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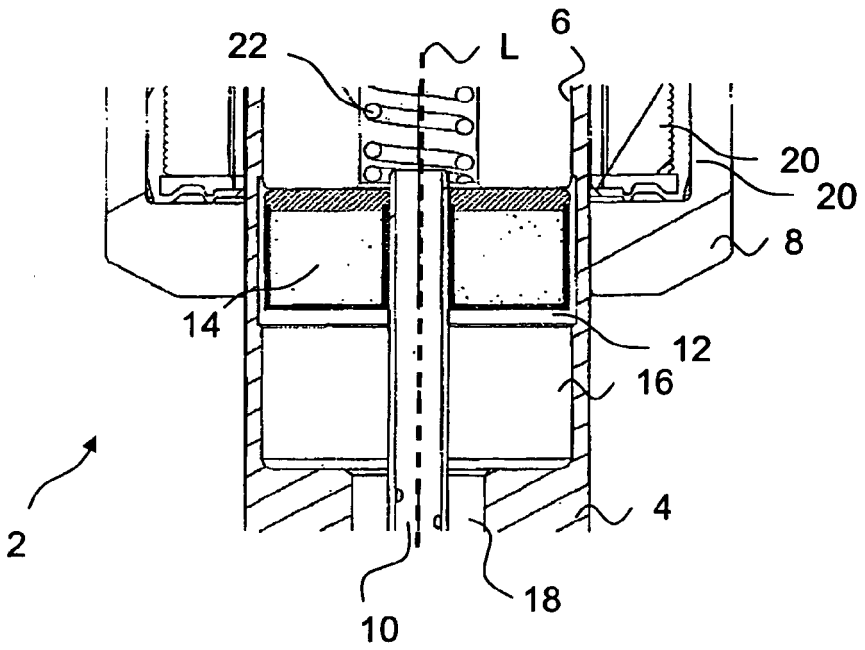
(54) Injection valve

(57) Injection valve (2) comprising a valve body (4) with a central longitudinal axis (L) and a first cavity (16) and a second cavity (18). The injection valve (2) further comprises a valve needle (10) being axially moveable at least in the second cavity (18) and preventing a fluid injection in a closing position and permitting the fluid injection in further positions. Furthermore, the injection valve (2) comprises an armature (12), which is axially moveable at least partially within the first cavity (16) and which is fixedly coupled to the valve needle (10) and which comprises at least one armature cavity (14) being at least partially filled with a powder which features magnetic characteristics. The injection valve (2) also comprises an actuator unit (20) being operable to magnetically actuate the armature (12) to move axially.

FIG 2



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Description

[0001] The invention relates to an injection valve.

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

[0006] These objects are achieved by the features of the independent claim. Advantageous embodiments of the invention are given in the sub-claims.

[0007] The invention is distinguished by an injection valve, comprising a valve body with a central longitudinal axis and a first cavity and a second cavity. The injection valve further comprises a valve needle which is axially moveable at least in the second cavity and which prevents a fluid injection in a closing position and permits the fluid injection in further positions. Furthermore, the injection valve comprises an armature which is axially moveable at least partially within the first cavity and which is fixedly coupled to the valve needle. The armature comprises at least one armature cavity which is at least partially filled with a powder which features magnetic characteristics. The injection valve also comprises an actuator unit which is operable to magnetically actuate the armature to move axially.

[0008] The advantage is that a bouncing of the valve needle can be significantly reduced so that the injection valve facilitates a reliable and precise function. Due to the magnetic characteristics of the powder the armature basically behaves like an armature being solidly made of steel if the armature is actuated by the actuator unit. During an impact event of the valve needle, in which the valve needle for example impacts a valve needle seat, the powder preferably dissipates a resulting impact energy by an internal friction among the powder particles. This contributes to reducing, in particular preventing, a bouncing of the valve needle after impacting the valve needle seat.

[0009] The powder has preferably ferromagnetic characteristics. Furthermore, the at least one armature cavity is preferably completely filled with the powder. Preferably, the at least one armature cavity is loosely filled with the powder. That means, the powder is not actively compressed while filling it into the at least one armature cavity. If the at least one armature cavity is partially filled with powder, the valve needle is preferably guided in the second cavity of the valve body in such a way that an accumulation of the powder, resulting in an unbalanced weight distribution of the armature, results in no tilting and canting of the armature within the first cavity.

[0010] In an advantageous embodiment of the invention, the powder comprises metallic chippings. In a further advantageous embodiment of the invention, the powder comprises ferric chippings. This contributes to reliably actuating the armature by the actuator unit.

[0011] In a further advantageous embodiment of the invention, the at least one armature cavity is encapsulated in such a way that the powder stays in the at least one armature cavity while the armature moves axially. This contributes to reliably actuating the armature by the actuator unit.

[0012] In a further advantageous embodiment of the invention, the at least one armature cavity is shaped and/or positioned within the armature in such a way that a resulting centroid of the armature is in an area of a radial centre point of the armature. This contributes to reliably actuating the armature by the actuator unit. The centroid in the area of the radial centre point of the armature represents a balanced weight distribution of the armature.

[0013] In a further advantageous embodiment of the invention, the powder is allocated in the at least one armature cavity in such a way that the resulting centroid of the armature is in the area of the radial centre point of the armature. This contributes to reliably actuating the armature by the actuator unit.

[0014] Exemplary embodiments of the invention are explained in the following with the aid of schematic drawings. These are as follows:

Fig. 1 a valve needle with an armature,

Fig. 2 a section of an injection valve with the valve needle and the armature according to Fig. 1 in a longitudinal section view.

[0015] Elements of the same design and function that appear in different illustrations are identified by the same reference character.

[0016] A section of an injection valve 2, that is in particular suitable for dosing fuel to an internal combustion engine, is shown in Fig. 2 in a longitudinal section view. The injection valve 2 comprises an injector body 8 with an injection valve cavity 6.

[0017] The injection valve 2 also comprises a valve body 4 which is at least partially arranged within the in-

jection valve cavity 6. The valve body 4 comprises a central longitudinal axis L and a first cavity 16 and a second cavity 18. The valve body 4 takes in a valve needle 10 in its first and second cavity 16, 18. Furthermore, an armature 12 is arranged in the first cavity 16.

[0018] As shown in Fig. 1 the armature 12 is fixedly coupled to the valve needle 10, for example by welding. The armature 12 comprises an armature cavity 14 which is typically filled with powder. The armature 12 may also comprise multiple armature cavities 14, each being filled with the powder. Preferably, the powder features ferromagnetic characteristics and comprises by way of example ferric chippings. The armature cavity 14 is preferably encapsulated in such a way that the powder stays in the armature cavity 14 while the armature moves axially.

[0019] The injection valve 2 is provided with an actuator unit 20 being by way of example a coil assembly that comprises an electromagnetic actuator. The actuator unit 20 comprises preferably a bobbin that retains a coil which is preferably overmolded. The injector body 8 and the armature 12 filled with powder are forming a magnetic circuit if the actuator unit 20 is actuated accordingly.

[0020] The armature 12 is supplied with a magnetic force if the actuator unit 20 is actuated, thus resulting in an axial movement of the armature 12 and the valve needle 10 acting against a spring load of a bias spring 22 to open the injection valve 2 for injecting fluid through at least one injection nozzle. The injection nozzle may by way of example be an injection hole. However, it may also be of some other type suitable for dosing fluid.

[0021] In a closing position of the valve needle 10 it sealingly rests on a valve needle seat by this preventing a fluid flow. After stopping the actuation of the actuator unit 20, the armature 12 and the valve needle 10 are typically moving axially towards the valve needle seat driven by the spring load of the bias spring 22. In an impact event, for example when the valve needle 10 impacts the valve needle seat, the powder within the armature cavity 14 typically dissipates an impact energy resulting from the impact event by an internal friction among the powder particles. This contributes to reducing, in particular preventing, a bouncing of the valve needle after impacting the valve needle seat.

[0022] The impact event may also result if the armature 12 and/or valve needle 10 impact an inlet tube impact face which restricts an axial movement in an opening phase of the injection valve 2. By this, the powder contributes to dissipating the impact energy by internal friction also during the opening phase of the injection valve 2 to at least reduce the bouncing of the valve needle 10 after the opening impact event.

Claims

1. Injection valve (2), comprising

- a valve body (4) comprising a central longitudinal axis (L) and a first cavity (16) and a second cavity (18),
- a valve needle (10) being axially moveable at least in the second cavity (18) and preventing a fluid injection in a closing position and permitting the fluid injection in further positions,
- an armature (12), which is axially moveable at least partially within the first cavity (16) and which is fixedly coupled to the valve needle (10) and which comprises at least one armature cavity (14) being at least partially filled with a powder which features magnetic characteristics,
- an actuator unit (20) being operable to magnetically actuate the armature (12) to move axially.

2. Injection valve (2) according to claim 1, wherein the powder comprises metallic chippings.

3. Injection valve (2) according to claim 1 or 2, wherein the powder comprises ferric chippings.

4. Injection valve (2) according to one of the preceding claims, wherein the at least one armature cavity (14) is encapsulated in such a way that the powder stays in the at least one armature cavity (14) while the armature (12) moves axially.

5. Injection valve (2) according to one of the preceding claims, wherein the at least one armature cavity (14) is shaped and/or positioned within the armature (12) in such a way that a resulting centroid of the armature (12) is in an area of a radial centre point of the armature (12).

6. Injection valve (2) according to one of the preceding claims, wherein the powder is allocated in the at least one armature cavity (14) in such a way that the resulting centroid of the armature (12) is in the area of the radial centre point of the armature (12).

FIG 1

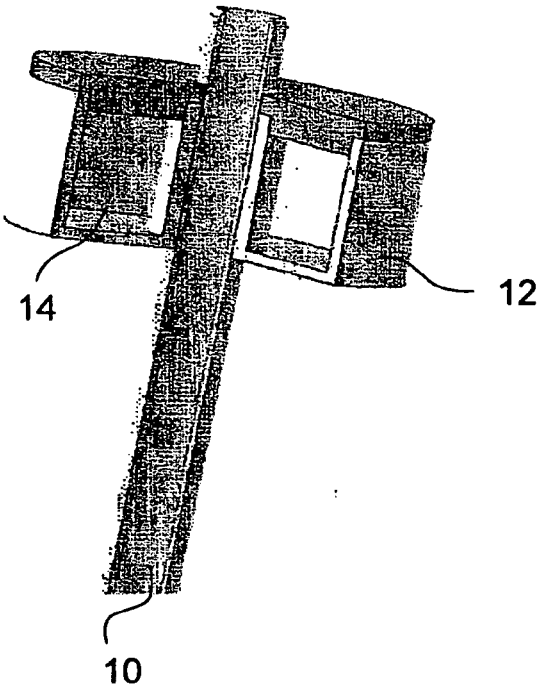


FIG 2

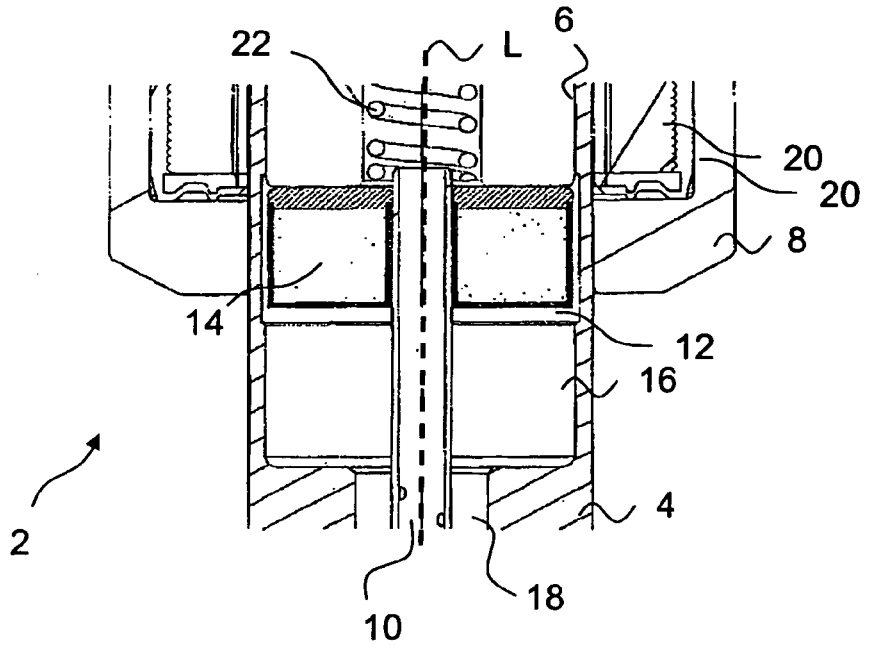
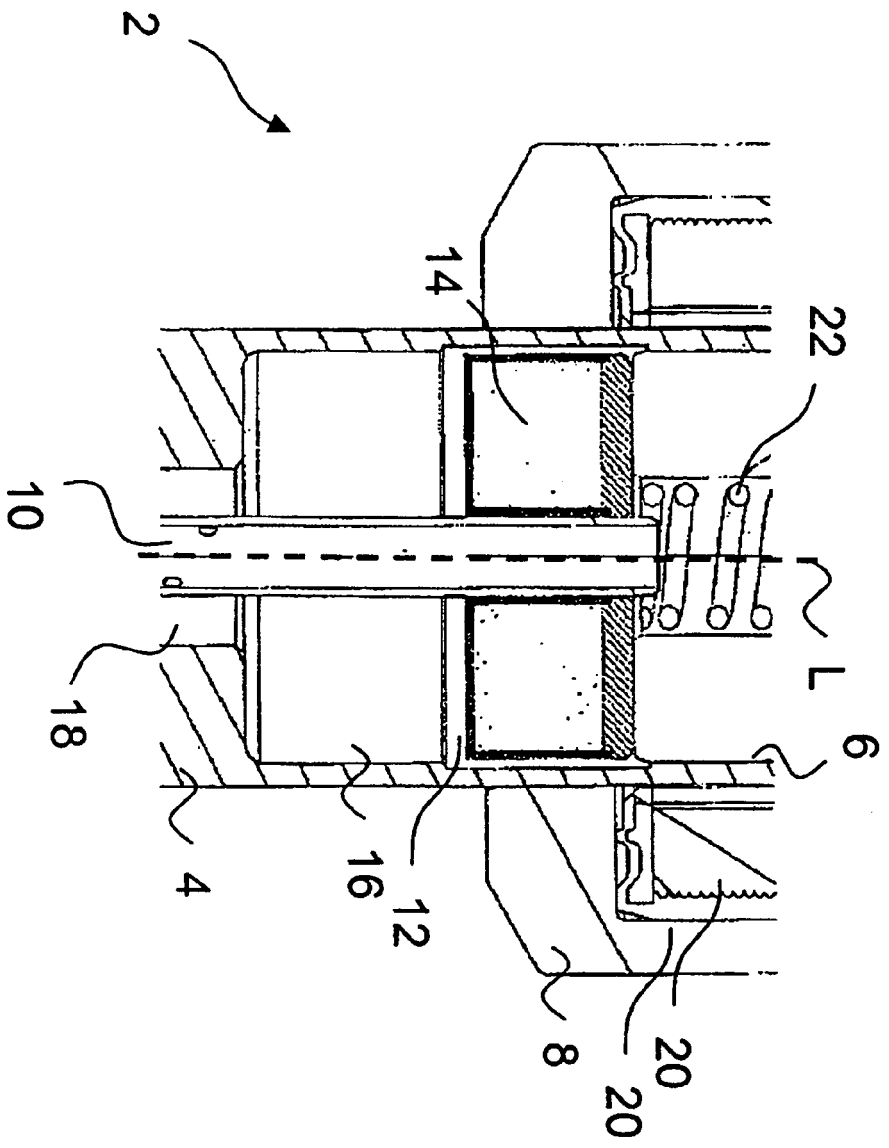


FIG 2



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EUROPEAN SEARCH REPORT

Application Number
EP 10 00 1953

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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
Munich	27 July 2010	Etschmann, Georg

CATEGORY OF CITED DOCUMENTS

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