 3, 4 and 5 are respectively side, front end and rear end views of the nozzle, illustrating the actual size of the same.

The injector shown in the drawing includes a holder 10 which is adapted to be mounted in the wall of an engine cylinder. The holder 10 contains a fuel chamber 11 in the front part of the same and a fuel inlet passage 12 at the rear of the chamber, which passage opens axially into the chamber and is adapted to be connected by a conduit with the fuel pump for the particular cylinder with which the injector is used. The holder 10 is open at its front end and is interiorly threaded for the reception of a nozzle 13. The nozzle 13 is screwed into the holder, to a point substantially flush with the latter, with the nozzle and certain associated parts projecting rearwardly into the chamber 11.

The nozzle 13 is characterized by an axial bore 14, a second relatively short axial bore 15 of 60

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increased diameter in front of the bore 14, a forwardly diverging valve seat 16 between the bore 14 and the bore 15, a plurality of ducts 17 (only one of which is shown) for delivering fuel to the bore 14, and a third bore 18 of still further increased diameter in front of the bore 15. The passage formed by the bores 14, 15 and 18 is of circular cross section at all points throughout its length and contains a longitudinally reciprocable pintle 19.

The pintle 19 is characterized by a stem 20 which is slidably mounted in the bore 14, a head 21 of increased diameter at the front end of the stem 20, which head is positioned in the bores 15 and 18 in but slightly spaced relation to the bore 15 and substantially spaced relation to the bore 18, an annular groove 22 in the stem 20 adjacent the head 21 for receiving the fuel delivered to the bore 14 by the ducts 17, and a forwardly diverging valve 23 between the groove 22 and the head 21 for engagement with the valve seat 16. The pintle is exposed at its rear end to the pressure of the fuel in the chamber 11 and is projected forwardly by periodic pressure on the fuel whereby to unseat the valve 23 and permit discharge of the fuel through the bore 18. The bore 18 constitutes the front end of the fuel discharge passage in the nozzle. The pintle 19 is normally maintained in its retracted position, with the valve 23 seated, by a helical coil spring 24. The spring 24 encircles a rearwardly extending tubular portion 25 of the nozzle and is compressed between the rear face 26 of the nozzle and a laterally separable retaining washer 27 which is positioned in axial abutment with a button-like enlargement 28 on the rear end of the pintle. A shim 29, which may be readily replaced by other shims of greater or less thickness, is positioned between the spring 24 and the rear face 26 of the nozzle for effecting any desired adjustment of the pressure controlling the opening of the valve 23. A filter cap 30 of perforate material surrounds the spring 24 and retaining washer 27, in spaced relation to such parts and also in spaced relation to the walls of the chamber 11. The cap 30 is secured at its forward end to the nozzle 13 in an annular groove 31 formed in the latter.

In the operation of the injector the bore 15 in the nozzle 13 cooperates with the head 21 on the pintle 19 to provide a very restricted annular fuel passage about the head during the first part only of the forward movement of the pintle, while the bore 18 cooperates with the head to provide a comparatively unrestricted annular fuel passage about the head during the remainder of the forward movement. The throttling which occurs during the initial part of the stroke is due to the restriction in flow resulting from the presence of the annular step 15 plus the rate of the spring 24. The annular step 15 between the valve 16 and the

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main discharge bore 18, may of course be made shorter or longer with respect to the stroke of the pintle, whereby to correspondingly vary the period in the injection during which the flow is initially throttled. In Fig. 2 the pintle is shown in full lines in its retracted position, with the valve 23 seated, and is shown in dotted lines in its forwardly projected position, with the passage about the head 21 unrestricted. The extent to which the pintle is projected upon each injection is determined by the thickness of the retaining washer 27, which washer acts as a stop by engaging at its front face with the rear end 32 of the tubular portion 25 of the nozzle.

The nozzle 13 and the pintle 19 are very small parts—the diameter of even the enlarged head 21 on the front end of the pintle being as small as .0590" in a typical injector. The flow restricting bore 15 in an assembly having a head 21 of the above mentioned size would have a diameter somewhere in the neighborhood of .0594"—from which it will be appreciated that the clearance between the bore 15 and the head 21 would be something like .0002" on each side.

To enable the improved nozzle and pintle organization to be easily machined, the bores 14, 15 and 18 in the nozzle are preferably all made cylindrical and cut, with the seat 16, in a single cutting operation. As the multiple-step passage in the nozzle formed by the bores 14, 15 and 18 increases in diameter toward the front end of the nozzle at every point where there is any change in diameter, the cutting tool can be operated from the front end, permitting the entire nozzle to be made in one piece.

I claim:

1. In a high pressure fuel injector, a nozzle having an axial bore, a second relatively short axial bore of increased diameter immediately in front of the first bore, a forwardly diverging valve seat between the first bore and the second bore, means for delivering fuel to the first bore, and a third axial bore of still further increased diameter immediately in front of the second bore; a pintle having a stem slidably mounted in the first bore, a head of increased diameter at the front end of the stem, which head is positioned in the second and third bores in but slightly spaced relation to the second bore and substantially spaced relation to the third bore, an annular groove in the stem adjacent the head for receiving the fuel delivered to the first bore, and a forwardly diverging valve between the groove and the head for engagement with the valve seat; said pintle being projected forwardly by periodic pressure on the fuel to unseat the valve and permit discharge of the fuel; and spring means for normally maintaining the pintle in its retracted position with the valve seated; the second bore in the nozzle cooperating with the head on the pintle to provide a restricted annular fuel passage about the head during the first part only of the forward movement of the pintle, and the third bore cooperating with the head to provide a comparatively unrestricted annular fuel passage about the head during the remainder of the forward movement.

2. In a high pressure fuel injector, a nozzle having an axial bore, a second relatively short axial bore of increased diameter immediately in front of the first bore, a forwardly diverging valve seat between the first bore and the second bore, means for delivering fuel to the first bore, and a third axial bore of still further increased diameter immediately in front of the second bore; a

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pintle having a stem slidably mounted in the first bore, a head of increased diameter at the front end of the stem, which head is positioned in the second and third bores in but slightly spaced relation to the second bore and substantially spaced relation to the third bore, an annular groove in the stem adjacent the head for receiving the fuel delivered to the first bore, and a forwardly diverging valve between the groove and the head for engagement with the valve seat; said pintle being projected forwardly by periodic pressure on the fuel to unseat the valve and permit discharge of the fuel; and spring means for normally maintaining the pintle in its retracted position with the valve seated; the second bore in the nozzle cooperating with the head on the pintle to provide a restricted annular fuel passage about the head during the first part only of the forward movement of the pintle, and the third bore cooperating with the head to provide a comparatively unrestricted annular fuel passage about the head during the remainder of the forward movement; the axial passage through the nozzle formed by the first, second and third bores being circular at all points throughout the length of the passage.

3. In a high pressure fuel injector, a one-piece nozzle having an axial bore, a second relatively short axial bore of increased diameter immediately in front of the first bore, a forwardly diverging valve seat between the first bore and the second bore, means for delivering fuel to the first bore, and a third axial bore of still further increased diameter immediately in front of the second bore; a pintle having a stem slidably mounted in the first bore, a head of increased diameter at the front end of the stem, which head is positioned in the second and third bores in but slightly spaced relation to the second bore and substantially spaced relation to the third bore, an annular groove in the stem adjacent the head for receiving the fuel delivered to the first bore, and a forwardly diverging valve between the groove and the head for engagement with the valve seat; said pintle being projected forwardly by periodic pressure on the fuel to unseat the valve and permit discharge of the fuel; and spring means for normally maintaining the pintle in its retracted position with the valve seated; the second bore in the nozzle cooperating with the head on the pintle to provide a restricted annular fuel passage about the head during the first part only of the forward movement of the pintle, and the third bore cooperating with the head to provide a comparatively unrestricted annular fuel passage about the head during the remainder of the forward movement; the third bore constituting the front end of the fuel discharge passage in the nozzle.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,154,875	Streby	Apr. 18, 1939
2,172,556	Edwards	Sept. 12, 1939
2,192,803	Purdy et al.	Mar. 5, 1940
2,210,783	Tabb et al.	Aug. 6, 1940
2,263,197	Tabb et al.	Nov. 18, 1941
2,291,218	Hoffer	July 28, 1942