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(71) Applicant: **Continental Automotive GmbH
30165 Hannover (DE)**

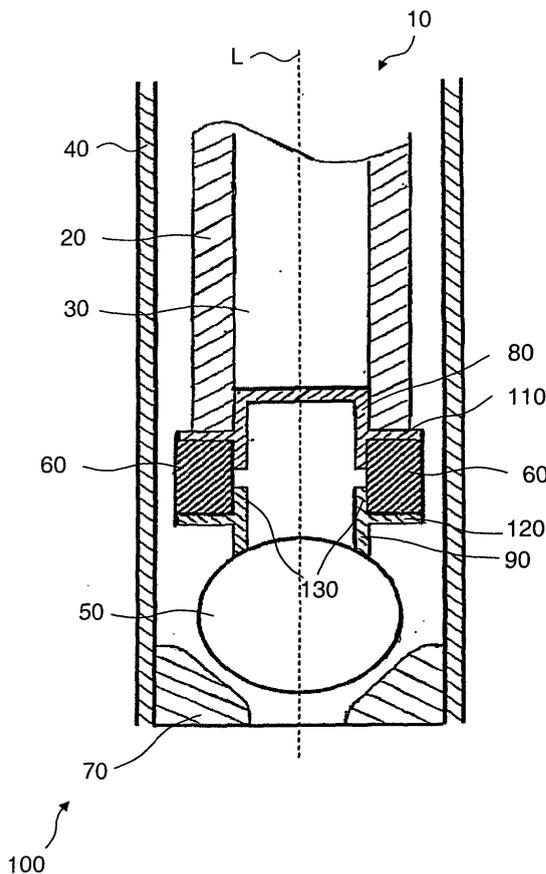
(72) Inventor: **Guarneri, Giovanni
56042 Crespina (Pisa) (IT)**

(54) **Injection valve**

(57) Injection valve comprising a central longitudinal axis (L) and a valve needle (10). The valve needle (10) comprises a valve needle body (20) being actuated to move axially. The valve needle (10) further comprises a sealing element (50) preventing a fluid injection in a closing position and permitting the fluid injection in further

positions. Furthermore the valve needle (10) comprises at least one damping element (60) being arranged to couple the valve needle body (20) to the sealing element (50). The damping element (60) is operable to absorb at least partially a kinetic energy of the valve needle body (20), if the sealing element (50) reaches its closing position.

FIG



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Description

[0001] The invention relates to an injection valve comprising a valve needle.

[0002] Injection valves are in widespread use, in particular for internal combustion engines where they may be arranged in order to dose the fluid into an intake manifold of the internal combustion engine or directly into the combustion chamber of a cylinder of the internal combustion engine.

[0003] Injection valves are manufactured in various forms in order to satisfy the various needs for the various combustion engines. Therefore, for example, their length, their diameter and also various elements of the injection valve being responsible for the way the fluid is dosed may vary in a wide range. In addition to that, injection valves may accommodate an actuator for actuating a valve needle of the injection valve, which may, for example, be an electromagnetic actuator.

[0004] In order to enhance the combustion process in view of the creation of unwanted emissions, the respective injection valve may be suited to dose fluids under very high pressures. The pressures may be in case of a gasoline engine, for example, in the range of up to 200 bar and in the case of diesel engines in the range of up to 2000 bar.

[0005] US 6,523,759 B1 discloses that during operation of the injection valve, a close action of the valve needle to prevent dosing of fluid into the intake manifold or into the combustion chamber is followed by an unwanted reopen and close phase of the valve needle, called needle bounce. During the unwanted reopen and close phase, unwanted fluid is dispensed from the injection valve, resulting in a degraded performance of the injection valve. Therefore, a flow restrictor is disposed in an armature of the valve needle to restrict fluid flow towards an upstream end of the armature, resulting in a reduced bouncing of the valve needle.

[0006] The object of the invention is to create an injection valve which facilitates a reliable and precise function.

[0007] These objects are achieved by the features of the independent claim. Advantageous embodiments of the invention are given in the sub-claims.

[0008] The invention is distinguished by an injection valve comprising a central longitudinal axis and a valve needle. The valve needle comprises a valve needle body being actuated to move axially. The valve needle further comprises a sealing element preventing a fluid injection in a closing position and permitting the fluid injection in further positions. Furthermore, the valve needle comprises at least one damping element being arranged to couple the valve needle body to the sealing element. The damping element is operable to absorb at least partially a kinetic energy of the valve needle body, if the sealing element reaches its closing position. This contributes to minimizing a bouncing of the valve needle and by this contributes to ensuring a reliable and precise fuel injection. Preferably the valve needle body is coupled to an

armature which is actuated by a solenoid in case of an electromagnetic actuated injection valve. In case of a piezoelectric injection valve, the valve needle body is preferably coupled to a piezoelectric actuator. The valve needle body and the sealing element are axially moveable relative to each other and are axially spaced to each other via the at least one damping element. In the moment of reaching the closing position, the damping element at least partially absorbs the kinetic energy of the movement of the valve needle body, thus reducing the bouncing of the sealing element and an uncontrolled fuel injection while the injection valve is in a closing phase.

[0009] In an advantageous embodiment of the invention the valve needle body comprises a cavity. The valve needle further comprises a first fixing device being arranged at least partially within the cavity. The first fixing device comprises at least one first retainer being coupled to a first end of the at least one damping element. Furthermore the valve needle comprises a second fixing device being coupled to the sealing element. The second fixing device comprises at least one second retainer being coupled to a second end of the at least one damping element. The first and the second fixing device are axially spaced to each other via the at least one damping element. The first fixing device is fixedly coupled to the valve needle body and the second fixing device is fixedly coupled to the sealing element. The first and second fixing device facilitate a coupling of the sealing element to the valve needle body via the damping element while reducing a bouncing of the valve needle when the sealing element reaches the closing position. The first and second fixing device are separate components and only coupled via the damping element.

[0010] In a further advantageous embodiment of the invention the first and/or second fixing device are shaped and/or operable to arrange the sealing element coaxial to the valve needle body. This contributes to ensuring a precise and reliable fuel injection while the bouncing of the valve needle is reduced.

[0011] In a further advantageous embodiment of the invention the first and the second fixing device are basically identical in construction. This contributes to ensuring a simple and cost-efficient manufacturing of the injection valve.

[0012] In a further advantageous embodiment of the invention the sealing element has a spherical or conical shape. This contributes to ensuring a reliable and precise function of the injection valve.

[0013] In a further advantageous embodiment of the invention the at least one damping element comprises polymer material. This contributes to ensuring a good damping of the movement of the valve needle body, if the sealing element reaches its closing position.

[0014] In a further advantageous embodiment of the invention the at least one damping element is fixed to the first and/or second fixing device by means of vulcanization. This contributes to ensuring a robust coupling of the at least one damping element to the corresponding fixing

device.

[0015] An exemplary embodiment of the invention is explained in the following with the aid of a schematic drawing. The figure depicts an injection valve with a valve needle.

[0016] Elements of the same design and function are identified by the same reference character.

[0017] An injection valve 100 (figure), that is in particular suitable for dosing fuel into an internal combustion engine, comprises an injection valve housing 40 with a central longitudinal axis L, a valve needle 10 and a valve needle seat 70. The valve needle 10 comprises a valve needle body 20, a sealing element 50, a first and second fixing device 80, 90 and two damping elements 60.

[0018] The valve needle body 20 preferably has a cylindrical shape and is actuated by an actuator of the injection valve 100, e.g. an electromagnetic actuator or a piezoelectric actuator. While being actuated the valve needle body 20 moves axially within the injection, valve housing 40. The valve needle body 20 comprises a cavity 30 wherein the first fixing device 80 is partially disposed. The first fixing device 80 is fixedly coupled to the valve needle body 20, e.g. by welding or press-fitting. The first fixing device 80 comprises in the case of two damping elements 60, two retainers 110, each being fixedly coupled to a first end of the particular damping element 60, preferably by means of vulcanization.

[0019] Also the second fixing device 90 comprises two retainers 120, each being fixedly coupled to a second end of the particular damping element 60, preferably by means of vulcanization. The second fixing device 90 is fixedly coupled to the sealing element 50, e.g. by welding. Preferably the first and second fixing device 80, 90 are basically identical in construction. This facilitates a simple manufacturing of the valve needle 10.

[0020] The sealing element 50 and the valve needle body 20 are coupled to each other via the damping elements 60. The use of the retainers and fixed coupling of the damping element 60 to the particular fixing device contributes to ensuring a coaxial position of the sealing element 50 to the valve needle body 20 while the valve needle 10 is actuated. Preferably each of the fixing devices 80, 90 comprises at least one guiding part 130, being arranged to axially stabilize a movement of the sealing element 50 and to facilitate a reliable and precise fuel injection. By this both damping elements 80, 90 basically contribute to the damping of the valve needle body 20 in equal parts. In the closing position of the valve needle 10, the first and second device 80, 90 are still axially spaced to each other.

[0021] The sealing element 50 has a spherical shape. Alternatively, the sealing element 50 can have a conical shape. In a closing position of the valve needle 10, the sealing element 50 sealingly rests on the valve needle seat 70, by this preventing a fluid flow through at least one injection nozzle of the injection valve 100. The injection nozzle may be, for example, an injection hole. However, it may also be of some other type suitable for dosing

fluid. The sealing element 50 permits the fluid injection into the combustion chamber in further positions, i.e. when it does not rest on the valve needle seat 70. The further positions represent non-closing positions.

[0022] Preferably each damping element 60 is at least partially made of polymer material which has damping properties and is therefore suitable for at least partially absorbing the kinetic energy of the valve needle body 20, if the sealing element 50 impacts the valve needle seat 70.

[0023] If the sealing element 50 impacts the valve needle seat 70 in a closing phase of the injection valve 100 the damping elements 60 basically decouple the sealing element 50 from the movement of the valve needle body 20. By this the movement of the valve needle body 20 does not affect the position of the sealing element 50 which still rests on the valve needle seat 70, while the kinetic energy of the valve needle body 20 is at least partially absorbed by the damping elements 60. Preferably the kinetic energy is absorbed and/or dissipated via the damping elements 60.

[0024] The damping elements 60 can also have elastic properties, so after the sealing element 50 impacts the valve needle seat 70, the valve needle body 20 typically oscillates in axial direction with decreasing oscillation amplitude. A damping constant of the decreasing oscillation of the valve needle body 20 is, among other effects, dependent on the damping elements 60. Due to the decoupling of the axial oscillation of the valve needle body 20 and the sealing element 50, the sealing element 50 still rests on the valve needle seat 70 and by this contributes to eliminating a bouncing of the sealing element 50 after impacting the valve needle seat 70. This contributes to preventing an uncontrolled fuel injection during the closing phase of the injection valve 100.

[0025] Alternatively the injection valve 100 comprises only one damping element 60 or more than two damping elements.

Claims

1. Injection valve, comprising a central longitudinal axis (L) and a valve needle (10), the valve needle (10) comprising
 - a valve needle body (20) being actuated to move axially,
 - a sealing element (50) preventing a fluid injection in a closing position and permitting the fluid injection in further positions,
 - at least one damping element (60), being arranged to couple the valve needle body (20) to the sealing element (50), the damping element (60) being operable to absorb at least partially a kinetic energy of the valve needle body (20), if the sealing element (50) reaches its closing position.

2. Injection valve according to claim 1, the valve needle (10) comprising
- a cavity (30) within the valve needle body (20),
 - a first fixing device (80), being arranged at least partially within the cavity (30) and comprising at least one first retainer (110), the first retainer (110) being coupled to a first end of the at least one damping element (60),
 - a second fixing device (90), being coupled to the sealing element (50) and comprising at least one second retainer (120), the second retainer (120) being coupled to a second end of the at least one damping element (60), whereas the first and the second fixing device (80, 90) are axially spaced to each other via the at least one damping element (60).
3. Injection valve according to claim 2, the first and/or second fixing device (80, 90) being shaped and/or being operable to arrange the sealing element (50) coaxial to the valve needle body (20).
4. Injection valve according to claim 2 or 3, wherein the first and the second fixing device (80, 90) are basically identical in construction.
5. Injection valve according to one of the preceding claims, the sealing element (50) having a spherical or conical shape.
6. Injection valve according to one of the preceding claims, the at least one damping element (60) comprises polymer material.
7. Injection valve according to one of claims 2 to 6, wherein the at least one damping element (60) is fixed to the first and/or second fixing device (80, 90) by means of vulcanization.

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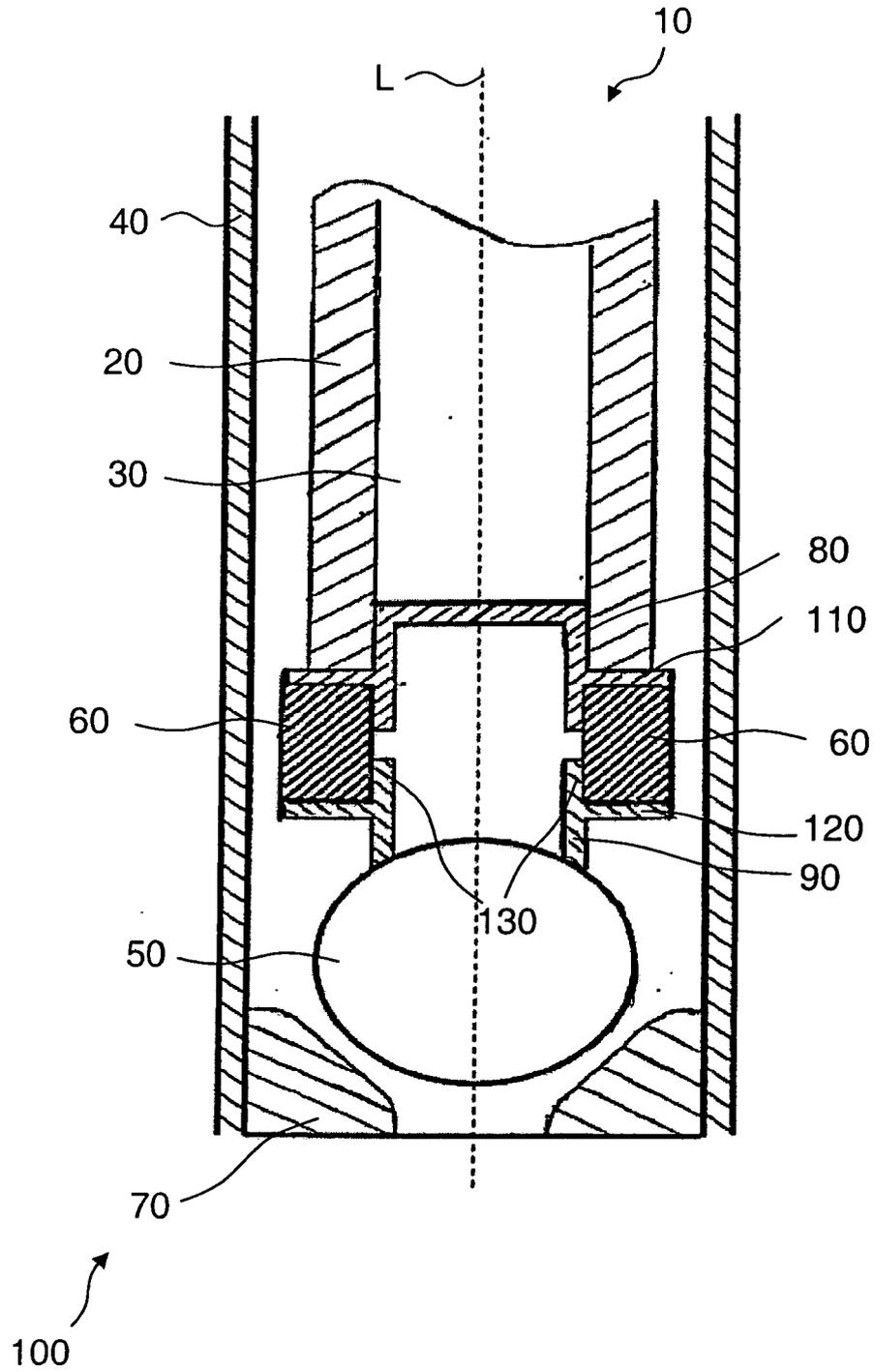
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FIG





EUROPEAN SEARCH REPORT

Application Number
EP 09 00 3115

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2 957 631 A (ARMSTRONG JAMES F) 25 October 1960 (1960-10-25) * column 2, lines 41-64; figure 3 * -----	1-8	INV. F02M61/20
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 21 August 2009	Examiner Etschmann, Georg
CATEGORY OF CITED DOCUMENTS		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	
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 09 00 3115

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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