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

(11) **EP 2 439 400 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.04.2012 Bulletin 2012/15

(51) Int Cl.:
F02M 61/10 *(2006.01)* ***F02M 61/16*** *(2006.01)*
F02M 61/18 *(2006.01)*

(21) Application number: **10186580.6**

(22) Date of filing: **05.10.2010**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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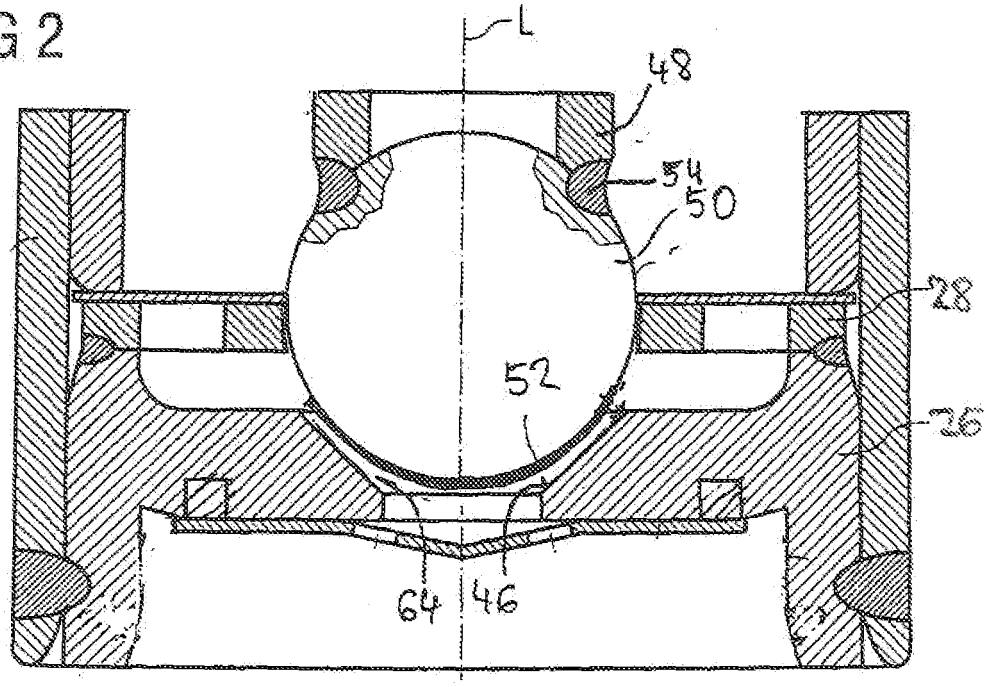
(54) **Valve assembly for an injection valve and injection valve**

(57) Valve assembly (60) of an injection valve (62), the valve assembly (60) comprising a valve body (4) including a central longitudinal axis (L), the valve body (4) comprising a cavity (8) with a fluid inlet portion (42), a fluid outlet portion (44) and a needle seat (46), a valve needle (10) axially movable in the cavity (8), the valve needle (10) comprising a seat part (50) with a sealing layer (52) forming a surface of the seat part (50), the valve needle (10) preventing a fluid flow through the fluid outlet portion (44) in a closing position in which the sealing layer (52) rests on the needle seat (46) and releasing the fluid flow through the fluid outlet portion (44) in further positions, the needle seat (46) consisting of a first material and the sealing layer (52) consisting of a second material being a metal, and the hardness of the first material being greater than the hardness of the second material.

FIG 2



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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 widespread use, in particular for an internal combustion engine 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 all the 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 can accommodate an actuator for actuating a needle of the injection valve, which may, for example, be an electromagnetic actuator or a piezoelectric actuator.

[0004] In order to enhance the combustion process in view of degradation 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.

[0005] The object of the invention is to create a valve assembly for an injection valve and an injection valve which is simple to be manufactured and which facilitates a reliable and precise function.

[0006] This object is achieved by the features of the independent claim. 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 of an injection valve, the valve assembly comprising a valve body including a central longitudinal axis, the valve body comprising a cavity with a fluid inlet portion, a fluid outlet portion and a needle seat. The valve assembly further comprises a valve needle axially movable in the cavity, the valve needle comprising a seat part with a sealing layer, the valve needle preventing a fluid flow through the fluid outlet portion in a closing position in which the sealing layer rests on the needle seat and releasing the fluid flow through the fluid outlet portion in further positions. The needle seat consists of a first material and the sealing layer consists of a second material being a metal, and the hardness of the first material is greater than the hardness of the second material.

[0008] This has the advantage, that different parts of the valve needle can be better adapted according to the particular requirements. The seat part of the valve needle may be better adapted to prevent a fluid flow through the fluid outlet portion in a closing position of the valve needle if deformations and surface roughness of the needle seat of the valve body occur. Furthermore, in the case of misalignments of the valve needle relative to the valve body, a compensation of the misalignment is possible and consequently, a fluid flow through the fluid outlet portion in a closing position of the valve needle can be prevented. Additionally, it is possible to apply small axial forces on the valve needle because of the good elastic deformability of the seat part of the valve needle. This can result in a good dynamic performance of the injection valve by the reduction of transient effects. Consequently, fast responses of the injection valve are possible which enable a linear performance of the valve needle movement. Furthermore, it is possible to avoid coining of the needle seat by the valve needle. Additionally, metals can be well-conductive materials which may be simply deposited on a carrier material. Furthermore, a low thickness of the second material can be obtained.

[0009] In a advantageous embodiment of the invention, the second material comprises gold, silver or nickel. These materials can be easy available, well processable and have a high resistance against reactions with fluids like fuels.

[0010] In a further advantageous embodiment of the invention, the sealing layer has a thickness of up to 3 μm. This makes it possible to prevent a contamination of the valve assembly by the sealing layer.

[0011] According to a second aspect the invention is distinguished by an injection valve with a valve assembly.

[0012] Exemplary embodiments of the invention are explained in the following with the aid of schematic drawings. These are as follows:

Figure 1, an injection valve in a longitudinal section view, and

figure 2, a section of a valve assembly of the injection valve in a longitudinal section view.

[0013] Elements of the same design and function that appear in different illustrations are identified by the same reference characters.

[0014] An injection valve 62 (figure 1) that is in particular suitable for dosing fuel to an internal combustion engine, preferably under a pressure of up to 200 bar, comprises an inlet tube 2, a housing 6 and a valve assembly 60.

[0015] The valve assembly 60 comprises a valve body 4 with a central longitudinal axis L and a cavity 8 which takes in a valve needle 10 and preferably a part of an armature 12. In the inlet tube 2, a recess 16 is provided which further extends to a recess 18 of the armature 12. A spring 14 is arranged in the recess 16 of the inlet tube 2 and/or the recess 18 of the armature 12. Preferably, it rests on a spring seat being formed by an anti-bounce disk 20. By this, the spring 14 is mechanically coupled to the needle 10. An adjusting tube 22 is provided in the recess 16 of the inlet tube 2. The adjusting tube 22 forms a further seat for the spring 14 and may be axially moved during the manufacturing process of the fluid injection valve in order to preload the spring 14 in a desired way.

[0016] In a closing position of the valve needle 10, it

sealingly rests on a needle seat 46 of a seat body 26, by this preventing a fluid flow through at least one injection nozzle 24. The injection nozzle 24 may be, for example, an injection hole. However, it may also be of some other types suitable for dosing fluid. The seat body 26 may be made in one part with the valve body 4 or be a part separate from the valve body 4. In addition to that, a lower guide 28 for guiding the needle 10 and a swirl disk 30 is provided.

[0017] The fluid injection valve is provided with an actuator unit 40 that comprises preferably an electromagnetic actuator comprising a coil 36 which is preferably overmolded. A valve body shell 38, the armature 12 and the inlet tube 2 are forming an electromagnetic circuit. The actuator unit 40 may, however, also comprise another type of actuator, which is known to persons skilled in the art for that purpose. Such an actuator may be, for example, a piezoelectric actuator.

[0018] A fluid inlet portion 42 is provided in the valve body 4 which communicates with a fluid outlet portion 44 which is part of the cavity 8 near the seat body 26.

[0019] As can be seen in figure 2, the valve needle 10 comprises a hollow shaft portion 48 and a seat part 50. The seat part 50 is preferably of a material comprising a steel. The seat part 50 comprises a sealing layer 52.

[0020] The shaft portion 48 of the valve needle 10 is coupled to the seat part 50 through a welding seam 54 to obtain an exact fixing of the seat part 50 relative to the shaft portion 48. It is obvious that any other method for coupling the seat part 50 with the shaft portion 48 may be applied as well as long as an exact positioning of the seat part 50 relative to the shaft portion 48 and a rigid coupling of the seat part 50 with the shaft portion 48 may be obtained.

[0021] The needle seat 46 consists of a first material which is preferably a metal, in particular a steel. The sealing layer 52 of the seat part 50 consists of second material which is a metal and the hardness of the first material is higher than the hardness of the second material. Preferably the metal of the second material is selected from the group of gold, silver and nickel. These materials are well-conductive and can be well deposited on a carrier material like a steel. Furthermore, a low thickness of these metals of preferably 2-3 μm can be obtained. This low thickness enables that a contamination of the fluid in the valve assembly 60 can be prevented.

[0022] In case of deformations and surface roughness of the sealing layer 52 of the seat part 50 the use of a less hard material for the sealing layer 52 of the seat part 50 of the valve needle 10 allows a good adaptation of the sealing layer 52 of the seat part 50 of the valve needle 10, if it is in contact with the seat body 26 in the area of the needle seat 46.

[0023] Furthermore, if the valve needle 10 is misaligned relative to the valve body 4, in particular if the seat part 50 is misaligned relative to the seat body 26, it is possible to compensate the deviation between these two parts in the case the material of the sealing layer 52 of the seat part 50 of the valve needle 10 is less hard than the material of the seat body 26. Therefore, good sealing properties can be obtained and a fluid flow through the fluid outlet portion 44 in a closing position of the valve needle 10 can be prevented.

[0024] Additionally, only small axial forces for the movement of the valve needle 10 are necessary as the sealing layer 52 of the seat part 52 of the valve needle 10 is well deformable. By this, a good dynamic performance may be obtained due to small transient effects. This allows a fast response of the injection valve which enables a linearity of the injection valve performance.

[0025] Figure 2 shows the valve assembly wherein the sealing layer 52 preferably comprises gold, silver or nickel which are materials with a high resistance against fluids such as fuels thereby enabling a long cycle time of the injection valve.

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

[0027] The fluid is led from the inlet tube 2 to the hollow valve needle 10 and then to the fluid outlet portion 44.

[0028] The spring 14 forces the valve needle 10 via the anti-bounce disk 20 towards the actuator unit 40. In the case when the actuator unit 40 is de-energized the spring 14 can force the valve needle 10 to move in axial direction in its closing position. It is depending on the force balance between the force on the valve needle 10 caused by the actuator unit 40 and the force on the valve needle 22 caused by the spring 14 whether the valve needle 10 is in its closing position or not.

[0029] In the closing position of the valve needle 10 the sealing layer 52 of the seat part 50 of the valve needle 10 sealingly rests on the needle seat 46 of the seat body 26 and consequently prevents a fluid flow through the fluid outlet portion 44 and the injection nozzle 24. The use of metals for the sealing layer 52 which have a lower hardness than the material for the needle seat 46 of the seat body 26 can result in a good sealing between the needle seat 46 of the seat body 26 and the sealing layer 52 of the valve needle 10.

[0030] In the case that the actuator unit 40 gets energized, the actuator unit 40 may effect a force on the valve needle 10. The valve needle 10 is able to move in axial direction out of the closing position. Outside of the closing position of the valve needle 10, a gap 64 is opened between the seat body 26 and the valve needle 10 at an axial end of the valve needle 10 facing away from the shaft portion 40 of the valve needle 10. This enables a fluid flow through the injection nozzle 24.

Claims

1. Valve assembly (60) of an injection valve (62), the valve assembly (60) comprising

   - a valve body (4) including a central longitudinal axis (L), the valve body (4) comprising a cavity

(8) with a fluid inlet portion (42), a fluid outlet portion (44) and a needle seat (46),
- a valve needle (10) axially movable in the cavity (8), the valve needle (10) comprising a seat part (50) with a sealing layer (52) forming a surface of the seat part (50), the valve needle (10) preventing a fluid flow through the fluid outlet portion (44) in a closing position in which the sealing layer (52) rests on the needle seat (46) and releasing the fluid flow through the fluid outlet portion (44) in further positions,
the needle seat (46) consisting of a first material and the sealing layer (52) consisting of a second material being a metal, and the hardness of the first material being greater than the hardness of the second material.

2. Valve assembly (60) in accordance with claim 1, with the second material comprising gold, silver or nickel.

3. Valve assembly (60) in accordance with one of the preceding claims with the sealing layer (52) having a thickness of up to 3 μm.

4. Injection valve (62) with a valve assembly (60) according to one of the preceding claims.

FIG 1

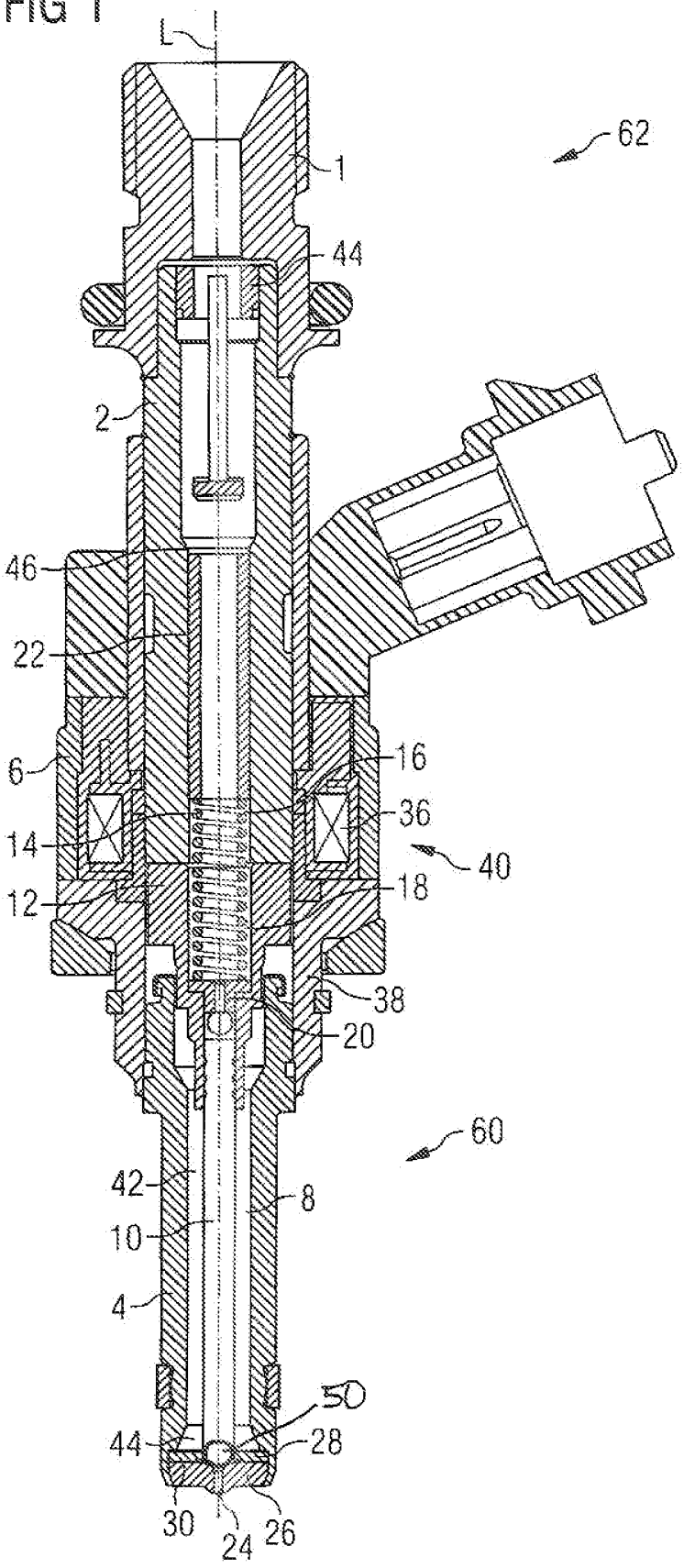
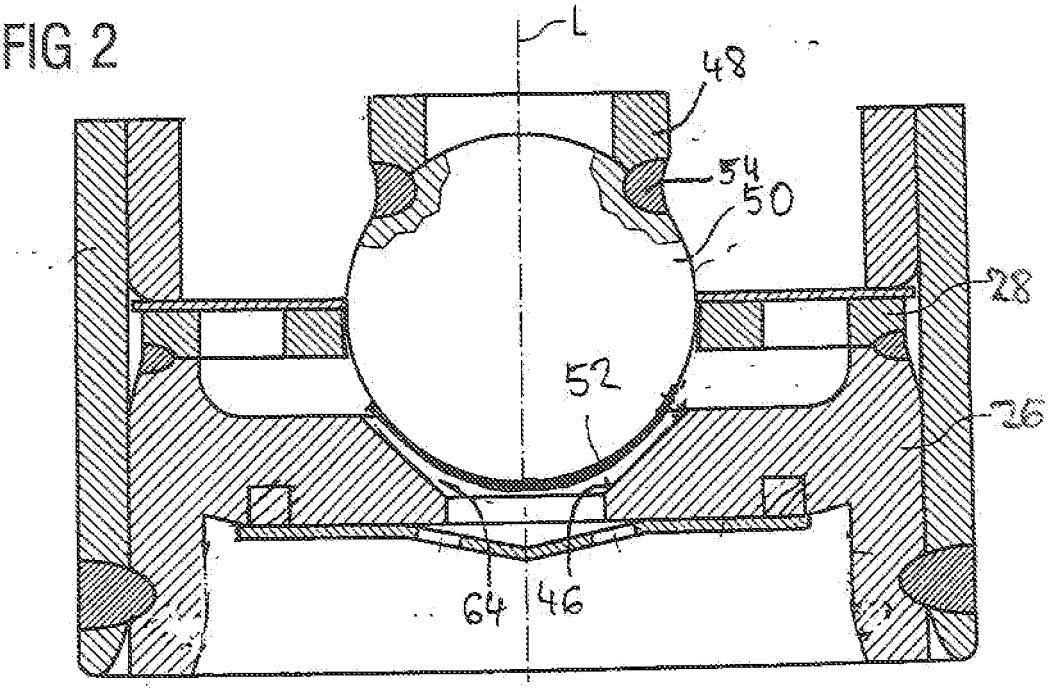


FIG 2



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EUROPEAN SEARCH REPORT

Application Number
EP 10 18 6580

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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	11 March 2011	Landriscina, V

CATEGORY OF CITED DOCUMENTS

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