(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 391 609 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
01.06.2005 Bulletin 2005/22

(51) Int Cl.[7]: **F02M 61/12**, F02M 61/16, F02M 61/08

(21) Application number: **02018660.7**

(22) Date of filing: **20.08.2002**

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

Dosiervorrichtung mit hydraulischem Ring

Appareil de dosage avec une bague hydraulique

(84) Designated Contracting States:
DE FR IT

(43) Date of publication of application:
25.02.2004 Bulletin 2004/09

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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] DE 100 54 182 A1 discloses a metering device with metal bellows as a sealing element. One end of the metal bellows is fixed to an inner assembly sleeve that is welded to a valve needle. The opposite end of the metal bellows is welded to one end of an outer assembly sleeve and the metal bellows is arranged inside the outer assembly sleeve. A collar is arranged at the opposite end of the outer assembly sleeve that is welded to a valve body. The inner assembly sleeve is arranged inside the outer assembly sleeve and the high pressure fuel can only pass through an allowance between the inner assembly sleeve and the outer assembly sleeve. Pressure pulses of the high pressure fuel are thus damped before reaching the metal bellows.

[0006] DE 2 032 005 discloses a fuel injection valve with a valve needle and a guiding sleeve arranged at the valve needle. The end of the guiding sleeve opposite to the valve needle seat is formed as a rounded head that rests at a support with a conical inner surface. The support is fixed to the valve body. This arrangement allows the self-centering of the valve needle. To prevent high pressure fuel from passing between the rounded head of the guiding sleeve and the conical inner surface of the support two metal washers and an elastic sealing ring are arranged on the high pressure side around the guiding sleeve and adjacent to the rounded head. The elastic sealing ring is arranged in sealing contact with the guiding sleeve and the valve body and seals in axial and in radial direction. The first metal washer is arranged such that it is in contact with the guiding sleeve and the elastic sealing ring. The second metal washer is arranged such that it is in contact with the valve body and the first metal washer. The arrangement of the elastic sealing ring and the two metal washers allows for small movements of the valve needle and the guiding sleeve in radial direction for centering the valve needle. High pressure fuel pulses press the metal washers in the direction of the elastic sealing ring and the rounded head. The sealing effect is increased by the elastic deformation of the sealing ring. Simultaneously, the guiding sleeve is pressed with its rounded head against the conical support. When the fuel pressure decreases the guiding sleeve becomes movable to center the valve needle.

[0007] 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.

[0008] 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.

[0009] 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. 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. The elastic element further comprises 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 ± 30% of the expected pressure level of 200 bar.

[0010] 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.

[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 an 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 ± 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 pressurised 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 pressurised 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 brushing element (30, 38) for the valve needle (22), hydraulically isolating the actuator chamber (40) and the fluid passage (20), that is formed by an elastic element (30, 38), hermetically fastened to the valve needle (22) and the valve body (12), comprising 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,

characterised in that
the elastic element further comprises a bendable conical section (34) connecting the first and second fastening sections (32, 36) and a ring (38) of a resilient material, such as rubber, arranged in contact with the bendable conical section (34).

2. The metering device according to Claim 1, **characterised 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).

3. The metering device according to Claim 1 or 2, **characterised in that**
the ring (38) of resilient material has a trapezoidal cross section.

Patentansprüche

1. Zumeßvorrichtung zum Dosieren von unter Druck stehenden Fluids, insbesondere ein Einspritzventil für ein Treibstoffeinspritzsystem in einer Verbrennungskraftmaschine, mit:

- einem Ventilkörper (12), der einen Fluidkanal (20) für das zu dosierende, unter Druck stehende Fluid enthält, wobei der Fluidkanal (20) mit einer Zumeßöffnung (16) endet,
- einer axial bewegbaren, durch den Fluidkanal (20) verlaufenden Ventilnadel (22), wobei die Ventilnadel (22) ein erstes Ende (24) in dem Fluidkanal (20) aufweist, das Öffnen und Schließen der Zumeßöffnung (22) steuert, und in einer Betätigungskammer (40) ein zweites Ende (26) aufweist, wobei das zweite Ende (26), das mit einer Betätigungsanordnung (42) in der Betätigungskammer (40) zusammenwirkt, die Axialbewegung der Nadel (22) steuert, wobei in Betrieb der Druck in der Betätigungskammer (40) kleiner als der Druck in dem Fluidkanal (20) ist, und
- einem Buchsenelement (30, 38) für die Ventilnadel (22), das die Betätigungskammer (40) und den Fluidkanal (20) hydraulisch isoliert, das von einem elastischen Element (30, 38) gebildet wird, das hermetisch an der Ventilnadel (22) und an dem Ventilkörper (12) befestigt ist, und das ein Metallelement (30) mit ersten und zweiten Befestigungsabschnitten (32, 36) zum Befestigen des Metallelementes (30) an der Ventilnadel (22) bzw, an dem Ventilkörper (12) umfaßt,

dadurch gekennzeichnet, daß
das elastische Element außerdem einen biegbaren konischen Abschnitt (34), der die ersten und zweiten Befestigungsabschnitte (32, 36) verbindet, und einen Ring (38) aus elastischem Material wie beispielsweise Gummi umfaßt, der in Kontakt mit dem biegbaren konischen Abschnitt (34) angeordnet ist.

2. Zumeßvorrichtung nach Anspruch 1, **dadurch gekennzeichnet, daß** der erste Befestigungsabschnitt von einem hohlen Zylinderabschnitt (32) in hermetischem Kontakt mit der Ventilnadel (32) gebildet ist, und daß der zweite Befestigungsabschnitt von einem ringförmigen Abschnitt (36) in hermetischem Kontakt mit dem Ventilkörper (12) gebildet ist, wobei der Innendurchmesser des ringförmigen Abschnitt (36) größer als der Durchmesser des hohlen Zylinderabschnitts (32) ist.

3. Zumeßvorrichtung nach Anspruch 1 oder 2, **dadurch gekennzeichnet, daß** der Ring (38) aus elastischem Material einen trapezförmigen Querschnitt aufweist.

Revendications

1. Dispositif de dosage de fluides pressurisés, en particulier un injecteur pour un système d'injection de carburant dans un moteur à combustion interne, comprenant :

- un corps d'injecteur (12) contenant un passage de fluide (20) pour le fluide pressurisé à doser, le passage de fluide (20) se terminant par une ouverture de dosage (16),
- une aiguille (22) d'injecteur axialement mobile traversant le passage de fluide (20), l'aiguille (22) d'injecteur ayant une première extrémité (24) située à l'intérieur du passage de fluide (20), contrôlant l'ouverture et la fermeture de l'ouverture de dosage (22), et ayant une seconde extrémité (26) située à l'intérieur d'une chambre de commande (40), la seconde extrémité coopérant avec un groupe de commande

(42) dans la chambre de commande (40) contrôlant le mouvement axial de l'aiguille (22), dans laquelle la pression dans la chambre de commande (40) est inférieure pendant le fonctionnement à la pression dans le passage de fluide (20), et

- un élément formant manchon (30, 38) prévu pour l'aiguille (22) d'injecteur, isolant hydrauliquement la chambre de commande (40) et le passage de fluide (20), lequel est formé par un élément élastique (30, 38), fixé hermétiquement à l'aiguille (22) d'injecteur et au corps d'injecteur (12), comprenant un élément métallique (30) ayant des première et seconde sections de fixation (32, 36) pour la fixation de l'élément métallique (30) à l'aiguille (22) d'injecteur et au corps d'injecteur (12) respectivement,

caractérisé en ce que, l'élément élastique comprend en outre une section conique cintrable (34) reliant les première et seconde sections de fixation (32, 36) et un anneau (38) de matériau élastique, tel que du caoutchouc, disposé en contact avec la section conique cintrable (34).

2. Dispositif de dosage selon la revendication 1, **caractérisé en ce que** la première section de fixation est formée par une section de cylindre creux (32) en contact hermétique avec l'aiguille d'injecteur (22), et **en ce que** la seconde section de fixation est formée par une section d'anneau (36) en contact hermétique avec le corps d'injecteur (12), dans lesquelles le diamètre interne de la section d'anneau (36) est supérieur au diamètre de la section de cylindre creux (32).

3. Dispositif de dosage selon la revendication 1 ou 2, **caractérisé en ce que**, l'anneau (38) de matériau élastique présente une section transversale trapézoïdale.

FIG 1

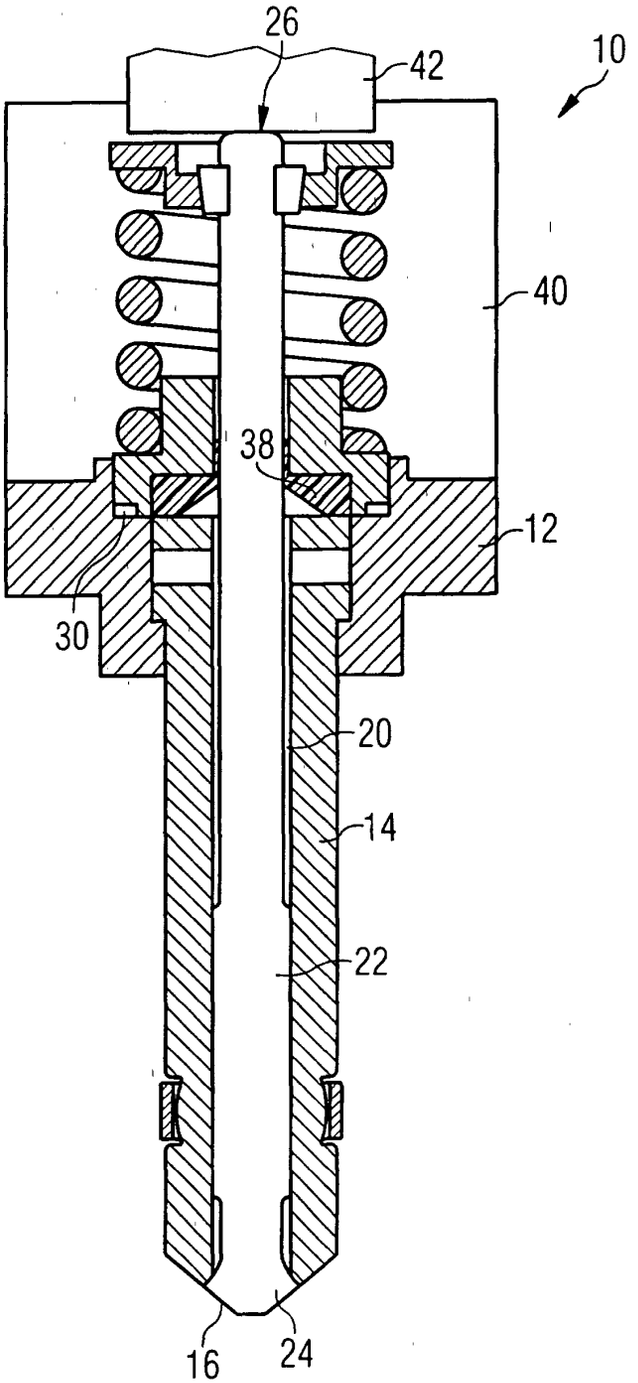

FIG 2