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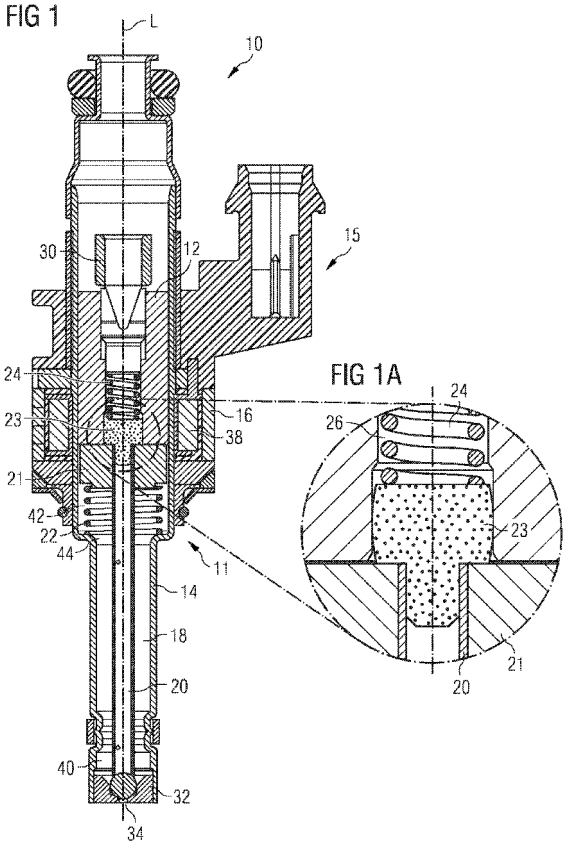
(54) Valve assembly for an injection valve and injection valve

(57) The invention concerns a valve assembly (11) 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 (42) and a fluid outlet portion (40), a valve needle (20) axially movable in the cavity (18), the valve needle (20) preventing a fluid flow through the fluid outlet portion (40) in a closing position and releasing the fluid flow through the fluid outlet portion (40) in at least one further position, an upper retainer (23) being arranged in the cavity (18) and being fixedly coupled to the valve needle (20), and an actuator unit (36) being designed to actuate the valve needle (20), the actuator unit (36) especially being an electro-magnetic actuator unit (36) comprising an armature (21), which is arranged in the cavity (18) and which is axially movable relative to the valve needle (20), the armature (21) being designed to be coupled to the upper retainer (23) when the valve needle (20) is actuated to leave the closing position, and wherein the upper retainer (23) is a sintered material.

FIG 1



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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, for example, be an electromagnetic actuator or piezo electric 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. Already in the near future, need will arise to operate internal combustion engines at still higher fuel pressure values. On the other hand, it is important to provide the engines with different amounts of fuel at different operating conditions. Especially the minimum amount of fuel necessary for operating an engine at idle running conditions will decrease in the future in order to reduce unwanted emissions.

[0005] The object of the invention is to create a valve assembly for an injection valve and an injection valve which facilitate a reliable and precise function under almost each of a lot of different operating conditions, when being operated in an internal combustion engine.

[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, a valve needle axially movable 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 at least one further position, an upper retainer being arranged in the cavity and being fixedly coupled to the valve needle, and an actuator unit being designed to actuate the valve needle, the actuator unit especially being an electro-magnetic actuator unit comprising an armature, which is arranged in the cavity and which is axially movable relative to the valve needle, the armature being designed to be coupled to the upper retainer when the valve needle is actuated to leave the closing position, wherein the upper retainer is made of a sintered material.

[0008] With traditional valve assemblies comprising an upper retainer the upper retainer is made of stainless steel. This has the advantage that the material of the upper retainer is of high resistance against aggressive fuel. However, it has the disadvantage, that in the course of time, when running the valve assembly, there occur wearing effects in the area between the upper retainer and the armature due to the high impact force of the armature, when hitting the upper retainer. During field application of the respective injection valve these wearing effects lead to a static flow drift, which impairs the quality of the combustion process. And in addition sticking phenomena occur between the impact faces of the armature and of the inlet tube.

[0009] In order to overcome these disadvantages, in the past the hardness of the upper retainer was increased by applying special hardening processes. However, this was only possible by using specialized materials for the upper retainer, which are expensive, and by applying additional steps in the production process. Further on, the upper retainer had to be provided with special geometries in order to increase the fluid flux of the fuel, and thereby to minimize the sticking phenomena.

[0010] However, these disadvantages can be overcome by replacing the stainless steel material by sintered material like ceramic, metal, or plastic: sintered material is cheaper than stainless steel; the step of specifically hardening the upper retainer can be omitted, because sintered material is originally provided with a very good hardness, which is greater than the hardness of stainless steel; additionally, with sintered materials said sticking phenomena do not arise.

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

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

Figures 1, 2: different embodiments of injection valves with a valve assembly in a longitudinal section view, and

Figure 1A: an enlarged detail of the embodiment of Fig. 1.

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

[0014] An injection valve 10 that is in particular suitable for dosing fuel to an internal combustion engine is shown in Fig. 1 in a longitudinal section view. It comprises in particular a valve assembly 11.

[0015] The valve assembly 11 comprises a valve body 14 with a central longitudinal axis L and a housing 16. The housing 16 is partially arranged around the valve

body 14. A cavity 18 is arranged in the valve body 14.

[0016] The cavity 18 takes in a valve needle 20, which is hollow, an upper retainer 23, and an armature 21. According to the invention, the upper retainer 23 is made of a sintered material. This sintered material may be a ceramic material, a plastic material or a metallic material. It is fixedly coupled to the valve needle 20, for example by means of press fitting and/or gluing. As sintered material is generally of a great hardness, the disadvantage of static flow drift, caused by wearing effects, cannot occur, as such wearing effects are avoided by using sintered material. Sintered material is a porous material, what is known generally. Accordingly, in the embodiment of Fig. 1 the upper retainer 23 is made in the form of a solid body. Due to this porosity the fuel can pass through the upper retainer 23 into the valve needle 20 thereby avoiding the occurrence of said sticking phenomena, when the fuel reaches the armature impact face of the upper retainer 23.

[0017] The armature 21 is axially movable in the cavity 18, relative to the valve needle 20. The armature 21 is decoupled from the valve needle 20 in axial direction. A main spring 24 is arranged in a recess 26 provided in the inlet tube 12. The main spring 24 is mechanically coupled to the upper retainer 23. The upper retainer 23 is fixedly coupled to the valve needle 20, and it can guide the valve needle 20 in axial and radial direction inside the inlet tube 12.

[0018] A filter element 30 is arranged in the inlet tube 12 and forms a further seat for the main spring 24. During the manufacturing process of the injection valve 10 the filter element 30 can be axially moved in the inlet tube 12 in order to preload the main spring 24 in a desired manner. By this the main spring 24 exerts a force on the valve needle 20 towards an injection nozzle 34 of the injection valve 10.

[0019] In a closing position of the valve needle 20 it sealingly rests on a seat plate 32 by this preventing a fluid flow through the at least one injection nozzle 34. The injection nozzle 34 may be, for example, an injection hole. However, it may also be of some other type suitable for dosing fluid.

[0020] The valve assembly 11 is provided with an actuator unit 36 that is preferably an electro-magnetic actuator. The electro-magnetic actuator unit 36 comprises a coil 38, which is preferably arranged inside the housing 16. Furthermore, the electro-magnetic actuator unit 36 comprises the armature 21. The housing 16, the inlet tube 12, the valve body 14, and the armature 21 are forming an electromagnetic circuit. The actuator unit 36 is electrically energized by a connection means 15, which, in turn, may be coupled to an external plug connector.

[0021] The armature 21 is designed to be coupled to the upper retainer 23 when the valve needle 20 is actuated to leave the closing position, and it is designed to be decoupled from the upper retainer when the valve needle 20 is actuated to move to the closing position.

[0022] The cavity 18 comprises a fluid outlet portion 40 which is arranged near the seat plate 32. The fluid outlet portion 40 communicates with a fluid inlet portion 42 which is provided in the valve body 14.

[0023] Below the armature 21, in the direction towards the fluid outlet portion 40, there is arranged an anti-bounce means 22 in the form of an anti-bounce spring. It is fixedly coupled to the valve body 14. Fixing may be achieved, for example, by welding to an inner surface of the valve body 14 in the area of the fluid inlet portion 42 or by providing a step 44 at the fluid inlet portion 42 and coupling the anti-bounce means 22 to said step 44.

[0024] Fig. 1A shows the main spring 24, the upper retainer 23, the armature 21, and the tubular valve needle 20 of the embodiment of Fig. 1 in more detail.

[0025] Fig. 2 shows another embodiment of the injection valve. With this embodiment the upper retainer 23 is made in the form of a guide bush, arranged like a collar around the valve needle 20, and the anti-bounce means 22 is made in the form of a permanent magnet. This permanent magnet is fixedly coupled to the valve body 14. Fixing may be achieved, for example, by welding to an inner surface of the valve body 14 in the area of the fluid inlet portion 42 or by providing a step 44 at the fluid inlet portion 42 and coupling the permanent magnet to said step 44.

Claims

1. Valve assembly (11) 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 (42) and a fluid outlet portion (40),
   - a valve needle (20) axially movable in the cavity (18), the valve needle (20) preventing a fluid flow through the fluid outlet portion (40) in a closing position and releasing the fluid flow through the fluid outlet portion (40) in at least one further position,
   - an upper retainer (23) being arranged in the cavity (18) and being fixedly coupled to the valve needle (20), and
   - an actuator unit (36) being designed to actuate the valve needle (20), the actuator unit (36) especially being an electro-magnetic actuator unit (36) comprising an armature (21), which is arranged in the cavity (18) and which is axially movable relative to the valve needle (20), the armature (21) being designed to be coupled to the upper retainer (23) when the valve needle (20) is actuated to leave the closing position,
   wherein the upper retainer (23) is a sintered material.

2. Valve assembly (11) according to claim 1, wherein

the sintered material is a ceramic, metal or plastic material.

3. Valve assembly (11) according to claim 1 or 2, wherein the upper retainer (23) is in the form of a guide bush.

4. Valve assembly (11) according to claim 1 or 2, wherein the upper retainer (23) is in the form of a solid body.

5. Injection valve (10) with a valve assembly (11) according to one of the preceding claims.

FIG 1

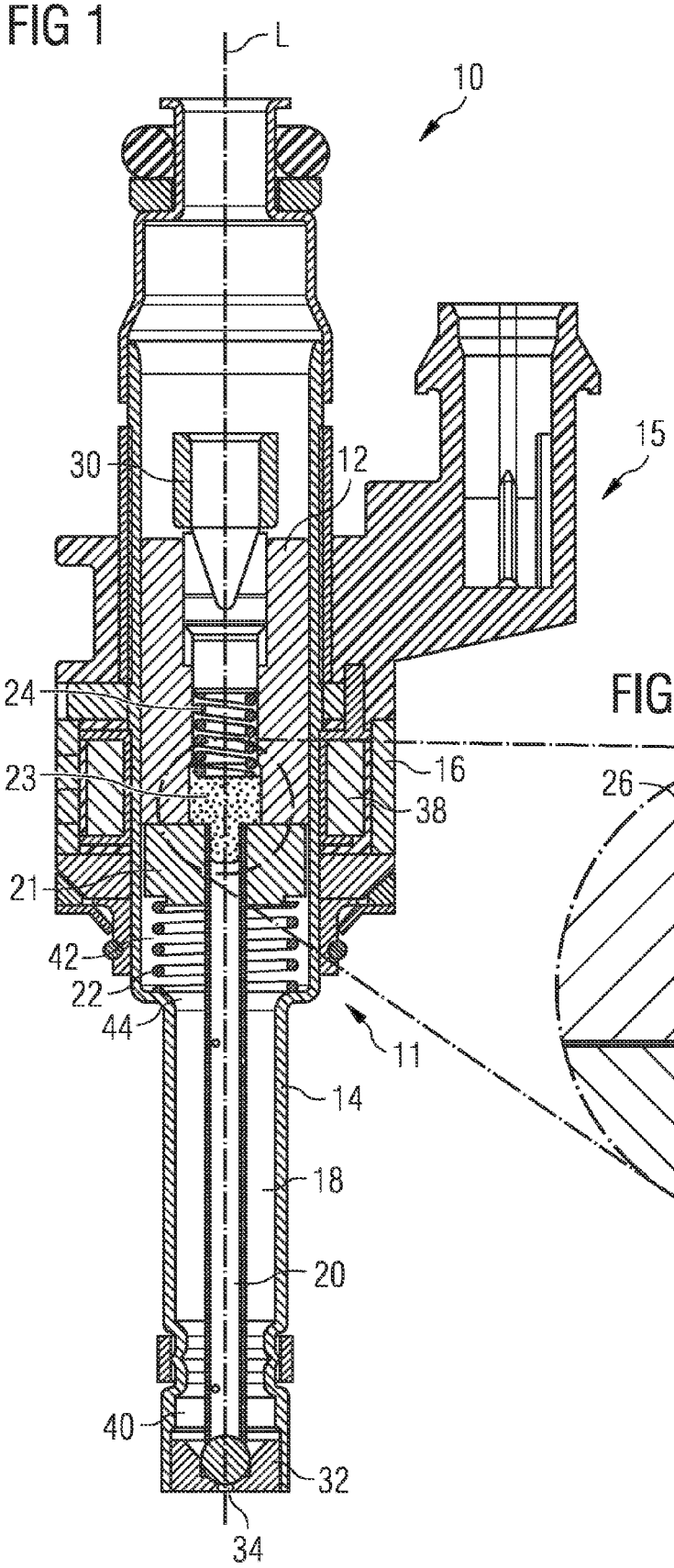


FIG 1A

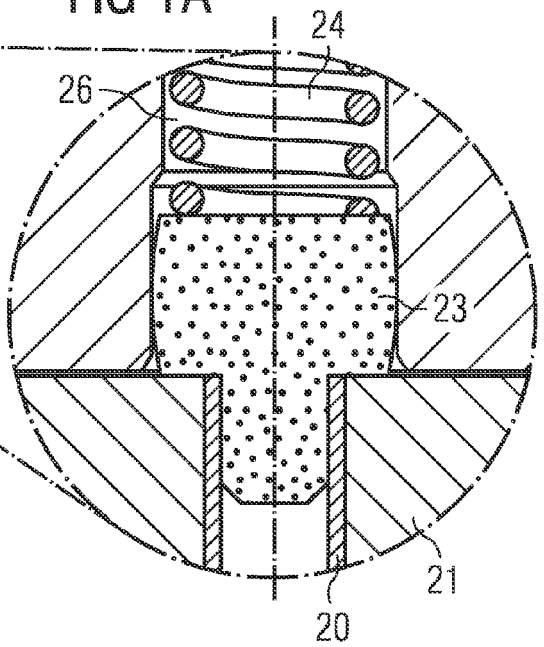
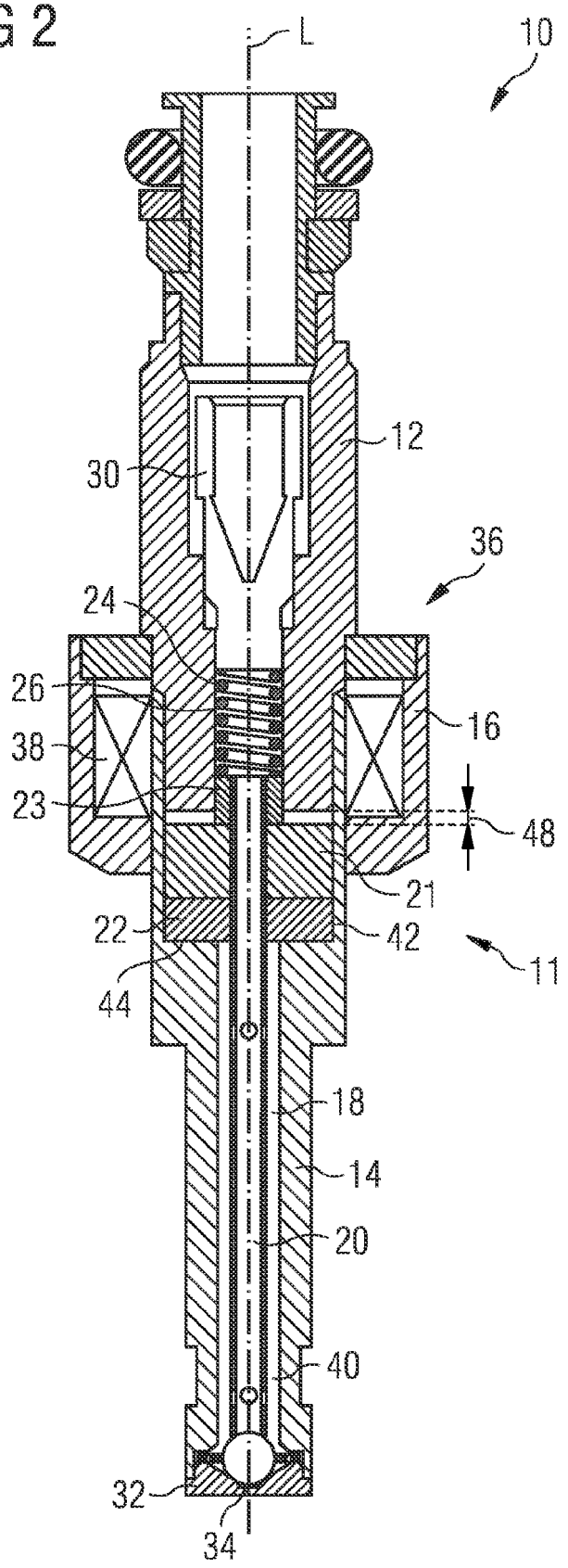


FIG 2



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EUROPEAN SEARCH REPORT

Application Number
EP 10 19 4884

DOCUMENTS CONSIDERED TO BE RELEVANT

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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	19 April 2011	Etschmann, Georg

CATEGORY OF CITED DOCUMENTS

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