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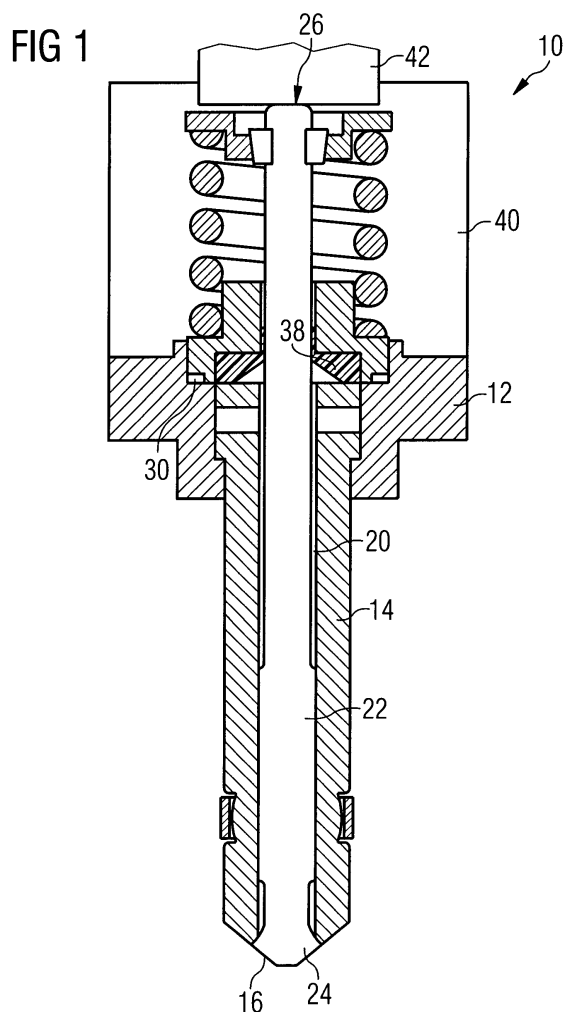
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(54) **Metering device with hydraulic bushing element**

(57) The invention relates to a metering device comprising a valve body (12) containing a fluid passage (20) for the pressurized fluid to be dosed, the fluid passage (20) terminating with a metering opening (16), an axially moveable valve needle (22) passing through the fluid passage (20), the valve needle (22) having a first end (24) inside the fluid passage (20), controlling the opening and closing of the metering opening (22), and having a second end (26) inside an actuator chamber (40), the second end cooperating with an actuator assembly (42) in the actuator chamber (40) controlling the axial movement of the needle (22), wherein in operation the pressure in the actuator chamber (40) is smaller than the pressure in the fluid passage (20), and a bushing element (30, 38) for the valve needle (22), hydraulically isolating the actuator chamber (40) and the fluid passage (20). The bushing element is formed by an elastic element (30, 38), hermetically fastened to the valve needle (22) and to the valve body (12).



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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 a valve body containing a fluid passage for the pressurized fluid to be dosed, the fluid passage terminating with a metering opening, an axially moveable valve needle passing through the fluid passage, the valve needle having a first end inside the fluid passage, controlling the opening and closing of the metering opening, and having a second end inside an actuator chamber, the second end cooperating with an actuator assembly in the actuator chamber controlling the axial movement of the needle, wherein in operation the pressure in the actuator chamber is smaller than the pressure in the fluid passage, and a bushing element for the valve needle, hydraulically isolating the actuator chamber and the fluid passage.

[0002] Such a metering device is disclosed for example in the European Patent application EP 1 046 809 A2. In the manufacture of piezoelectric actuator-controlled valves for high-pressure direct injection for gasoline engines, it is essential to provide a hydraulic seal capable of isolating the space through which the pressurized gasoline travels from that containing the abovementioned actuator.

[0003] Fundamental requirements for this sealing element are

- the ability to operate at high pressures, exceeding 200 bar,
- the resistance to pressure peaks and hydraulic ram induced by the opening and closing of the injector needle, including resistance to breakage, creep, fatigue loading, and the like, and
- satisfactory service life of the component in its operating environment, including chemical tolerance to gasoline, resistance to thermal stresses, and the like.

[0004] In document EP 1 046 809 A2, the sealing element is formed by a metal bellows with the top and bottom collars attached to the injector needle and the valve body, respectively. A metal bellows offers a high mechanical elasticity in the direction of movement of the needle, a sufficient resistance to fuel pressures of up to 500 bar, and a high reliability with respect to leakage throughout the required temperature range of -40 °C to +150 °C. However, an injector valve with a metal bellows has disadvantages of high component manufacturing costs and a complex assembly, requiring two hermetic welds.

[0005] In view of the foregoing, it is an object of the present invention to provide a metering device of the

above mentioned type which is easier and more economic to manufacture, while still fulfilling the requirements specified above.

[0006] The above 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.

[0007] According to the invention, in a metering device with the features of the preamble of claim 1, the bushing element is formed by an elastic element, hermetically fastened to the valve needle and to the valve body.

[0008] In a preferred embodiment of the invention, the elastic element comprises a metal element having first and second fastening sections for fastening the metal element to the valve needle and to the valve body, respectively, and a bendable conical section connecting the first and second fastening sections. Bending the conical section allows the valve needle to move axially in its seat by the required amount to start the fuel injection.

[0009] In an advantageous embodiment of the metering device, the first fastening section is formed by a hollow cylinder section in hermetic contact with the valve needle, and the second fastening section is formed by a ring section in hermetic contact with the valve body, wherein the inner diameter of the ring section is larger than the diameter of the hollow cylinder section.

[0010] According to the invention, the elastic element may further comprise a ring of a resilient material, such as rubber, arranged in contact with the bendable conical section, thereby increasing the stiffness of the elastic element. Also the ring is capable of damping the forces produced by the pressure peaks of the gasoline in this region of the valve body, which may otherwise amount to up to $\pm 30\%$ of the expected pressure level of 200 bar.

[0011] It is considered to be especially advantageous, if the ring of resilient material has a trapezoidal cross section, as it then allows a tight fit with the conical section of the metal element.

[0012] In addition to the advantages mentioned above, the invention provides a remarkable reduction in the costs of the bushing element. The manufacture can easily be integrated in current assembly and welding procedures and the components used can straightforwardly be adapted to mass production.

[0013] The invention, both its construction and its method of operation together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawings, wherein

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

Figure 2 is a schematic perspective view of the elastic element of Fig. 1, however without the

rubber ring.

[0014] Figure 1 illustrates the lower part of an injection valve 10 for direct-injection gasoline engines, according to a specific embodiment of the invention.

[0015] The valve body 12 contains an outlet passage 20 for the pressurized fluid which terminates with a metering opening 16. A valve needle 22 is disposed axially slidable in the outlet passage 20. In the closed state of the injection valve, a mushroom-shaped plunger 24 on a first end of the needle 22 is pressed against the valve seat 14 and closes the metering opening 16.

[0016] Upon activation of a piezoelectric actuator assembly 42, which acts on a second end 26 of the valve needle 22, needle 22 lifts from the valve seat 24 to begin the injection of pressurized gasoline into the cylinder of the engine.

[0017] As the pressure in the actuator chamber 40 is smaller than the pressure of the pressurized gasoline in the outlet passage 20, an elastic element 30 and 38 hydraulically isolates the actuator chamber 40 and the outlet passage 20 from each other.

[0018] The elastic element comprises a metal element 30 and a rubber ring 38 with trapezoidal cross section. As best seen in the perspective view of Fig. 2, the metal element 30 consists of a hollow cylinder section 32, forming a first fastening section, a ring section 36, forming a second fastening section and a bendable conical section 34, connecting the two fastening sections 32 and 36.

[0019] Returning to Fig. 1, the metal element 30 is hermetically fastened to the valve needle 22 with the first fastening section 32 and to the valve body 12 with the second fastening section 36. The conical part 34 of the metal element is designed to be able to bend to such a degree that the needle can move axially in its seat up to 100 μm , which gives rise to the flow of gasoline into the combustion chamber of the engine cylinder.

[0020] The trapezoidal shape of the rubber ring 38 is chosen to tightly fit onto the conical section 34, conferring greater stiffness thereto. The rubber ring 38 has further the effect of damping the forces produced by the pressure peaks of the gasoline in this region of the valve body 12, which otherwise may be as large as $\pm 30\%$ at a pressure level of 200 bar.

[0021] 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

- a valve body (12) containing a fluid passage

(20) for the pressurized fluid to be dosed, the fluid passage (20) terminating with a metering opening (16),

- an axially moveable valve needle (22) passing through the fluid passage (20), the valve needle (22) having a first end (24) inside the fluid passage (20), controlling the opening and closing of the metering opening (22), and having a second end (26) inside an actuator chamber (40), the second end cooperating with an actuator assembly (42) in the actuator chamber (40) controlling the axial movement of the needle (22), wherein in operation the pressure in the actuator chamber (40) is smaller than the pressure in the fluid passage (20), and
- a bushing element (30, 38) for the valve needle (22), hydraulically isolating the actuator chamber (40) and the fluid passage (20),

characterized in that

the bushing element is formed by an elastic element (30, 38), hermetically fastened to the valve needle (22) and to the valve body (12).

2. The metering device according to claim 1,

characterized in that

the elastic element comprises a metal element (30) having first and second fastening sections (32, 36) for fastening the metal element (30) to the valve needle (22) and to the valve body (12), respectively, and a bendable conical section (34) connecting the first and second fastening sections (32, 36).

3. The metering device according to claim 1 or 2,

characterized in that

the first fastening section is formed by a hollow cylinder section (32) in hermetic contact with the valve needle (22), and that the second fastening section is formed by a ring section (36) in hermetic contact with the valve body (12), wherein the inner diameter of the ring section (36) is larger than the diameter of the hollow cylinder section (32).

4. The metering device according to claim 2 or 3,

characterized in that

the elastic element further comprises a ring (38) of a resilient material, such as rubber, arranged in contact with the bendable conical section (34).

5. The metering device according to claim 4,

characterized in that

the ring (38) of resilient material has a trapezoidal cross section.

FIG 1

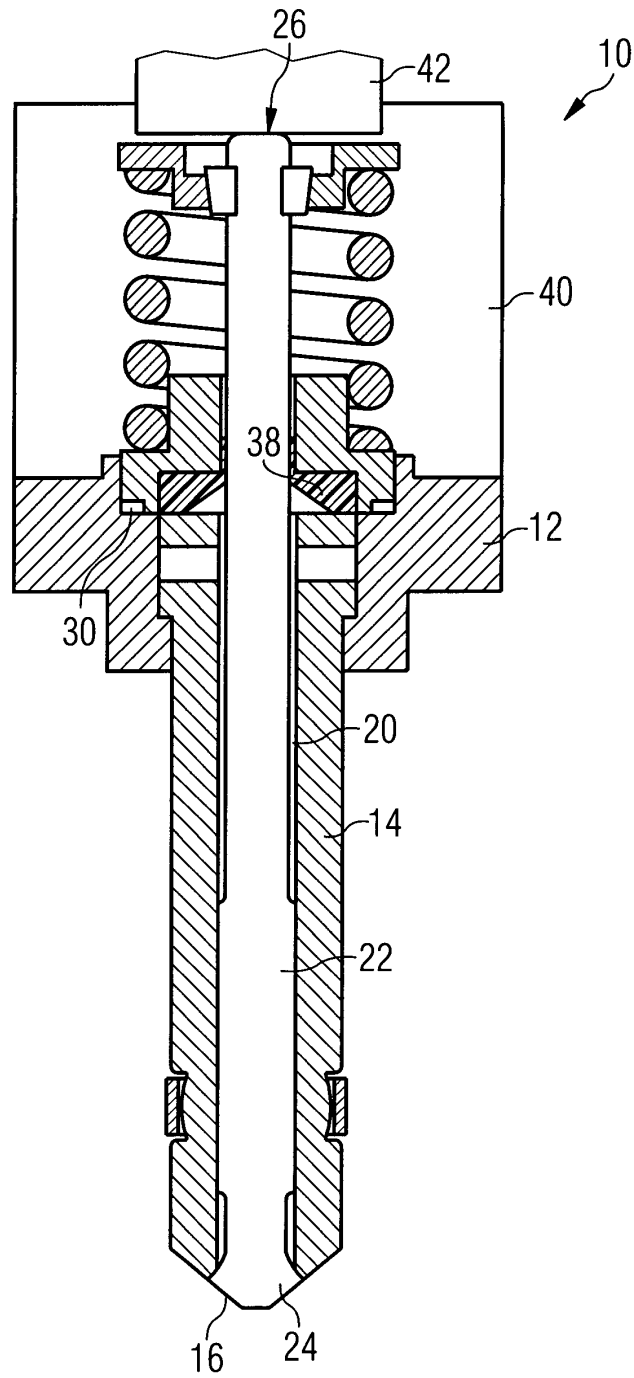
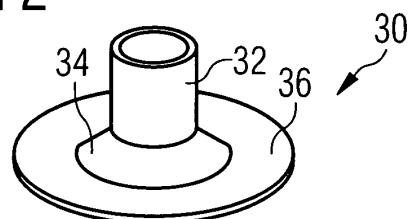


FIG 2





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 02 01 8660

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Y	* column 3, paragraph 21 - column 4, paragraph 23; figures 1,2 *	2-5	F02M61/16
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		13 January 2003	Blanc, S
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/92 (P04001)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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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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