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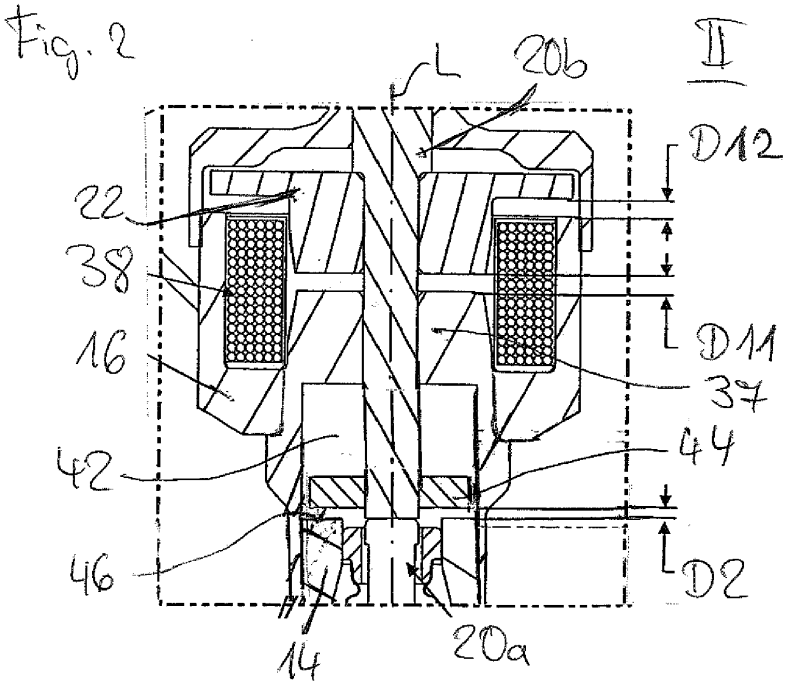
(54) **Valve assembly for an injection valve and injection valve**

(57) The invention relates to a valve assembly (12) for an injection valve (10), comprising a valve body (14) including a central longitudinal axis (L), the valve body (14) comprising a cavity (18) with a fluid inlet portion (26) and a fluid outlet portion (28), a valve needle (20) axially movable in the cavity (18), the valve needle (20) preventing a fluid flow through the fluid outlet portion (28) in a closing position and releasing the fluid flow through the fluid outlet portion (28) in further positions, and an electromagnetic actuator unit (36) being designed to actuate the valve needle (20), the actuator unit (36) comprising an armature (22), the armature (22) being axially movable in the cavity (18) and being fixedly coupled to the valve needle (20). A stop element (44) is arranged in the cavity (18) and is fixedly coupled to the valve needle (20). The stop element (44) is arranged and designed in a manner that the valve needle (20) has a maximum distance from the closing position when the stop element (44) rests on a stop surface (46) of the valve body (14). The stop surface (46) of the valve body (14) is arranged outside the range of the magnetic field of the actuator unit (36) which is effective to actuate the valve needle (20).



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Description

[0001] The invention relates to a valve assembly for an injection valve and an injection valve.

[0002] Injection valves are in wide spread 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 be, for example, 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 a valve assembly of an injection valve and an injection valve which facilitate a reliable and precise function of the injection valve.

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

[0007] According to a first aspect the invention is distinguished by a valve assembly for an injection valve, comprising a valve body including a central longitudinal axis, the valve body comprising a cavity with a fluid inlet portion and a fluid outlet portion, and a valve needle axially moveable in the cavity, the valve needle preventing a fluid flow through the fluid outlet portion in a closing position and releasing the fluid flow through the fluid outlet portion in further positions. Furthermore, the valve assembly comprises an electro-magnetic actuator unit which is designed to actuate the valve needle. The actuator unit comprises an armature. The armature is axially movable in the cavity and is fixedly coupled to the valve needle. A stop element is arranged in the cavity and is fixedly coupled to the valve needle. The stop element is arranged and designed in a manner that the valve needle has a maximum distance from the closing position when the stop element rests on a stop surface of the valve body. The stop surface of the valve body is arranged outside the range of the magnetic field of the actuator unit which is effective to actuate the valve needle.

[0008] This has the advantage that the stop element and the stop surface may come into contact with each other during a moving of the valve needle while an impact on the armature may be avoided. Consequently, a coating of the armature to prevent wearing effects can be avoided. Furthermore, as the stop surface of the valve body is arranged outside the range of the magnetic field of the actuator unit which is effective to actuate the valve needle it is possible that the stop element does not influence the magnetic field of the actuator unit.

[0009] In an advantageous embodiment an axial distance between the armature and the valve body or between the armature and a further part of the valve assembly being fixedly coupled to the valve body is greater than an axial distance between the stop element and the stop surface of the valve body. This has the advantage that a contact between the armature and the further part of the valve assembly being fixedly coupled to the valve body can be avoided. Consequently, a coating of the armature to prevent wearing effects on the armature can be avoided.

[0010] In a further advantageous embodiment the actuator unit comprises a pole piece being fixedly coupled to the valve body, and an axial distance between the armature and the pole piece is greater than the axial distance between the stop element and the stop surface of the valve body. This has the advantage that a contact between the armature and the pole piece can be avoided. Consequently, a coating of the pole piece and the armature to prevent wearing effects can be avoided.

[0011] In a further advantageous embodiment the stop element is disk shaped and is extending in radial direction from the valve needle. This has the advantage that the stop element has a shape which enables to obtain a well-defined position of the valve needle at a maximum distance from the closing position.

[0012] According to a second aspect the invention is distinguished by an injection valve comprising the valve assembly in accordance with the first aspect of the invention.

[0013] Exemplary embodiments of the invention are explained in the following with the aid of schematic drawings. These are as follows:

[0014] Figure 1, an injection valve with a valve assembly in a longitudinal section view, and

[0015] Figure 2, an enlarged view of a section II of Figure 1.

[0016] Elements of the same design and function that appear in different illustrations are identified by the same reference character.

[0017] An injection valve 10 that is in particular suitable for dosing fuel to an internal combustion engine comprises in particular a valve assembly 12. The shown injection valve 10 is of an outward opening type. In an alternative embodiment the injection valve 10 may be of an inward opening type.

[0018] The valve assembly 12 comprises a valve body 14 with a central longitudinal axis L and a housing 16. The housing 16 is fixedly coupled to the valve body 14. The valve assembly 12 has a cavity 18 which is axially led through the valve body 14. The cavity 18 takes in a valve needle 20 and an armature 22. The valve needle

20 and the armature 22 are axially movable in the cavity 18. The valve needle 20 comprises a first part 20a and a second part 20b. The second part 20b of the valve needle 20 is designed as a push rod and is fixedly coupled to the armature 22.

[0019] The injection valve 10 has a fluid inlet portion 26 which is hydraulically coupled to the cavity 18. On one of the free ends of the cavity 18, a fluid outlet portion 28 is formed which is closed or opened depending on the axial position of the valve needle 20. The fluid inlet portion 26 is hydraulically coupled to a fuel connector 30 which is designed to be connected to a high pressure fuel chamber of an internal combustion engine, the fuel is stored under high pressure, for example, under the pressure above 200 bar.

[0020] The valve body 14 has a valve body spring rest 32 and the valve needle 22 comprises a valve needle spring rest 34. A main spring 35 is arranged in the cavity 18 between the valve body spring rest 32 and the valve needle spring rest 34.

[0021] The valve assembly 12 is provided with an electro-magnetic actuator unit 36. The electro-magnetic actuator unit 36 comprises a pole piece 37 and a coil 38. The pole piece 37 is fixedly coupled to the housing 16. The coil 38 is preferably arranged inside the housing 16. Furthermore, the electro-magnetic actuator unit 36 comprises the armature 22.

[0022] The housing 16, the armature 22 and the pole piece 37 are forming an electromagnetic circuit.

[0023] Between the valve needle 20 and the valve body 14 a bellow 40 is arranged which is sealingly coupling the valve body 14 with the valve needle 20. By this a fluid flow between the fluid inlet portion 26 and a chamber 42 is prevented.

[0024] The valve assembly 12 comprises a stop element 44 which is arranged in the chamber 42. The stop element 44 is disk-shaped and is fixedly coupled to the valve needle 20. The stop element 44 is extending in radial direction from the valve needle 20. The valve body 14 has a stop surface 46. If the stop element 44 rests on the stop surface 46 the valve needle 20 is in a position in which a gap 48 between the valve needle 20 and the valve body 14 has a maximum width. The stop surface 46 of the valve body 14 is arranged outside the range of the magnetic field of the electromagnetic circuit of the actuator unit 36 which is effective to activate the valve needle 20. The effective magnetic field to activate the valve needle 20 is in particular dependent from the extension of the housing 16, the armature 22 and the pole piece 37. The stop element 44 and the stop surface 46 of the valve body 14 may be of a material or comprise a material with a very high hardness. Consequently, a coating of the stop surface 46 and the stop element 44 to prevent wearing effects may be avoided.

[0025] In the shown embodiment the stop element 44 is arranged in the chamber 42 which is free from fluid. In a further embodiment the stop element 44 may be arranged in a part of the cavity 18 which is charged with fluid, for example between the fluid inlet portion 26 and the fluid outlet portion 28.

[0026] In the following, the function of the injection valve 10 is described in detail:

The fluid is led from the fluid inlet portion 26 towards the fluid outlet portion 28.

[0027] The valve needle 20 prevents a fluid flow through the fluid outlet portion 28 in the valve body 14 in a closing position of the valve needle 20. Outside of the closing position of the valve needle 20, the valve needle 20 enables the fluid flow through the fluid outlet portion 28.

[0028] In the case when the electro-magnetic actuator unit 36 with the coil 38 gets energized the actuator unit 36 may effect an electro-magnetic force on the armature 22. The armature 22 is attracted by the coil 38 and moves in axial direction to the fluid outlet portion 28. The armature 22 takes the valve needle 20 with it so that the valve needle 20 moves in axial direction out of the closing position. Outside of the closing position of the valve needle 20 the gap 48 between the valve body 14 and the valve needle 20 at the axial end of the injection valve 10 facing away from of the actuator unit 36 forms a fluid path. The gap 48 forms an injection nozzle.

[0029] In the case when the actuator unit 36 is de-energized the main spring 35 can force the valve needle 20 to move in axial direction in its closing position. It is depending on the force balance between the force on the valve needle 20 caused by the actuator unit 36 with the coil 38 and the force on the valve needle 20 caused by the main spring 35 whether the valve needle 20 is moving in its closing position or not.

[0030] The armature 22 and the pole piece 37 have an axial distance D11 to each other (Figure 2). The stop element 44 and the stop surface 46 of the valve body 14 have an axial distance D2 to each other. The axial distance D11 between the armature 22 and the pole piece 37 is greater than the axial distance D2 between the stop element 44 and the stop surface 46 of the valve body 14. This makes it possible that if the stop element 44 is in contact with the stop surface 46 of the valve body 14 the axial distance D11 between the armature 22 and the pole piece 37 is greater than zero. Therefore, if the axial distance D2 between the stop element 44 and the stop surface 46 of the valve body is zero and the valve needle 20 has its maximum distance from the closing position, the axial distance D11 between the armature 22 and the pole piece 37 is greater than zero. Therefore, a coating for wearing resistance of the armature 22 and the pole piece 37 may be avoided. Furthermore, as the armature 22 is distanced from the pole piece 37 in the case that the axial distance D2 between the stop element 44 and the stop surface 46 of the valve body is zero, a coating to generate a magnetic gap between the armature 22 and the pole piece 37 can be avoided.

[0031] The armature 22 and the housing 16 which is

fixedly coupled to the valve body 14 have an axial distance D12. The axial distance D12 between the armature 22 and the housing 16 is greater than the axial distance D2 between the stop element 44 and the stop surface 46. Due to this a contact between the armature 22 and the housing 16 can be avoided even in the case that the stop element 44 is in contact with the stop surface 46. Therefore, a coating for wearing resistance of the armature 22 and the housing 16 may be avoided. Furthermore, a magnetic gap between the armature 22 and the housing 16 can be obtained which allows a fast closing of the valve needle 20. Consequently, a coating to generate a magnetic gap between the armature 22 and the housing 16 can be avoided.

Claims

1. Valve assembly (12) for an injection valve (10), comprising

- a valve body (14) including a central longitudinal axis (L), the valve body (14) comprising a cavity (18) with a fluid inlet portion (26) and a fluid outlet portion (28),
- a valve needle (20) axially movable in the cavity (18), the valve needle (20) preventing a fluid flow through the fluid outlet portion (28) in a closing position and releasing the fluid flow through the fluid outlet portion (28) in further positions, and
- an electro-magnetic actuator unit (36) being designed to actuate the valve needle (20), the actuator unit (36) comprising an armature (22), the armature (22) being axially movable in the cavity (18) and being fixedly coupled to the valve needle (20), wherein a stop element (44) is arranged in the cavity (18) and is fixedly coupled to the valve needle (20), the stop element (44) being arranged and designed in a manner that the valve needle (20) has a maximum distance from the closing position when the stop element (44) rests on a stop surface (46) of the valve body (14), and

wherein the stop surface (46) of the valve body (14) is arranged outside the range of the magnetic field of the actuator unit (36) which is effective to actuate the valve needle (20).

2. Valve assembly (12) according to claim 1, wherein an axial distance (D11, D12) between the armature (22) and the valve body (14) or between the armature (22) and a further part of the valve assembly (12) being fixedly coupled to the valve body (14) is greater than an axial distance (D2) between the stop element (44) and the stop surface (46) of the valve body (14).

3. Valve assembly (12) according to claim 2, wherein the actuator unit (36) comprises a pole piece (37) being fixedly coupled to the valve body (14), and an axial distance (D11) between the armature (22) and the pole piece (37) is greater than the axial distance (D2) between the stop element (44) and the stop surface (46) of the valve body (14).

4. Valve assembly (12) according to one of the preceding claims, wherein the stop element (44) is disk-shaped and is extending in radial direction from the valve needle (20).

5. Injection valve (10) with a valve assembly (12) according to one of the preceding claims.

Fig. 1

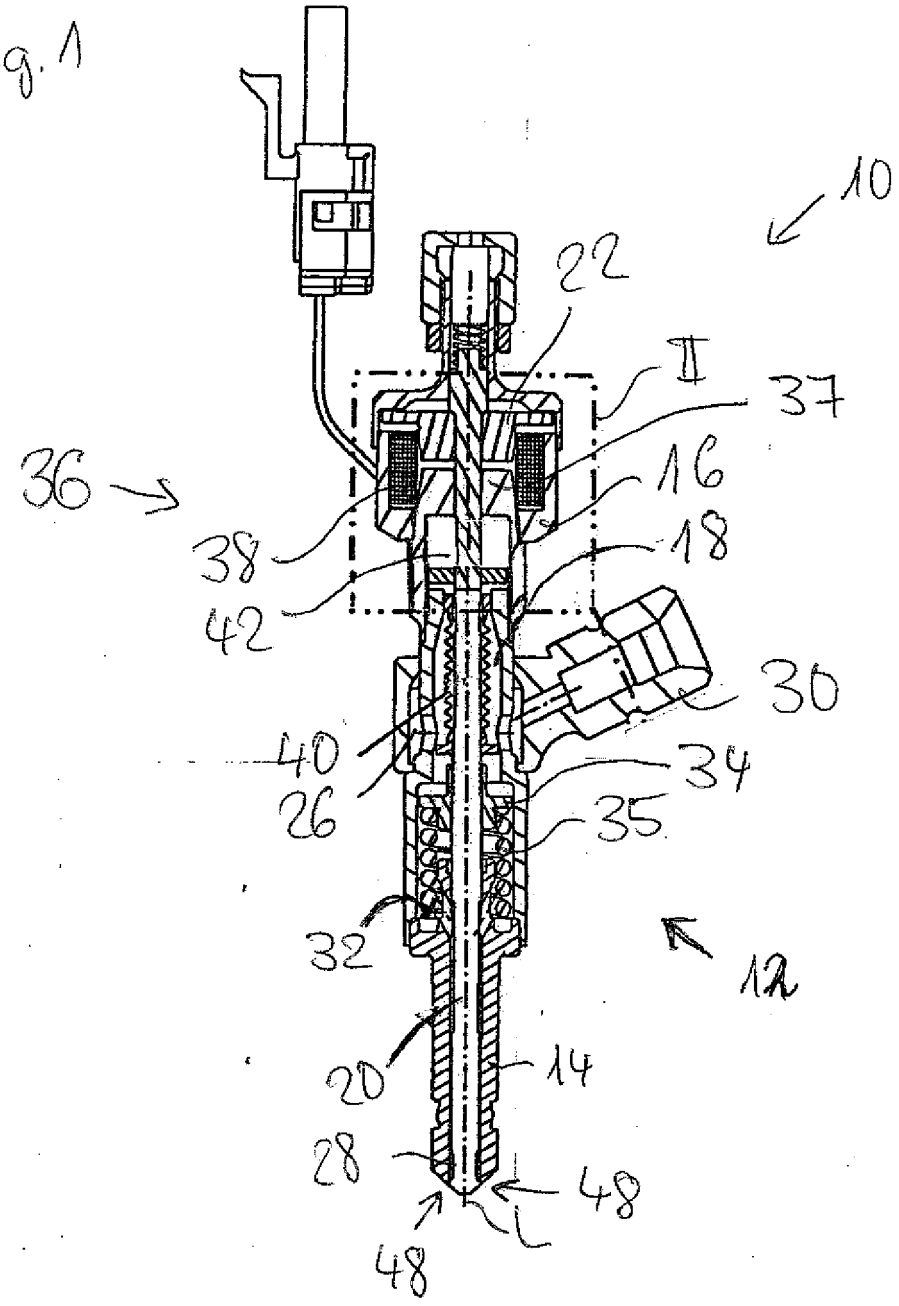
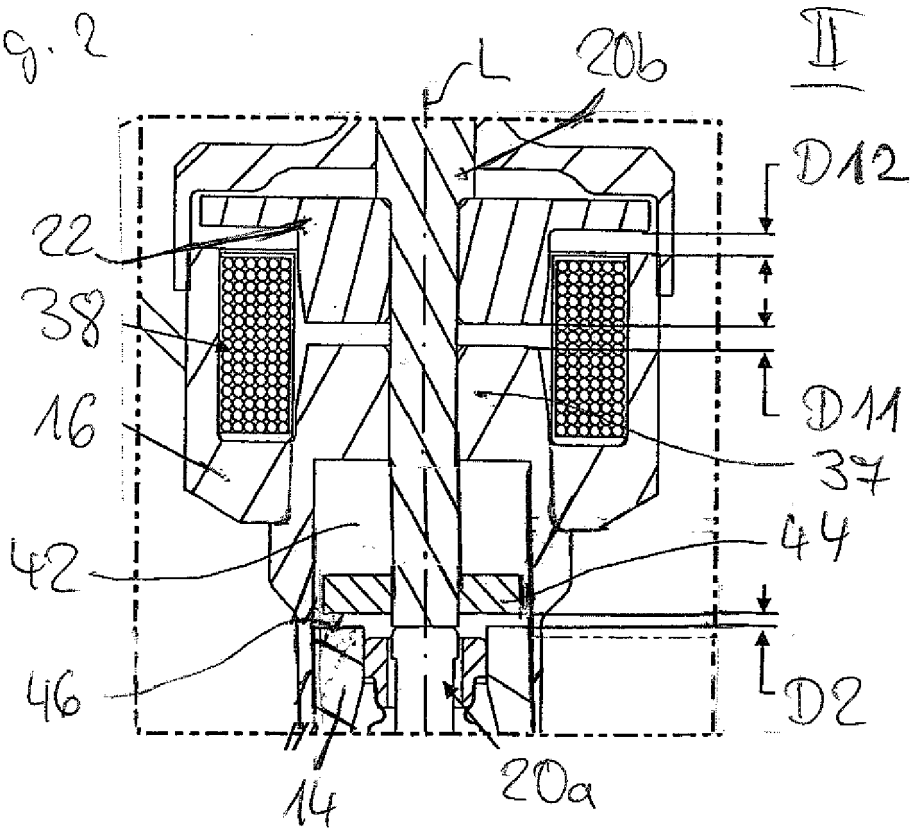


Fig. 2



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EUROPEAN SEARCH REPORT

Application Number
EP 10 18 6217

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	EP 1 734 251 A1 (MAGNETI MARELLI POWERTRAIN SPA [IT]) 20 December 2006 (2006-12-20) * the whole document *	1-5	INV. F02M51/06 F02M61/16 F02M61/08 F02M61/10
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TECHNICAL FIELDS SEARCHED (IPC)

F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 February 2011	Tortosa Masiá, A

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 18 6217

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