

(19)



(11)

EP 2 653 711 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

23.10.2013 Bulletin 2013/43

(51) Int Cl.:

F02M 61/16 (2006.01)

(21) Application number: **12164524.6**

(22) Date of filing: **18.04.2012**

(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

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

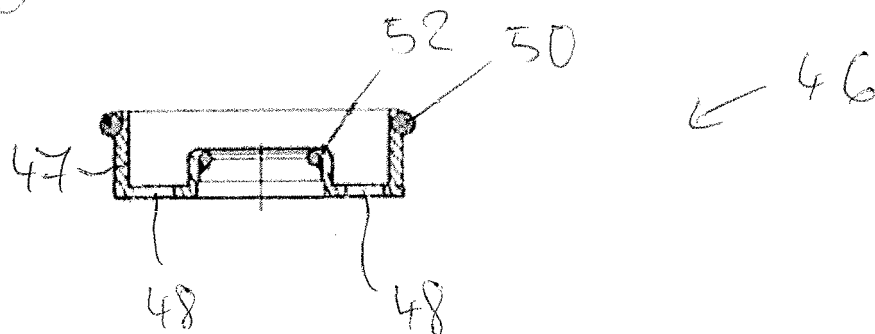
(72) Inventor: **Grandi, Mauro**
57128 Livorno (IT)

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

(57) Valve assembly (80) of an injection valve (82), the valve assembly (80) comprising a valve body (4) including a central longitudinal axis (L), the valve body (4) comprising a cavity (8) forming an inner surface (18) of the valve body (4), the cavity (8) having a fluid inlet portion (42), and a fluid outlet portion (44), a valve needle (10) axially movable in the cavity (8), the valve needle (10) preventing a fluid flow through the fluid outlet portion (44) in a closing position and releasing the fluid flow through

the fluid outlet portion (44) in further positions, and a filter element (46) being arranged in the cavity (8) axially upstream the fluid outlet portion (44) and radially between the inner surface (18) of the valve body (4) and an outer surface (12) of the valve needle (10), the filter element (46) being designed to filter the fluid. At least one sealing element (50, 52) is arranged radially between the filter element (46) and the inner surface (18) of the valve body (4) and/or radially between the filter element (46) and the outer surface (12) of the valve needle (10).

FIG. 3



EP 2 653 711 A1

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 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 are simple to be manufactured and which facilitate a reliable and precise function.

[0006] This object is 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 of an injection valve. The valve assembly comprises a valve body including a central longitudinal axis, the valve body comprising a cavity forming an inner surface of the valve body, the cavity having 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 further positions, and a filter element being arranged in the cavity axially upstream the fluid outlet portion and radially between the inner surface of the valve body and an outer surface of the valve needle, the filter element being designed to filter the fluid. At least one sealing element is arranged radially between the filter element and the inner surface of the valve body and/or radially between the filter element and the outer surface of the valve needle.

[0008] This has the advantage that the filter element is in close contact with the valve body and/or the valve needle. Consequently, a fluid bypass radially between the filter element and the inner surface of the valve body and/or radially between the filter element and the outer surface of the valve needle may be prevented. Consequently, the fluid may completely pass through the filter element. This may result in a high filter efficiency of the

filter element. Consequently, a contamination of the fluid outlet portion, for example with particles, may be avoided. Therefore, a good performance of the injection valve may be obtained. Furthermore, a high life-time of the valve assembly is possible. In an advantageous embodiment of the invention a first sealing element is arranged radially between the filter element and the inner surface of the valve body and a second sealing element is arranged radially between the filter element and the outer surface of the valve needle. This has the advantage that the filter element is in close contact with the valve body as well as with the valve needle, and a fluid bypass between the filter element and the valve body as well as between the filter element and the valve needle may be avoided. Therefore, a very high efficiency of the filter element may be reached.

[0009] In a further advantageous embodiment of the invention at least one of the sealing elements is in one piece with the filter element. This has the advantage that the filter element may be manufactured in a simple manner and that the assembly process of the valve assembly may be carried out easily.

[0010] In a further advantageous embodiment of the invention at least one of the sealing elements comprises an O-ring. This has the advantage that a very secure sealing function may be obtained by adapting the O-ring to the individual valve assembly. Furthermore, the filter element may be in a very close contact with the valve body and/or with the valve needle to avoid a contamination of the fluid outlet portion.

[0011] According to a second aspect the invention is distinguished by an injection valve with an actuator unit and a valve assembly according to the first aspect of the invention. The valve needle is actuable by the actuator unit. The advantages of the second aspect of the invention correspond to the advantages of 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:

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

Figure 2, a longitudinal section view of a first embodiment of a filter element, and

Figure 3, a longitudinal section view of a further embodiment of the filter element.

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

[0014] An injection valve 82 (figure 1) that is in particular suitable for dosing fuel to an internal combustion engine comprises a valve assembly 80.

[0015] The valve assembly 80 comprises an inlet tube 2. Furthermore, the valve assembly 80 comprises a valve

body 4. The valve body 4 has a central longitudinal axis L and a cavity 8. The cavity 8 takes in a valve needle 10. The valve needle 10 has an outer surface 12. The cavity 8 of the valve body 4 forms an inner surface 18.

[0016] The inlet tube 2 comprises a recess 16. A spring 14 is arranged in the recess 16. Preferably, the spring 14 rests on a spring seat being formed by an anti-bounce disk 20. By this, the spring 14 is mechanically coupled to the valve 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.

[0017] In a closing position of the valve needle 10, it sealingly rests on 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 type suitable for dosing fluid. The seat body 26 may be made in one part with the valve body 4 or be a separate part.

[0018] The injection valve 82 is provided with an actuator unit 30 that comprises preferably an electromagnetic actuator with an armature 32 and a coil 36. The armature 32 is coupled to the valve needle 10. The inlet tube 2, the armature 32 and a housing 38 are forming an electromagnetic circuit.

[0019] The actuator unit 30 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.

[0020] The valve assembly 80 has a fluid inlet portion 42 and a fluid outlet portion 44 which are provided in the valve body 4. The fluid inlet portion 42 communicates with the fluid outlet portion 44 which is part of the cavity 8 and is arranged near the seat body 26.

[0021] A filter element 46 is arranged in the cavity 8 of the valve body 4. The filter element 46 is arranged axially upstream the fluid outlet portion 44. The filter element 46 is situated radially between the inner surface 18 of the valve body 4 and the outer surface 12 of the valve needle 10. The filter element 46 has a frame 47 and a filter part 48. The filter part 48 is arranged inside the frame 47. The filter part 48 has preferably a flat shape as shown in the embodiments of Figures 2 and 3. In further embodiments the filter part 48 may have a block shape for very high filter efficiency. The filter element 46 can filter the fluid flowing to the fluid outlet portion 44. In particular, the filter element 46 is designed as a particle filter.

[0022] A first sealing element 50 is arranged radially between the filter element 46 and the inner surface 18 of the valve body 4. Furthermore, a second sealing element 52 is arranged radially between the filter element 46 and the outer surface 12 of the valve needle 10.

[0023] In the embodiment shown in Figure 2 the sealing elements 50, 52 are in one piece with the filter element 46. In this case the filter element 46 can be manufactured as a one-piece element and may be very easily assembled with valve body 4.

bled with valve body 4.

[0024] In the embodiment shown in Figure 3 the sealing elements 50, 52 comprise an O-ring. In this case the sealing of the filter element 46 may be carried out very securely. Furthermore, individual O-rings for the valve assembly may be selected to enable a very secure sealing of the filter element 46. As the O-rings may be carried out with a very high elasticity the filter element 46 may be in a very close contact with the valve body 4 and the valve needle 10 to avoid a contamination of the fluid outlet portion 44.

[0025] In the following, the function of the injection valve is described in detail:

The fluid is led from the recess 16 of the inlet tube 2 to the fluid inlet portion 42 and further to the fluid outlet portion 44.

The spring 14 forces the valve needle 10 via the anti-bounce disk 20 towards the actuator unit 30. In the case when the actuator unit 30 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 30 and the force on the valve needle 10 caused by the spring 14 whether the valve needle 10 is in its closing position or not.

[0026] In the closing position the valve needle 10 sealingly rests on the seat body 26 and consequently a fluid flow through the fluid outlet portion 44 and the injection nozzle 24 is prevented.

[0027] In the case that the actuator unit 30 gets energized, the actuator unit 30 may exert 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, there is a gap between the seat body 26 and the valve needle 10 which enables a fluid flow through the filter element 46 and further through the fluid outlet portion 44 and the injection nozzle 24.

[0028] The filter element 46 may prevent that particles reach the fluid outlet portion 44 and block the fluid flow through the injection nozzle 24.

[0029] Due to the sealing elements 50, 52 the filter element 46 may be tightly coupled to the valve body 4 and the valve needle 10. Therefore, fluid may pass completely through the filter element 46. A bypass of fluid between the filter element 46 and the valve body 4 or between the filter element 4 and the valve needle 10 may be avoided. Therefore, a very high amount of particles may be filtered by the filter element 46 and, consequently, a contamination of the fluid outlet portion 44 and the injection nozzle 24 with particles may be avoided.

Claims

1. Valve assembly (80) of an injection valve (82), the valve assembly (80) comprising
 - a valve body (4) including a central longitudinal axis (L), the valve body (4) comprising a cavity (8) forming an inner surface (18) of the valve body (4), the cavity (8) having a fluid inlet portion (42) and a fluid outlet portion (44),
 - a valve needle (10) axially movable in the cavity (8), the valve needle (10) preventing a fluid flow through the fluid outlet portion (44) in a closing position and releasing the fluid flow through the fluid outlet portion (44) in further positions, and
 - a filter element (46) being arranged in the cavity (8) axially upstream the fluid outlet portion (44) and radially between the inner surface (18) of the valve body (4) and an outer surface (12) of the valve needle (10), the filter element (46) being designed to filter the fluid, wherein at least one sealing element (50, 52) is arranged radially between the filter element (46) and the inner surface (18) of the valve body (4) and/or radially between the filter element (46) and the outer surface (12) of the valve needle (10).
2. Valve assembly (80) in accordance with claim 1, wherein a first sealing element (50) is arranged radially between the filter element (46) and the inner surface (18) of the valve body (4) and a second sealing element (52) is arranged radially between the filter element (46) and the outer surface (12) of the valve needle (10) .
3. Valve assembly (80) in accordance with claim 1 or 2, wherein at least one of the sealing elements (50, 52) is in one piece with the filter element (46).
4. Valve assembly (80) in accordance with claim 1 or 2, wherein at least one of the sealing elements (50, 52) comprises an O-ring.
5. Injection valve (82) with an actuator unit (30) and a valve assembly (80) according to one of the preceding claims, wherein the valve needle (10) is actuable by the actuator unit (30).

50

55

FIG 1

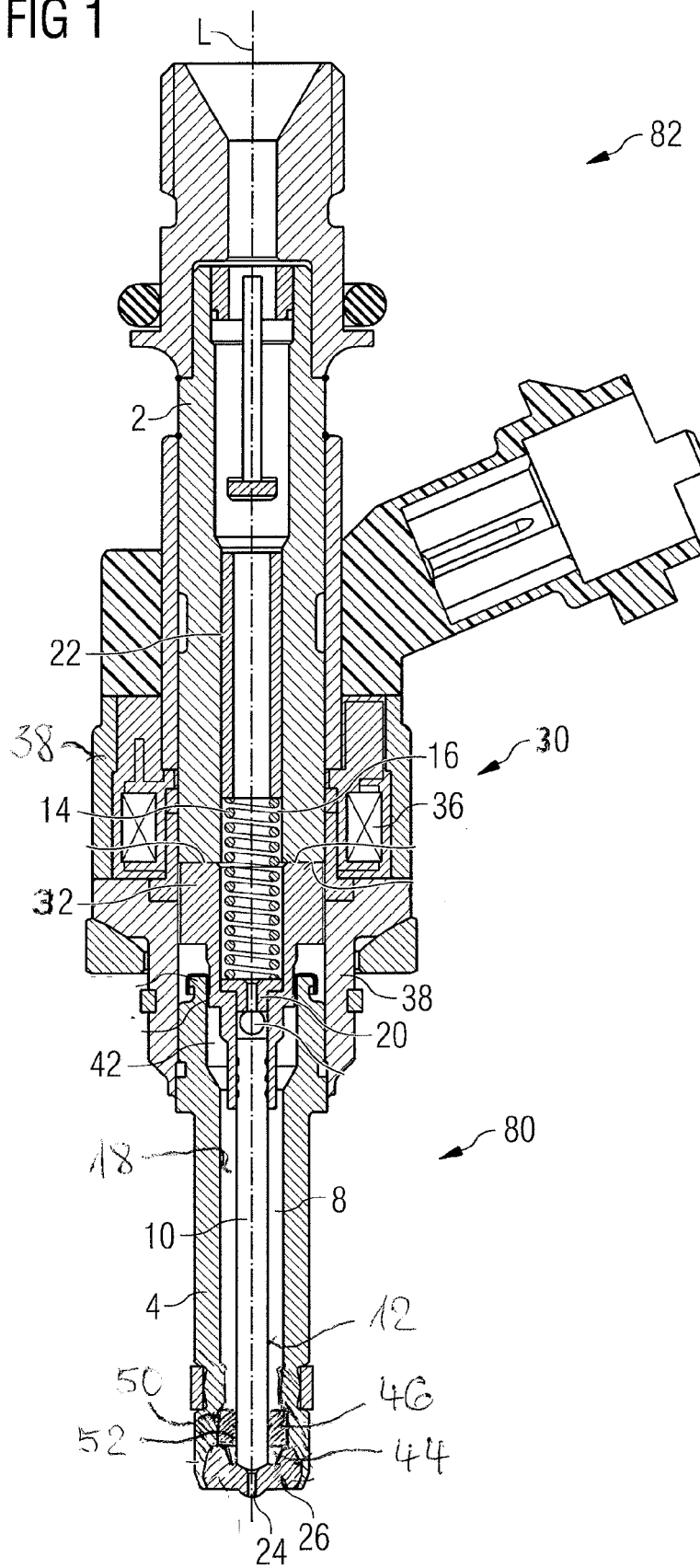


FIG. 2

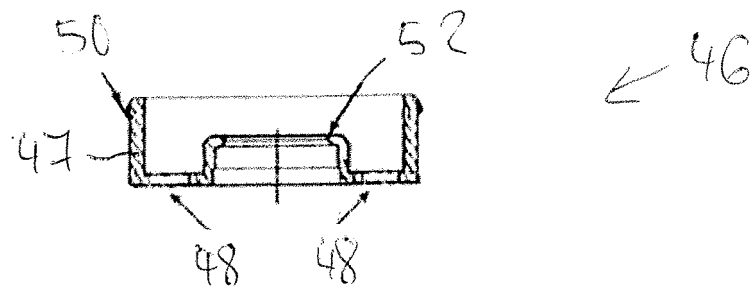
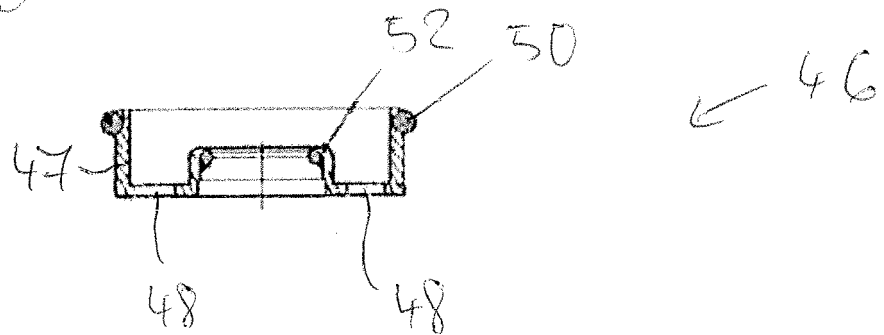


FIG. 3





EUROPEAN SEARCH REPORT

Application Number
EP 12 16 4524

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	WO 93/18299 A1 (SIEMENS AUTOMOTIVE LP [US]) 16 September 1993 (1993-09-16) * page 3, line 13 - page 5, line 20; figures 1-3 *	1-5	INV. F02M61/16
X	EP 2 060 777 A1 (DELPHI TECH INC [US]) 20 May 2009 (2009-05-20) * column 3, paragraph 0013; figures 1,4 * * column 4, paragraph 0018 *	1-5	
X	US 2011/006136 A1 (FLYNN VICKI A [US] ET AL) 13 January 2011 (2011-01-13) * abstract; figures 1-6 *	1,2,4,5	
A	EP 2 354 531 A1 (CONTINENTAL AUTOMOTIVE GMBH [DE]) 10 August 2011 (2011-08-10) * abstract; figure 2 *	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			F02M
Place of search		Date of completion of the search	Examiner
Munich		18 September 2012	Etschmann, Georg
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

1
EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 16 4524

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

18-09-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9318299 A1	16-09-1993	DE 69306766 D1	30-01-1997
		DE 69306766 T2	28-05-1997
		EP 0629266 A1	21-12-1994
		US 5423489 A	13-06-1995
		WO 9318299 A1	16-09-1993

EP 2060777 A1	20-05-2009	EP 2060777 A1	20-05-2009
		US 2009121049 A1	14-05-2009

US 2011006136 A1	13-01-2011	NONE	

EP 2354531 A1	10-08-2011	NONE	
