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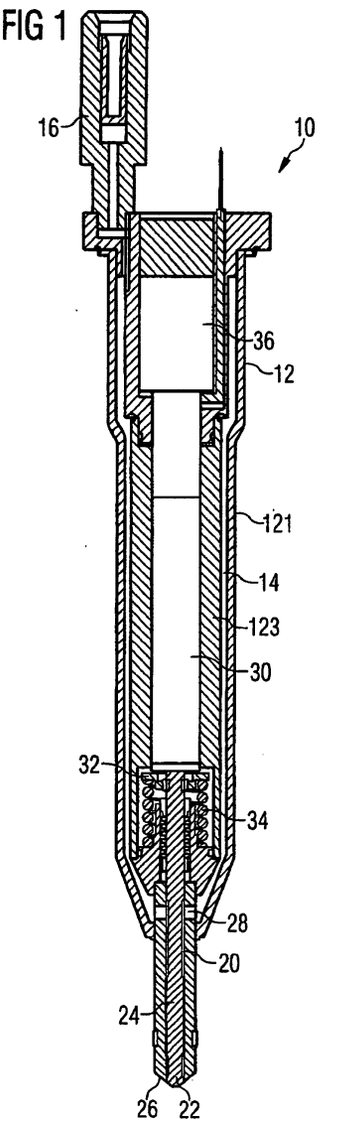
(54) Metering device

(57) The invention relates to a metering device for dosing pressurized fluids, particularly an injection valve for a fuel injection system in an internal combustion engine, comprising an axially extending housing (12) having an end part provided with an outlet passage (20) terminating with a metering opening (22) and a fluid inlet (16; 161) for supplying the fluid under pressure, arranged at the end part of the housing (12) opposite to the end part provided with the outlet passage (20), an axially moveable valve needle (24) passing through the outlet passage (20) and controlling opening and closing of the metering opening (22) by its axial movement, a piezoelectric actuator assembly (30) in axial alignment with the valve needle (24) and cooperating with the valve needle (24) to control its axial movement, and a fluid supply duct (14) communicating with the fluid inlet (16; 161) and the outlet passage (20) for transmitting the pressurized fluid to be dosed to the outlet passage (20). According to the invention the fluid supply duct forms an axially extended annular supply duct (14) within the housing (12).

FIG 1



EP 1 391 607 A1

Description

[0001] The present invention relates to a metering device for dosing pressurized fluids, particularly an injection valve for a fuel injection system in an internal combustion engine. The metering device is of the type which comprises an axially extending housing having an end part provided with an outlet passage terminating with a metering opening and a fluid inlet for supplying the fluid under pressure arranged at the end part of the housing opposite to the end part provided with the outlet passage, an axially moveable valve needle passing through the outlet passage and controlling opening and closing of the metering opening by its axial movement, a piezoelectric actuator assembly in axial alignment with the valve needle and cooperating with the valve needle to control its axial movement, and a fluid supply duct communicating with the fluid inlet and the outlet passage for transmitting the pressurized fluid to be dosed to the outlet passage.

[0002] Such an injection valve is disclosed for example in the European Patent application EP 1 046 809 A2. In this known type of injection valve, the housing includes a fluid chamber containing the pressurized gasoline which communicates via a line borehole with a fluid inlet.

[0003] The pressure of the gasoline in such injector valves is of the order of 200 bar. Because of the axial movements of the injector needle as it opens and closes the gap to allow the gasoline into the engine cylinder, the gasoline contained inside the injector is subjected to pressure peaks of between 20% and 50% compared with the above mentioned nominal value. These pressure fluctuations can overload elastic sealings of the valve body, separating the high pressure gasoline chamber from an actuator chamber at a lower pressure.

[0004] In view of the foregoing, it is an object of the present invention to improve known metering devices in such a way that the sensibility of the metering device to pressure fluctuations and the risk of gasoline leakage is reduced.

[0005] This object is achieved by a metering device with the features of appended claim 1. Advantageous embodiments of the invention are disclosed in the dependent claims.

[0006] According to the invention, in a metering device of the type mentioned above, the fluid supply duct forms an axially extended annular supply duct within the housing that extends down to the outlet passage (20). Thereby the volume of gasoline proximate to the valve body can be greatly increased, thus damping the pressure peaks arising form the opening/closing actions of the valve needle. Furthermore conducts connecting the supply duct with the outlet passage can easily be made in the outlet passage, e. g. by simply drilling holes in the outlet passage. This enables a cheap and reliable manufacturing process of the metering device.

[0007] In a preferred embodiment of the invention the housing comprises an inner tubular member containing the piezoelectric actuator assembly and an outer tubular member surrounding the inner tubular member and forming the outer jacket of the housing, wherein the fluid supply duct is formed between the inner tubular member and the outer tubular member.

[0008] Advantageously the annular fluid supply duct extends axially from the fluid inlet of the injector through fluid admission holes to the outlet passage.

[0009] In a further preferred embodiment of the invention,
the annular fluid supply duct extends axially over more than 20%, preferably over more than 30%, more preferably over more than 40% of the axial extension of the housing. This measure ensures a gasoline space of a large volume near the valve body.

[0010] In an advantageous embodiment of the invention, the fluid inlet is formed by a fluid entry duct, arranged as a separate element at the end part of the housing opposite to the end part provided with the outlet passage.

[0011] Alternatively, the fluid inlet may be formed by a fluid entry duct integral with the inner tubular member. Thereby the number of parts is reduced and the assembly of the parts is simplified.

[0012] In a further preferred embodiment of the invention the housing comprises an outer flange for installing the metering device to a cylinder head of an internal combustion engine.

[0013] In any of the above mentioned designs, the metering device according to the invention advantageously comprises spring means for urging the valve needle in the closing position and means for transmitting an axial extension of the piezoelectric actuator assembly to the valve needle to displace the needle from the closing position when activated.

[0014] The advantages gained by the technical features of the invention include

- a reduction of internal pressure pulsations in the gasoline spaces of the injector,
- a reduction of the number of parts and an attendant simplification of assembly,
- a reduced risk of hydraulic losses, since no internal O-ring sealings are required,
- a simplified design and simplified machining of the fluid inlet fitting,
- different calibration methods such as via a screw on top of the housing are feasible,
- an improved deburring operation,
- the possibility of packaging reduction,

- a simplified package body design,
- the possibility of implementing a modular electrical connector to provide a power supple to the piezoelectric actuator, and
- the availability of a robust flange for the installation of the injector on the cylinder head.

[0015] The invention, both its construction an its method of operation together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments when read in connection with the accompanying drawings, wherein

Figure 1 is a schematic axial cross section of an injector valve according to an embodiment of the invention;

Figure 2 is a schematic axial cross section of an injector valve according to another embodiment of the invention, in which the entry duct and the inner tubular member are a single part; and

Figure 3 is a schematic axial cross section of an injector valve with an outer flange according to a further embodiment of the invention.

[0016] Figure 1 shows an injection valve for direct-injection gasoline engines, generally designated by 10. The injection valve has a housing 12, which comprises an outer tubular member 121 and an inner tubular member 123.

[0017] The outer tubular member 121 forms the outer jacket of the injection valve 10, and the inner tubular member 123 contains the piezoelectric actuator assembly 30. The passage 14 formed between the outer tubular member 121 and the inner tubular member 123 provides a large annular pathway which transports the gasoline supplied by the gasoline entry duct 16 to the gasoline admission holes 28 and into the outlet passage 20 described below.

[0018] The valve body has an axial outlet passage 20 projecting through the lower part of the housing 12 and terminating in a metering opening 22. The metering opening 22 is surrounded by a valve seat 26 which is opened or closed by the axial movement of the valve needle 24 passing through the outlet passage 20.

[0019] The closed state of the injection valve 10, where the needle 24 is pressed against the valve seat 26 is provided by the biased pressure of a helical spring 34 which rests on a snap ring 32.

[0020] To open the injection valve to inject gasoline into the engine cylinder, a piezoelectric actuator which forms part of the piezoelectric actuator assembly 30 is activated. If an excitation voltage is applied to the piezoelectric actuator, it increases in length in axial direction by a predetermined amount, typically about several tens of micrometers. This extension in length is transmitted to the valve needle 24 which depresses the biasing spring 34 and lifts from the valve seat 26. In this position, the injection of pressurized gasoline in the cylinder starts.

[0021] When the excitation voltage is switched off, the length of the piezoelectric actuator in axial direction decreases to its normal value, whereby the biasing pressure of the helical spring 34 forces the valve needle 24 back to its closing position on the valve seat 26.

[0022] A thermal compensator 36 is provided to fix the position of the piezoelectric actuator assembly 30 during fast changes of its length, but compensates for slow changes in the position of the piezoelectric actuator assembly 30 due to, for example, thermal changes.

[0023] The passage 14 forms a large annular pathway for the gasoline. Because of its large axial and annular extent, the passage 14 has a large volume compared to conventional gasoline supply ducts. The large volume of passage 14 limits the value of the peaks of pressure fluctuations arising from the opening and closing of the metering opening 22. Thus, the provision of the passage 14 leads to a stabilizing effect on the gasoline pressure.

[0024] Figure 2 shows another embodiment of an injector 40 according to the invention. Elements which are similar to elements of Fig. 1 are designated by the same reference numerals and their discussion is omitted. While the embodiment of Fig. 1 shows the gasoline entry duct 16 to be a separate element, Fig. 2 shows an embodiment where the gasoline entry duct 161 is integral with the inner tubular member 123. As the inner tubular member 123 and the gasoline entry duct 161 are formed in one piece the number of mechanical parts is reduced. Also, in this embodiment, the thermal compensator 36 is arranged in the lower part of the housing 12, just above the snap ring 32.

[0025] A further improvement of the embodiment of Fig. 2 is shown in Fig. 3. In addition to the integral gasoline entry duct 161, the injector 50 has an outer flange 42 for fixing the injector 50 to a cylinder head of an internal combustion engine.

[0026] It has further a modular electrical connector 44 for providing the power supply to the piezoelectric actuator assembly 30.

[0027] In all embodiments the risk of hydraulic losses is reduced by replacing any O-rings with hermetic welds.

[0028] The features disclosed in the foregoing description, in the drawings, and in the claims may alone as well as in any possible combination be important for the realization of the invention.

Claims

1. A metering device for dosing pressurized fluids, particularly an injection valve for a fuel injection system in an internal combustion engine, comprising

- an axially extending housing (12) having an end part provided with an outlet passage (20) terminating with a metering opening (22) and a fluid inlet (16; 161) for supplying the fluid under pressure, arranged at the end part of the housing (12) opposite to the end part provided with the outlet passage (20),

- an axially moveable valve needle (24) passing through the outlet passage (20) and controlling opening and closing of the metering opening (22) by its axial movement,

- a piezoelectric actuator assembly (30) in axial alignment with the valve needle (24) and cooperating with the valve needle (24) to control its axial movement, and

- a fluid supply duct (14) communicating with the fluid inlet (16; 161) and the outlet passage (20) for transmitting the pressurized fluid to be dosed to the outlet passage (20),

characterized in that
the fluid supply duct forms an axially extended annular supply duct (14) within the housing (12), that extends down to the outletpassage (20).

2. The metering device according to claim 1,
characterized in that
the housing (12) comprises an inner tubular member (123) containing the piezoelectric actuator assembly (30) and an outer tubular member (121) surrounding the inner tubular member (123) and forming the outer jacket of the housing (12), wherein the fluid supply duct (14) is formed between the inner tubular member (123) and the outer tubular member (121).

3. The metering device according to claim 1 or 2,
characterized in that
the annular fluid supply duct (14) extends axially from the fluid inlet (16; 161) of the injector through fluid admission holes (28) to the outlet passage (20).

4. The metering device according to any of the preceding claims,
characterized in that
the annular fluid supply duct (14) extends axially over more than 20%, preferably over more than 30%, more preferably over more than 40% of the axial extension of the housing (12).

5. The metering device according to any of the preceding claims,
characterized in that
the fluid inlet is formed by a fluid entry duct (16), arranged as a separate element at the end part of the housing (12) opposite to the end part provided with the outlet passage (20).

6. The metering device according to any of claims 1 to 4,
characterized in that
the fluid inlet (161) is formed by a fluid entry duct integral with the inner tubular member (123).

7. The metering device according to any of the preceding claims,
characterized in that
the housing (12) comprises an outer flange (42) for installing the metering device to a cylinder head of an internal combustion engine.

8. The metering device according to any of the preceding claims,
characterized in that
the metering device further includes

- spring means (34) for urging the valve needle (24) in the closing position and

- means for transmitting an axial extension of the piezoelectric actuator assembly (30) to the valve needle (24) to displace the needle (24) from the closing position when activated.

FIG 1

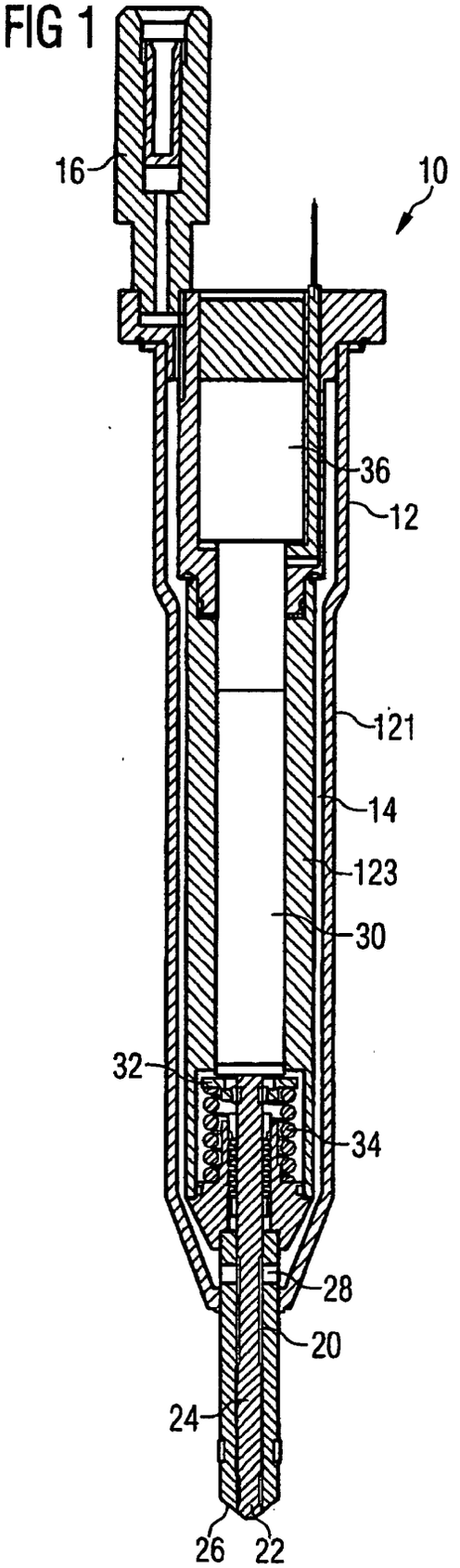

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FIG 2

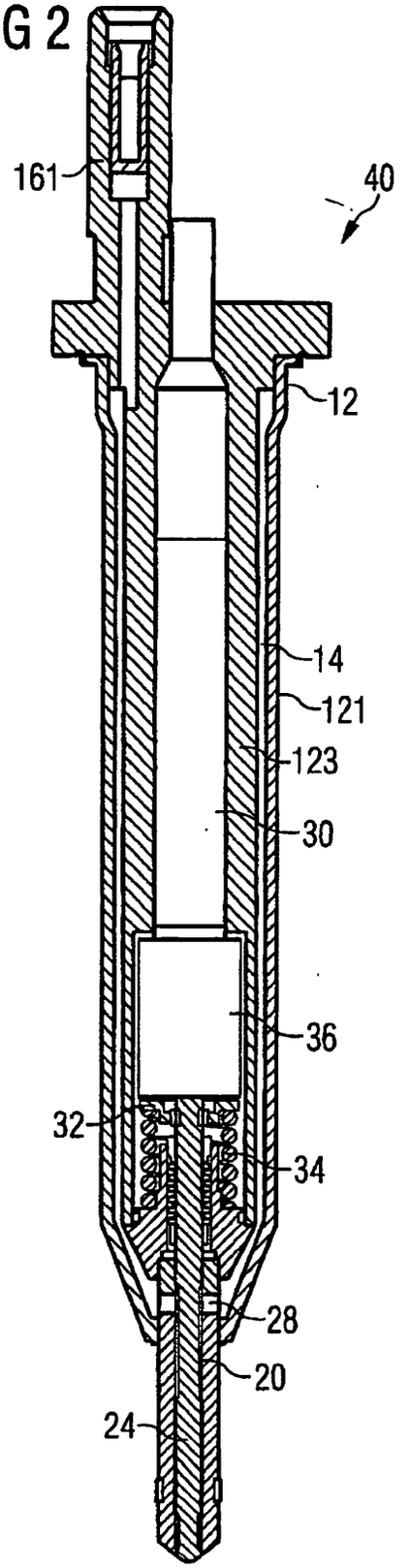
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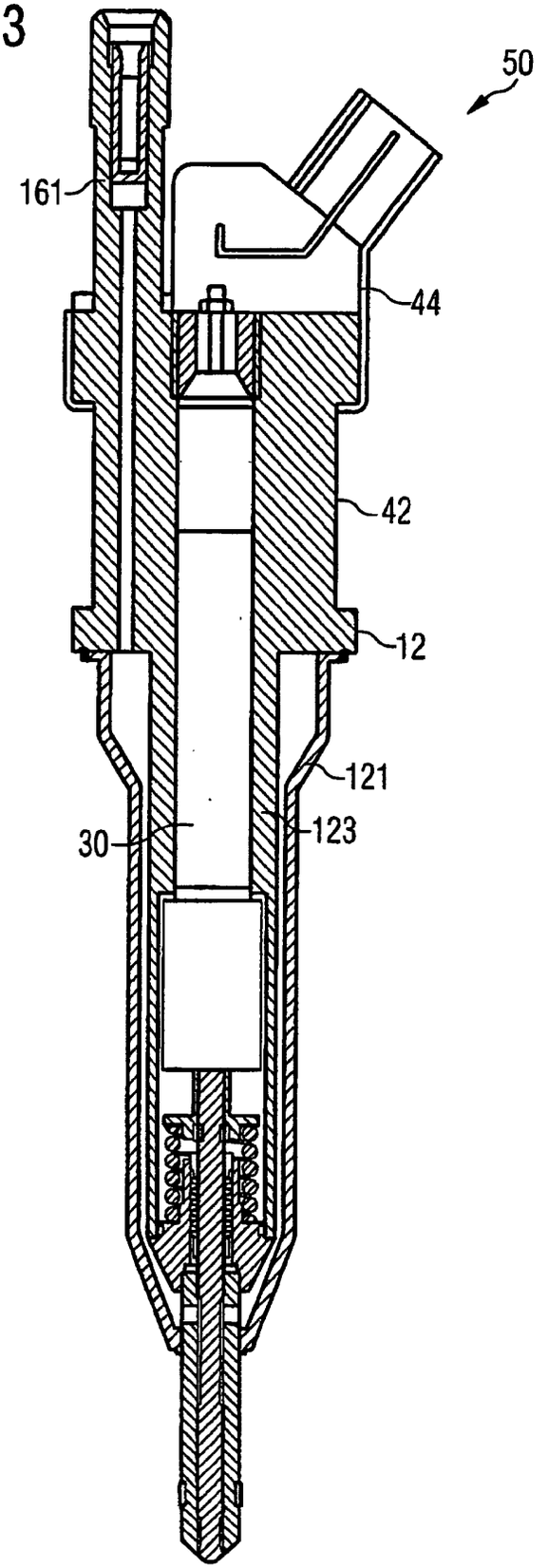
FIG 3



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EUROPEAN SEARCH REPORT

Application Number
EP 02 01 8663

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 6 302 333 B1 (HOFFMANN KARL-HEINZ ET AL) 16 October 2001 (2001-10-16)	1-4,8	F02M51/06 F02M61/08
Y	* column 3, line 9 - column 5, line 14; figures 1,2 *	5	F02M61/16
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 January 2003	Sideris, M

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 01 8663

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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15-01-2003

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