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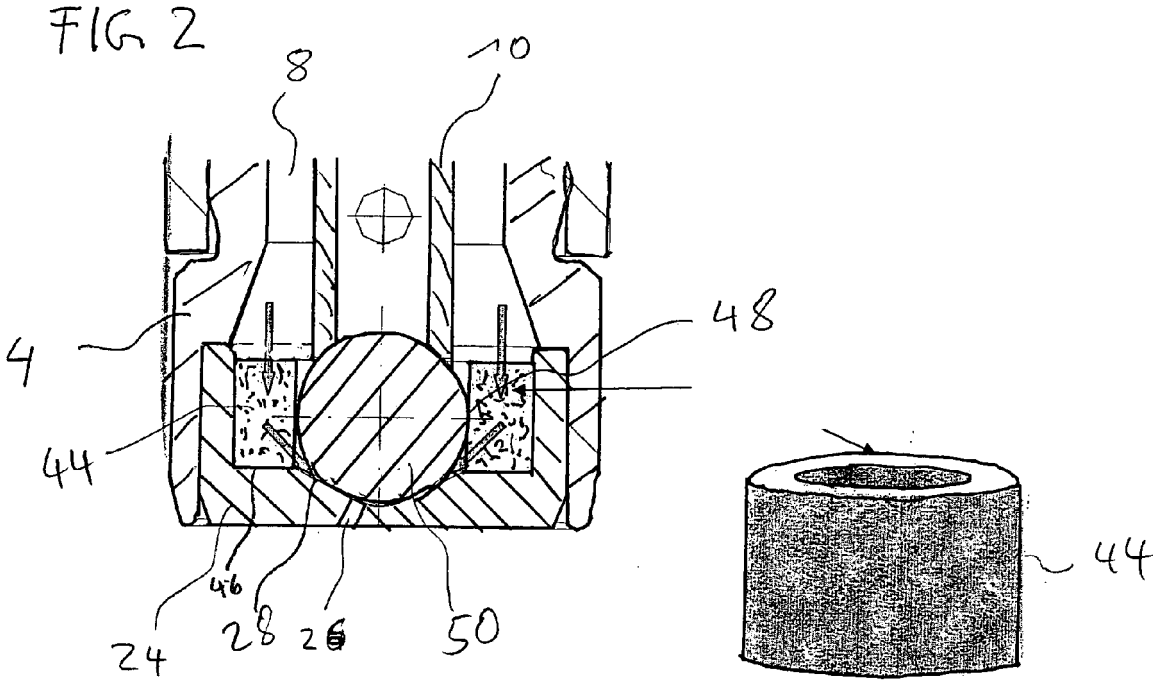
(71) Applicant: **Continental Automotive GmbH**
30165 Hannover (DE)

(72) Inventors:
- **Romeo, Ileana**
  58100 Grossetto (GR) (IT)
- **Lenzi, Francesco**
  57128 Livorno (IT)
- **Soriani, Matteo**
  57121 Livorno (IT)
- **Grandi, Mauro**
  57100 Livorno (IT)

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

(57) An injection valve comprises a valve assembly. The valve assembly (4) includes a central longitudinal axis. The valve body (4) comprises a cavity (8) and a fluid outlet portion (24) abutting the cavity (8). A valve needle (10) is axially moveable in the cavity (8) and prevents a fluid flow through the fluid outlet portion (24) in a closing position and releases the fluid flow through the fluid outlet portion (24) in further positions. A guide element (44) is designed to guide the valve needle (10) in the cavity and is further designed to filter fluid flowing in the cavity towards the fluid outlet portion (24).



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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.

[0005] The object underlying the invention is to create a valve assembly for an injection valve which contributes to a reliable and precise function of the valve assembly.

[0006] The object is achieved by the features of the independent claim. Advantageous embodiments of the invention are given in the dependent claims.

[0007] The invention is distinguished by a valve assembly for an injection valve. The valve assembly comprises a valve body including a central longitudinal axis. The valve body comprises a cavity and a fluid outlet portion abutting the cavity. The valve assembly further comprises a valve needle, which is axially moveable in the cavity and prevents a fluid flow through the fluid outlet portion in a closing position and releases the fluid flow through the fluid outlet portion in further positions. A guide element is designed to guide the valve needle in the cavity and is further designed to filter fluid flowing in the cavity towards the outlet portion. In this way the guide element realizes a double function which is, on the one hand, to guide the valve needle and, on the other hand, to filter the fluid flowing in the cavity towards the outlet portion. This enables a very compact and simple arrangement of the valve assembly and also contributes to prevent particles from getting stuck between the valve needle and the fluid outlet portion which may lead to the valve needle not being able to fully reach the closing position and in this way may lead to unwanted dosing of fluid and, in particular imprecise dosing of fluid.

[0008] In particular, the guide element may comprise a guiding portion and a filter, which are formed as a one-piece element.

[0009] An advantageous embodiment of a needle comprises a ball at its axial end towards the outlet portion and the guide element is designed to guide the ball. In this way a very reliable guide function at the axial end area of the valve needle may be accomplished and the valve needle may be manufactured in a simple way.

[0010] In a further advantageous embodiment the guide element comprises porous material forming a filter. In this way the filter may be manufactured in a very simple way and its properties can easily be adjusted in the desired way to achieve the expected filter function. In this way the porosity of the porous material provides the filter function and may, in particular, be adjusted in the desired way during the manufacturing process.

[0011] According to a further advantageous embodiment the guide element comprises a sintered material. This enables to form the guide element in a very simple way and to reliably give it the properties desired.

[0012] According to another advantageous embodiment the guide element comprises steel, in particular stainless steel. In this way the guide element is reliably resistant against aggressive fluids. For example fuel represents such an aggressive fluid. In this way a reliable operation of the valve assembly over a long time of operation may be achieved.

[0013] According to a further advantageous embodiment the porous material has a porosity such that particles flowing in the fluid towards the porous material which have at least a maximum extension around an axial lift of the valve needle get filtered out. In this way the valve needle may be efficiently prevented from getting stuck open due to a particle being stuck between the valve needle and the fluid outlet portion. Without the filtering particles with a maximum extension of at least around the axial lift of the valve needle may get stuck between the valve needle and the outlet portion and may not be able to be washed away by the fluid flowing in this area. Therefore, such a situation may be avoided efficiently in the valve assembly in this way and at the same time smaller particles may be passed and will be washed out of the fluid outlet portion and therefore do not get stuck in the filter.

[0014] In this respect it is particularly advantageous, if the maximum extension is around 60 μm.

[0015] According to a further advantageous embodiment the guide portion of the guide element is grinded or hardened. In this way a very precise finish of the guide portion may be achieved and a very reliable guide function may be accomplished. In addition to that, sintered material may also be applied in the guide portion, thus also achieving a good guiding function. The hardening may be achieved during the manufacturing process, e.g. by a tempering process.

[0016] According to a further advantageous embodiment the guide element comprises a bush being designed and arranged to couple the guide element with the valve body. In this way the guide element may be very reliably inserted in the valve body during the man-

ufacturing process. In particular if the bush is designed and arranged to couple the guide element with the valve body, the bush contributes to a very precise coupling of the guide element with the valve body.

[0017] The invention is further distinguished by an injection valve with the valve assembly, in particular also according to one of the advantageous embodiments.

[0018] 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 with a valve assembly in a longitudinal section view,

Figure 2 an enlargement of a lower part of the valve assembly according to Figure 1 in a first embodiment, and

Figure 3 an enlargement of a lower part of the valve assembly according to Figure 1 in a second embodiment.

[0019] Elements of the same design and function that appear in different illustrations are identified by the same reference character.

[0020] An injection valve 1 (Figure 1) is, in particular, suitable for dosing a fluid, in particular fuel and that in particular to an internal combustion engine. The injection valve 1 comprises an inlet tube 2, a housing 6 and a valve assembly 3.

[0021] The valve assembly 3 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.

[0022] In the inlet tube 2 a recess 16 of the inlet tube 2 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. The spring 14 rests on a spring seat being 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 1 in order to preload the spring 14 in a desired way.

[0023] The valve body 4 further comprises a fluid outlet portion 24 (Figure 2). The fluid outlet portion 24 may be formed as a separate part or alternatively integral with further parts of the valve body 4. A seat area 28 is formed on a surface of the fluid outlet portion 24. In addition to that an injection nozzle 26 and preferably multiple injection nozzles 26 are formed in the fluid outlet portion 24 downstream of a fluid path of the fluid from the seat area 28.

[0024] In a closing position of the valve needle 10 it sealingly rests on the fluid outlet portion 24 at the seat area 28 and by this prevents a fluid flow through the injection nozzle 26.

[0025] The injection nozzle 26 may be, for example, an injection hole. However, it may also be of some other form or type suitable for dosing a fluid. In particular, the fluid outlet portion may alternatively also be formed in a way that the fluid dosing is achieved by an outward opening valve needle 10.

[0026] The injection valve 1 is provided with an actuator unit, which preferably comprises an electromagnetic actuator. The electromagnetic actuator comprises a coil 36, which is preferably overmolded. A valve body shell 38, the armature 12 and the inlet tube 2 are preferably forming an electromagnetic circuit. The actuator unit may, however, also comprise another type of actuator which is known to the person skilled in the art for such a purpose, e.g. a solid state actuator, in particular a piezoelectric actuator.

[0027] A fluid inlet portion 42 is provided in the valve body 4 which communicates with the fluid outlet portion 24.

[0028] A guide element 44 (Figure 2) is provided, which may be located in the recess 8 proximate to the fluid outlet portion 24. Preferably the fluid outlet portion 24 comprises a protrusion 46 on which the guide element 44 rests in axial direction. The guide element 44 is located in the recess 8 in such a way that it is located upstream of the fluid path from the seat area 28. Therefore, it may alternatively also be located at some point in the recess 8 more axially distant to the seat area 28 other than that shown in Figure 2. The guide element 44 is designed to guide the valve needle 10 when it moves in axial direction. It preferably forms a lower guide for valve needle 10.

[0029] The valve needle 10 according to the embodiment in Figure 2, for example, comprises a ball 50 at its axial end area towards the fluid outlet portion 24. The guide element 44 is, for example, cylinder ring type shaped and comprises a guide portion 48 which is designed to guide the valve needle 10. For example it may be designed to guide the valve needle's ball 50 in its axial movement. The guide portion 48 may be grinded and/or hardened. The hardening may, for example, be achieved by a tempering process during the manufacturing of the guide element 44. The guide element 44 is further designed to filter fluid flowing through the cavity 8 towards the fluid outlet portion 24. Therefore the guide element 44 comprises the function of a filter for the fluid and the function of guiding the valve needle 10. In particular, a guide portion 48 may be formed in one piece together with the filter of the guide element 44.

[0030] The guide element 44 may comprise porous material forming the filter to filter fluid flowing in the recess 8. In particular, the degree of porosity of the material is responsible for the filtering characteristic of the guide element 44. Preferably the guide element in this respect comprises a sintered material. Preferably during the sintering process a pressure applied to the material to be sintered is applied in such a way as to control the density of the components in a given way and in this way to achieve the intended porosity in order to achieve the de-

sired filter characteristic.

[0031] Preferably the guide element comprises steel or consists of steel. In particular stainless steel is preferred. Steel, in particular stainless steel, is well suited for sintering and forming porous material.

[0032] Preferably the porous material has a porosity such that particles flowing with the fluid towards the porous material get filtered out, which have a least a maximum extension around an axial lift of the valve needle 10. The axial lift is the maximum movement of the valve needle 10 away from its closing position where it sealingly rests on the seat area 28.

[0033] In the arrangement of the injection valve according to Figure 1 the lift is approximately around 60 μm and therefore the particles to be filtered out have at least a maximum extension around 60 μm.

[0034] In a further embodiment (Figure 3) the guide element comprises a bush 52, in particular at its outer radial end and possibly at its end towards the protrusion 46. The bush 52 may also comprise steel, in particular, stainless steel that may have a different porosity, in particular a lower porosity than other parts of the guide element. It may have in particular, a significantly lower porosity, in particular a porosity of zero. It may also be manufactured in another way, e.g. not by a sintering process. The bush serves to mechanically couple the guide element to the valve body 4, in particular with the outlet portion 24.

[0035] Preferably, the guide element 44 is welded and/or press fitted to the valve body 4 in the area of its upper end in Figure 2 or respectively Figure 3.

[0036] In the following, the function of the injection valve 10 is described in further detail:

> The fluid is led from the fluid inlet portion 42 to the fluid outlet portion 24. The axial position of the valve needle 10, which determines whether the fluid outlet portion 24 is provided with a fluid flow, depends on the force balance between the forces provided by spring 14, the forces applied to the valve needle 10 by the actuator unit and in addition on hydraulic forces resulting from the pressure of the fluid being applied on the valve needle 10.

[0037] The valve needle 10 may be designed in a way that at least partly along its axial extension the fluid may flow through the valve needle and, at some point towards the outlet portion 24, exits the valve needle 10 and flows into the cavity 8 which takes place upstream in the flow path of the location of the guide element 44. The fluid flowing in the flow path then subsequently passes through the guide element 44 and therefore becomes filtered. After passing the guide element 44 it reaches the seat area 28. If the valve needle 10 is out of its closing position, then the fluid passes the seat area 28 and exits the injection valve 1 in the fluid outlet portion 24, preferably via the injection nozzles 26.

Claims

1. Valve assembly (3) for an injection valve (1), comprising

   - a valve body (4) including a central longitudinal axis (L), the valve body (4) comprising a cavity (8) and a fluid outlet portion (24) abutting the cavity (8),
   - a valve needle (10) axially movable in the cavity (8), the valve needle (10) preventing a fluid flow through the fluid outlet portion (24) in a closing position and releasing the fluid flow through the fluid outlet portion (24) in further positions, and
   - a guide element (44) being designed to guide the valve needle (10) in the cavity (8) and being further designed to filter a fluid flowing in the cavity (8) towards the fluid outlet portion (24).

2. Valve assembly according to claim 1, with the valve needle (10) comprising a ball (50) at its axial end towards the fluid outlet portion (24) and with the guide element (44) being designed to guide the ball (50).

3. Valve assembly (3) according to one of the previous claims with the guide element (44) comprising porous material forming a filter.

4. Valve assembly (3), with the guide element (44) comprising a sintered material.

5. Valve assembly (3) according to one of the previous claims with the guide element (44) comprising steel, in particular stainless steel.

6. Valve assembly (3), with the porous material having a porosity such that particles flowing with the fluid towards the porous material get filtered out, which have at least a maximum extension around an axial lift of the valve needle (10).

7. A valve assembly (3), according to claim 6, with the maximum extension being around 60 μm.

8. Valve assembly according to one of the previous claims, with a guide portion (48) of the guide element (44) being grinded and/or hardened.

9. Valve assembly (3) according to one of the previous claims with the guide element (44) comprising a bush (52) being designed and arranged to couple the guide element (44) with the valve body (4).

10. Injection valve (1), with a valve assembly (3) according to one of the previous claims.

FIG 1

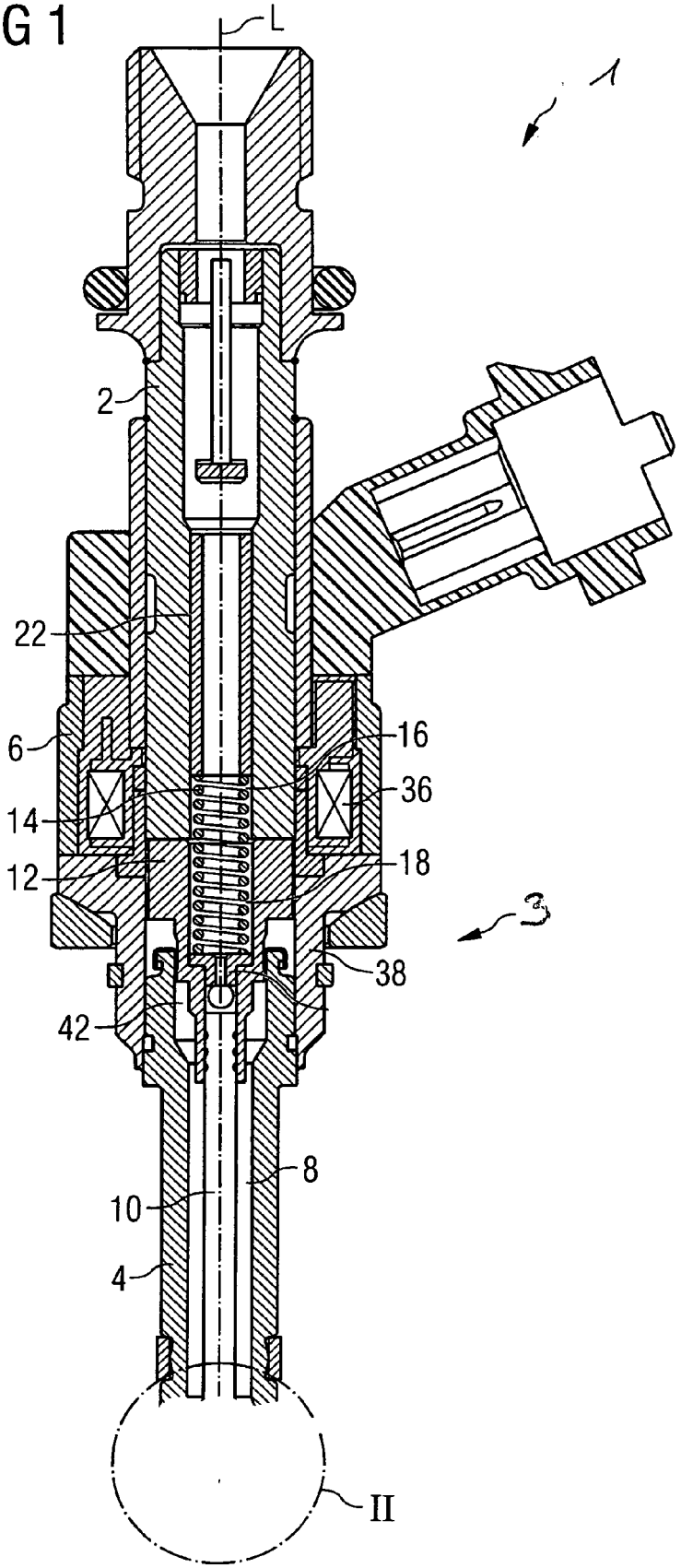


FIG 2

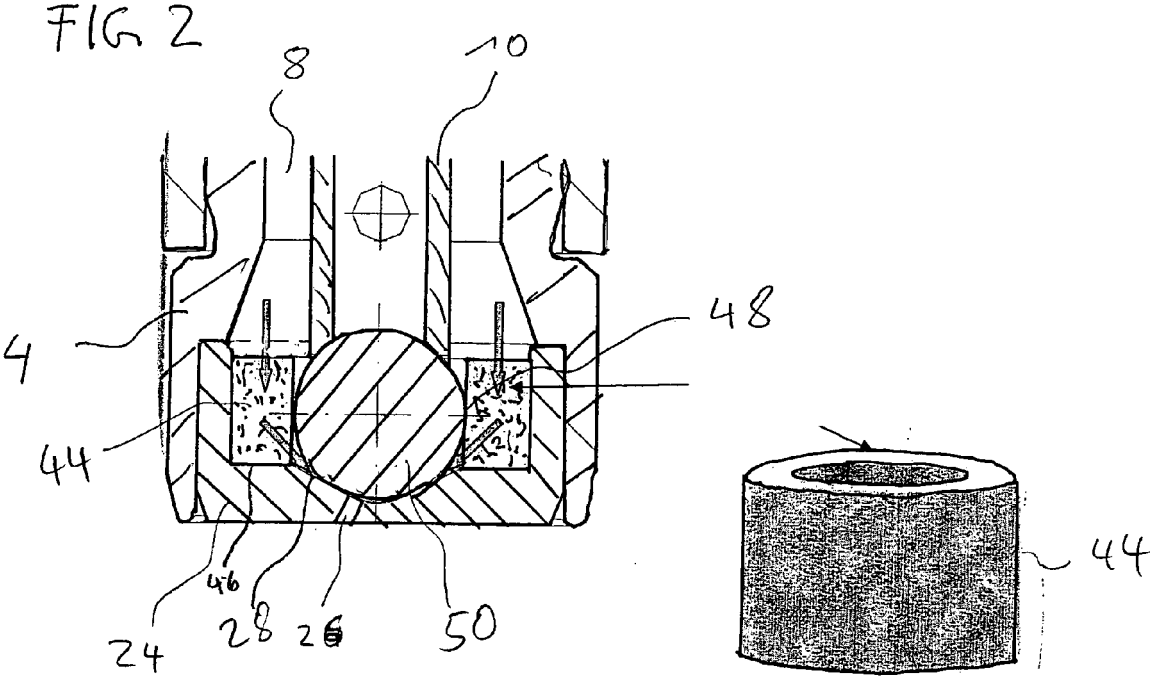
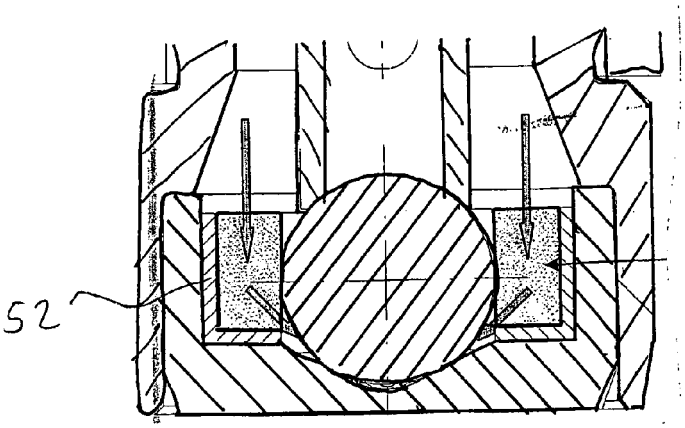


FIG 3



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EUROPEAN SEARCH REPORT

Application Number
EP 10 00 0469

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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	22 June 2010	Etschmann, Georg

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