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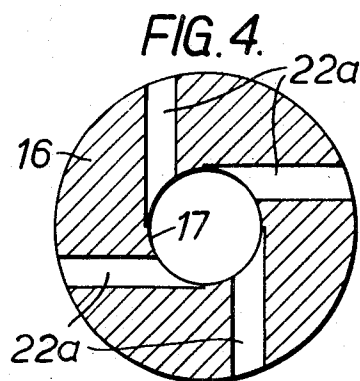
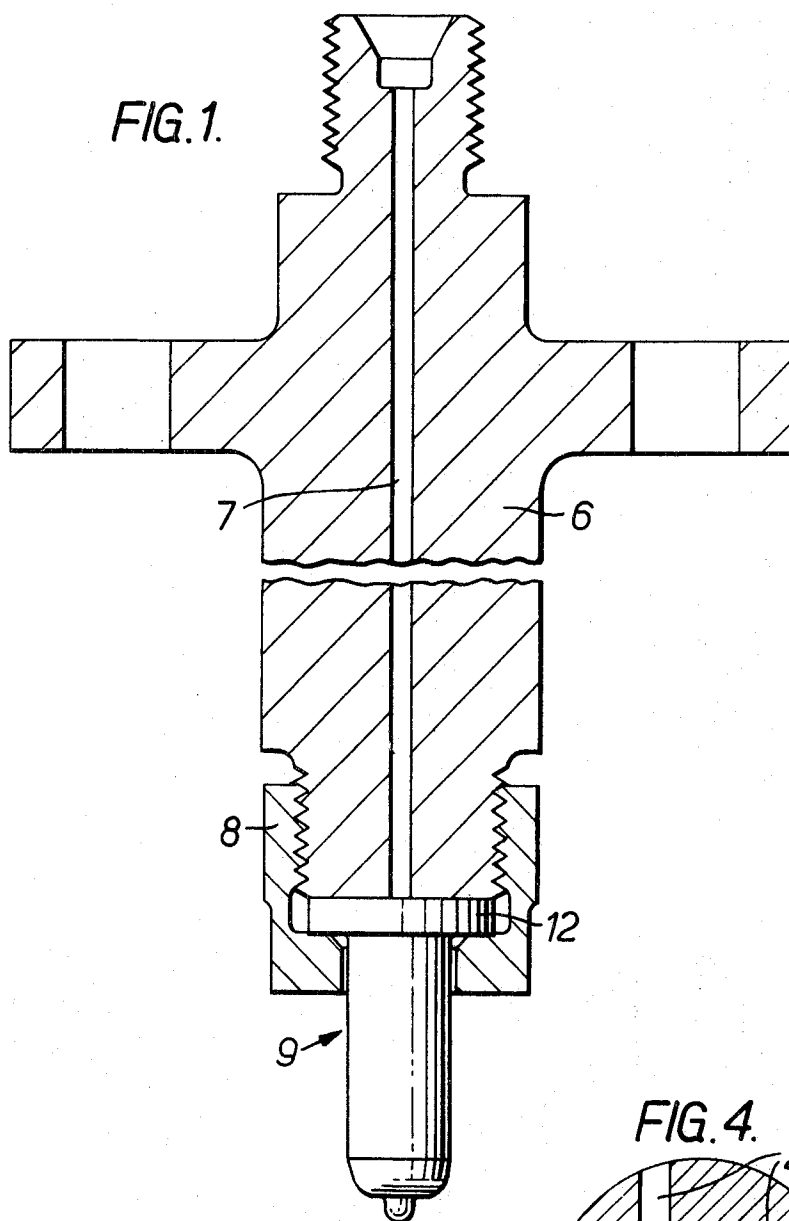
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3,528,613

FUEL INJECTOR FOR INTERNAL COMBUSTION ENGINES

Filed Jan. 15, 1968

4 Sheets-Sheet 1



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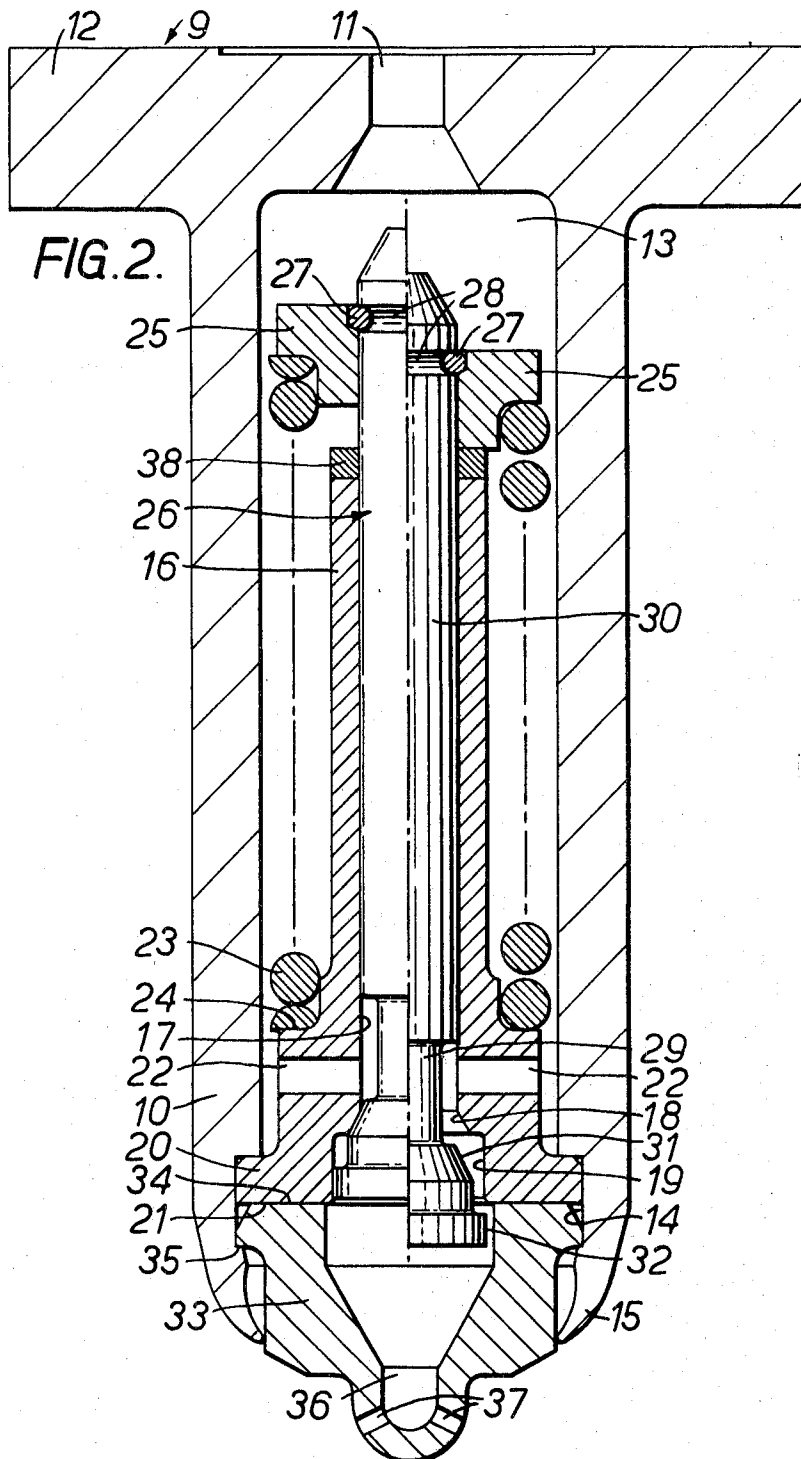
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4 Sheets-Sheet 2



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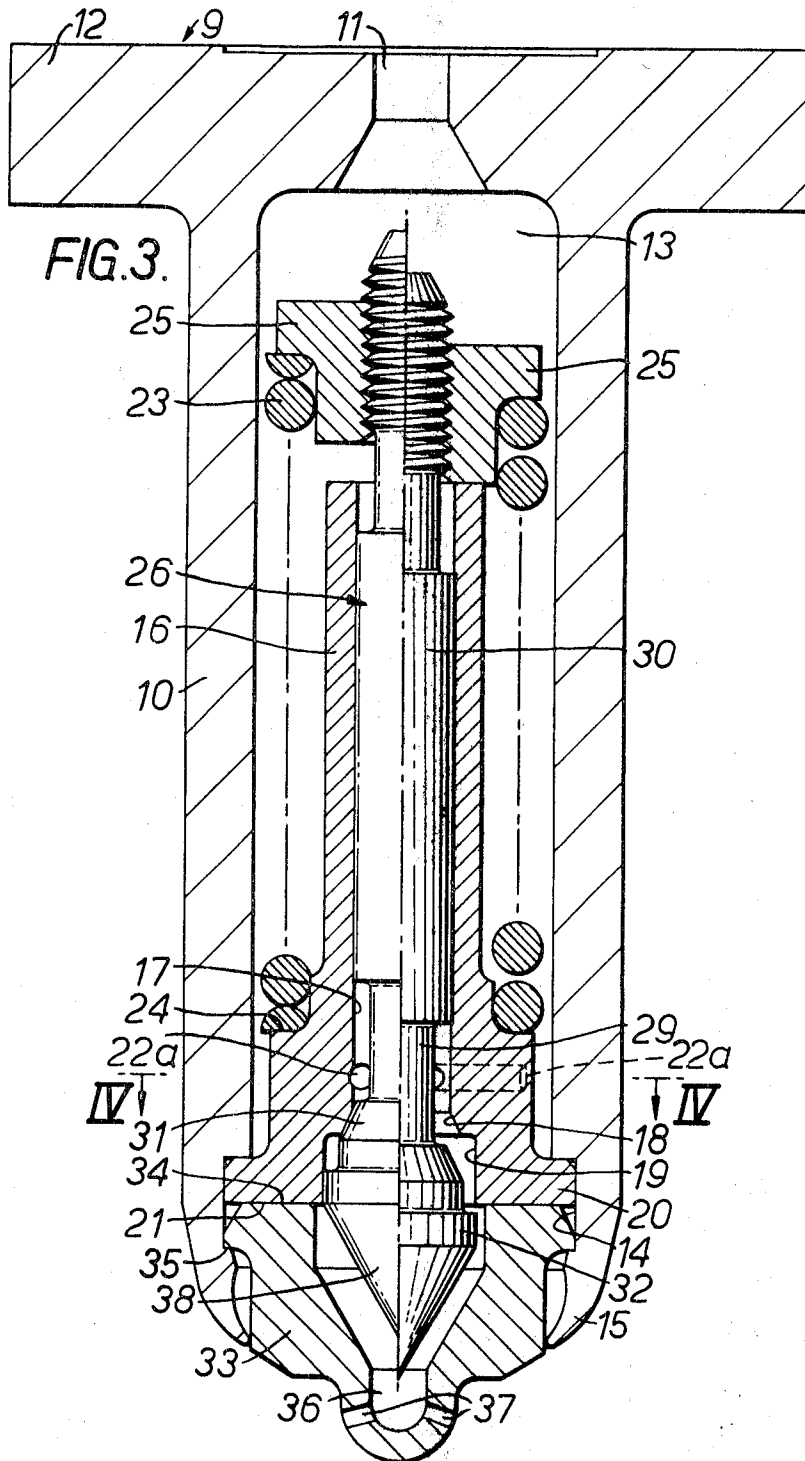
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FUEL INJECTOR FOR INTERNAL COMBUSTION ENGINES

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4 Sheets-Sheet 3



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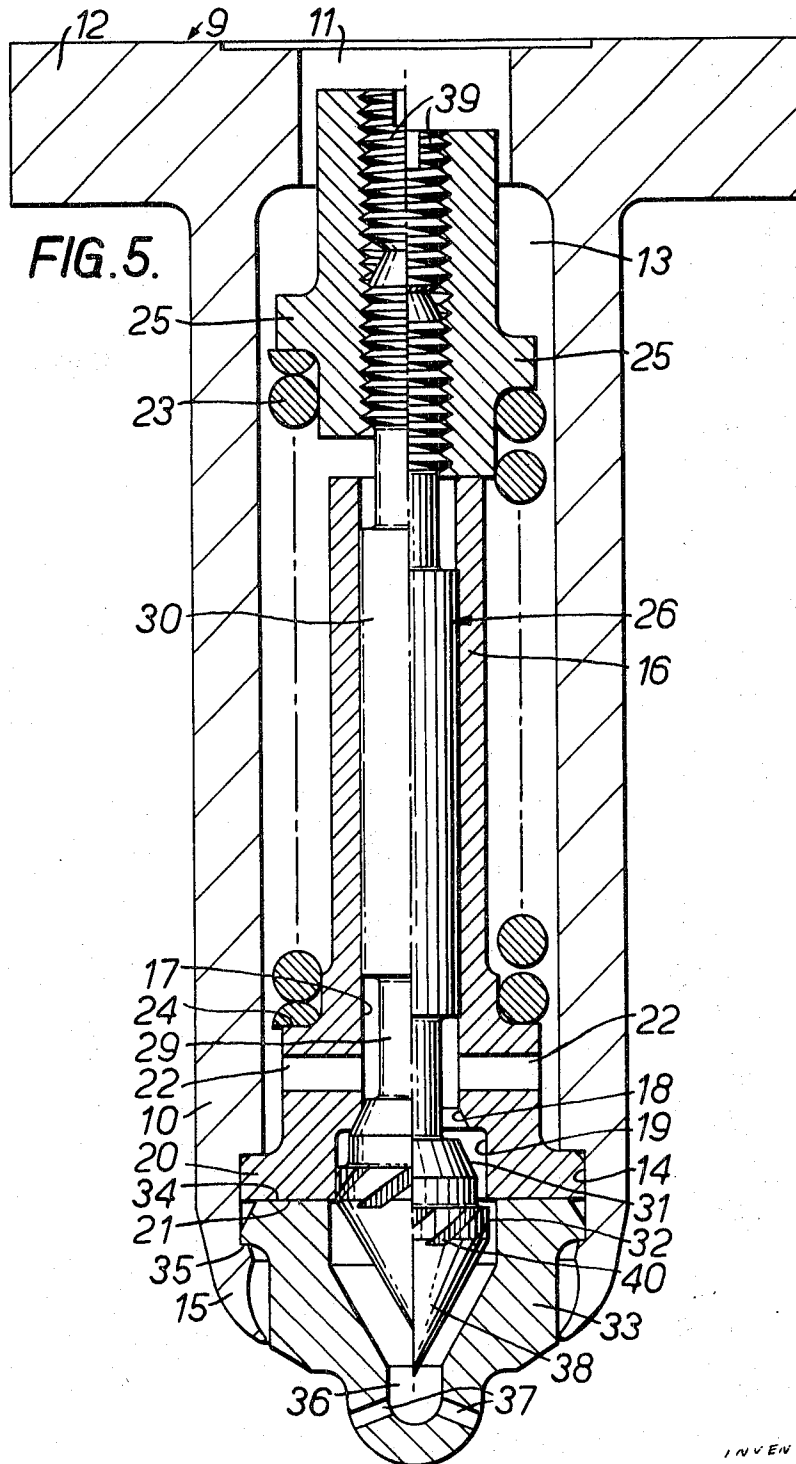
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FUEL INJECTOR FOR INTERNAL COMBUSTION ENGINES

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4 Sheets-Sheet 4



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3,528,613 FUEL INJECTOR FOR INTERNAL COMBUSTION ENGINES

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10 Claims

ABSTRACT OF THE DISCLOSURE

A fuel injector for internal combustion engines comprising a nozzle holder formed for mounting in the engine cylinder head and provided with a fuel supply duct, and an assembly of a differential valve, valve guide, loading spring and nozzle tip formed as a replaceable unit and clamped to the holder.

This invention relates to fuel injectors for internal combustion engines and, more particularly, to injectors for diesel engines of the open-chamber direct-injection type.

In such engines, the use of spring-loaded differential-valve multiple orifice injectors is now almost universal. No other type of injector has provided such generally satisfactory solutions to the problems of formation, dispersion and penetration of the fuel spray in open-chamber combustion spaces. Contemporary injector for open-chamber diesel engines are costly and must be reconditioned at intervals in order to keep them functioning satisfactorily. Contemporary injectors, furthermore, require two pipe connections each, one for fuel delivered from the pump and one for fuel leakoff from the injector back to the inlet side of the pump. This leakoff plumbing is not only an added item of first cost but complicates, and increases the cost of servicing the injectors.

Another shortcoming of contemporary injectors is that their functional components extend from the nozzle tip to the remote end of the nozzle holder so that, when the nozzle holder is axially compressed by the bolts or studs employed from making a gas-tight seal between the holder and its seat in the cylinder head, the settings of the functional components may be disturbed by axial shortening of the holder. In order to prevent the application of abusive installation forces to the injectors, some engine makers incorporate costly and bulky devices to limit the force it is possible to apply to the nozzle holders.

The object of the present invention is to provide an improved form of fuel injector which does not suffer from the above-mentioned defects associated with known fuel injectors, said improved injector being economical to produce and involving no substantial service charges in the maintenance of the injector in efficient operating condition.

According to the invention the improved fuel injector consisting of a nozzle holder formed for mounting in the cylinder head of the engine and incorporating a fuel supply duct, and an injector assembly comprising a hollow body provided with a fuel inlet port and, within said body, a spring-loaded differential valve coacting with a seating to control flow of fuel to a nozzle tip, said body, valve, the valve loading spring and the nozzle tip being formed as a replaceable unit adapted to be clamped to the nozzle holder with its inlet port in communication with said supply duct.

FIG. 1 shows in section a flanged nozzle holder with an injector according to this invention shown in elevation and clamped in place by a conventional nozzle nut which is shown in section,

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FIG. 2 is a diametral section of the injector assembly, FIG. 3 is a diametral section of an alternative execution of the injector assembly,

FIG. 4 is a fragmentary transverse section at 4—4 of FIG. 3, and

FIG. 5 is a diametral section of another alternative execution of the injector assembly.

In FIGS. 2, 3 and 5 the left-hand half of each section shows the valve in the closed position and the right hand half of each section shows the valve in the fully open position.

Referring first to FIG. 1, there is shown a nozzle holder 6 provided with a fuel duct 7 and threaded at its lower end to receive a nut 8 which serves to clamp an injector assembly 9 by means of its flange 12 upon the nozzle holder.

Referring now to FIG. 2, the injector assembly comprises a body 10 provided with an opening or port 11 for admission of fuel and an integral flange 12 by which it is clamped to the nozzle holder, a spring chamber 13, a counterbore 14 and a deformable skirt 15. A coaxial valve guide 16 is provided with a bore 17, a conical seat 18, an enlarged bore 19, a flange 20 having a face 21, and transverse ports 22. A spring 23 is held between a spring abutment 24 of valve guide 16 and a spring seat 25 which is retained on a valve member 26 by semicircular cotters 27 in groove 28 of valve member 26. The latter has a neck 29, of smaller diameter than valve stem 30, a conical face 31 and a piston 32 which is a fuel-throttling fit in the enlarged bore 19 of valve guide 16. A nozzle tip 33 is provided with a face 34, a shoulder 35, a sac hole 36 and spray orifices 37.

In assembly of the injector a subassembly is first made of valve member 26, guide 16, spring 23, spring seat 25, cotters 27 and valve lift adjustment shim 38 and this subassembly is inserted into body 10 until flange 20 of guide 16 is at the end of counterbore 14 of body 10. Nozzle tip 33 is then inserted into counterbore 14 of body 10 until face 34 of nozzle tip 33 abuts face 21 of flange 20 of guide 16 and deformable skirt 15 of body 10 is then folded over shoulder 35 of nozzle tip 33.

In operation of the injector, fuel from a pump is delivered through duct 7 of the nozzle holder and enters at opening 11, flowing through spring chamber 13 and by way of radial ports 22 into bore 17. Having forced valve 26 open by overcoming the valve-closing bias of spring 23, the fuel passes through enlarged bore 19 into sac hole 36 and through spray orifices 37.

If piston 32 is a fluid-throttling fit in enlarged bore 19, valve 26 reciprocates at high frequency during flow of fuel through the nozzle tip, this having a beneficial influence upon the dispersion of the spray from orifices 37 and results in improved combustion of the fuel.

In the modification according to FIGS. 3 and 4 it will be seen that the transverse ports 22a in valve guide 16 are tangential to bore 17. These tangential ports cause a rotary swirl of fuel about the axis of the nozzle which persists in the fuel passing conical face 31 and piston 32 of valve 26, and the rate of swirl is increased when the fuel reaches sac hole 36 of nozzle tip 33 due to the relatively small diameter of sac hole 36, this rotary swirl of the fuel in sac hole 36 breaking up the fuel issuing from orifice 37 into particles of small size. FIG. 3 also shows a conical fairing 38 on piston 32 of valve 26 such fairing having been found to improve the injector performance. FIG. 3 also shows an alternative fastening, by screw threads, of spring seat 25 to stem 30 of valve 26, this fastening method eliminating the need of the semicircular cotters 27 and lift adjustment shim 38. In this execution, the screw threads are locked by

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means of an anerobic sealant after the desired valve fit adjustment has been made.

FIG. 5 shows an alternative threaded fastening of spring seat 25 to stem 30 of valve 26 wherein a grubscrew 39 is employed for locking the screw threads after the valve lift adjustment has been made. FIG. 5 also shows diagonal grooves 40 in the piston 32 and fairing 38 of valve 26. These grooves provides a means of creating rotary swirl of fuel in sac hole 36 of nozzle tip 33 and may be employed as an alternative to the tangential ports 22a shown in FIGS. 3 and 4.

It will be understood that the injector according to the invention can be made at a fraction of the cost of contemporary injectors. It incorporates no lapped fits and its functional parts are permanently assembled in a small capsule and this small assembly may be thrown away and replaced with a new one for less than the cost of reconditioning a conventional injector. Moreover, as the nozzle holder contains no functional components, simply a fuel duct, it does not wear out, is cheap to make and requires no servicing. The injector requires only one pipe connection as there is no fuel leakoff, and as the functional components in the permanently-assembled capsule are isolated from installation forces, the settings of this injector are immune from disturbance. The improved injector is therefore characterised by low first cost, low operating cost to the user, immunity from maladjustment due to deformation, and elimination of leakoff and its concomitant plumbing.

I claim:

1. A fuel injector for internal combustion engines including a nozzle holder having means for mounting said injector in an internal combustion engine cylinder head and incorporating a fuel supply duct; and an injector assembly comprising a hollow body, a fuel inlet port in said body, a differential valve member, valve guiding means having a valve seat, and a bore in the outlet side of said seat, a spring mounted within said body and effective to urge said valve member against said seat, a piston mounted on said valve member and having a fuel throttling fit within said bore, and a nozzle tip in communication with said bore; said injector assembly being formed as a replaceable unit adapted to be clamped to said nozzle holder with said inlet port in communication with said fuel supply duct, and said valve guide being flanged at its lower end to engage a shoulder on said body, a deformable skirt portion on said body which bends over its shoulder on said nozzle tip to clamp said tip against the underface of said valve guide and thereby provide a permanent fuel tight assembly of said body, guide and nozzle tip.

2. An injector as claimed in claim 1, wherein the fuel supply duct terminates at the lower face of the nozzle holder, the fuel inlet port being located in the upper end of the body of the injector assembly, which body end is also flanged, whereby when the body is clamped by its flange upon said lower face of the nozzle holder, the fuel supply duct is automatically connected to the fuel inlet port.

3. An injector as claimed in claim 1, including means for creating a rotary swirl of fuel in the nozzle tip.

4. An injector as claimed in claim 3 wherein said swirl-creating means is provided by forming the transverse ports in the wall of the guide substantially tangential to the bore of the guide.

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5. An injector as claimed in claim 3, wherein said swirl-creating means consists of inclined grooves formed in the periphery of the piston of the poppet valve.

6. An injector as claimed in claim 1, including a substantially conical fairing on the underside of the piston of the poppet valve as and for the purpose set forth.

7. An injector as claimed in claim 1, wherein said valve member is of the poppet type and comprises a stem having on its lower end a head provided with a conical sealing face, said valve guiding means comprises a tubular valve guide having a conical valve seating for engagement with the conical face on said valve member and a number of transverse ports in the wall of said tubular guide to allow fuel to pass from the body into the guide through the valve past said piston to said nozzle tip when said valve is open, and said nozzle tip is perforated and located at the lower end of said body.

8. An injector as recited in claim 1, comprising an abutment on said valve guiding means and a spring seat on said valve member, said spring being interposed between said abutment and said spring seat and interchangeable means being provided for determining the degree of travel of said spring seat relative to said valve guide and thereby determining the degree of lift of said valve member.

9. An injector as recited in claim 7 wherein said swirl creating means is provided by forming the transverse ports in the wall of the guide substantially tangential to the bore of said guide.

10. A fuel injector for internal combustion engines including a nozzle holder having means for mounting said injector in an internal combustion engine cylinder head and incorporating a fuel supply duct; an injector assembly comprising a hollow body and a fuel inlet port in said body; valve guide means mounted in said body and having a guide bore, a valve seating face and port means communicating between said body and said guide bore upstream of said seating face; a differential valve member including a stem slidable in said guide bore, a valve seat section for engaging said seating face, and a reduced neck portion adjacent said port means and connecting said stem and valve seat section; a spring mounted within said body and effective to urge said valve seat section against said seating face; an enlarged cylindrical bore on the outlet side of said valve seating face; a cylindrical piston connected to said valve seat section and having a fuel throttling fit within said enlarged bore; a nozzle tip in communication with said enlarged bore; said injector assembly being formed as a replaceable unit adapted to be clamped to said nozzle holder with said fuel inlet port in communication with said fuel supply duct.

References Cited

UNITED STATES PATENTS

2,154,875	4/1939	Streby	239—453
2,951,647	9/1960	Dreislin	239—453
3,156,414	11/1964	Dressler	239—453

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