



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.10.2012 Bulletin 2012/42

(51) Int Cl.:
F02M 51/06 ^(2006.01) **F02M 63/00** ^(2006.01)

(21) Application number: **11162447.4**

(22) Date of filing: **14.04.2011**

(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

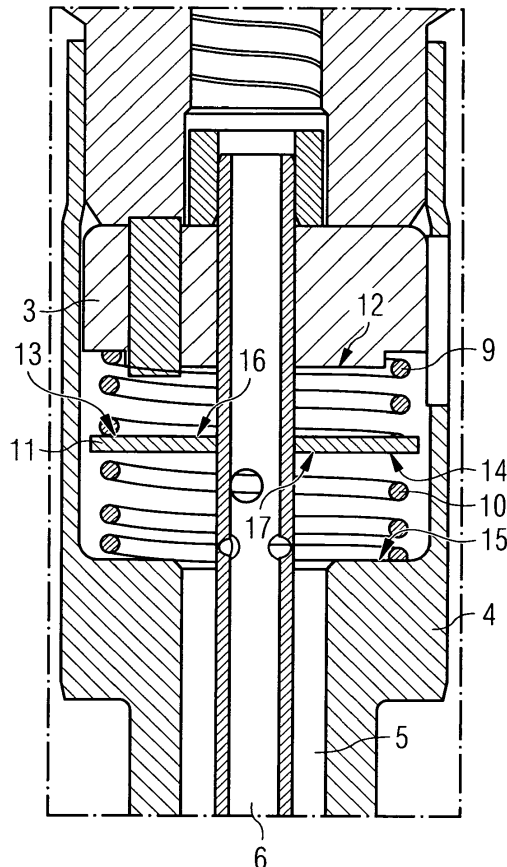
(72) Inventors:
• **Giorgetti, Edoardo**
57016, Rosignano Marittimo (LI) (IT)
• **Agresta, Antonio**
56122, Pisa (IT)
• **Gargiulo, Luigi**
56127, Pisa (IT)

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

(54) **Injector for injecting fluid**

(57) An injector for injecting fluid comprises:
- a valve needle (6), being axially moveable and being operable to prevent a fluid injection in a closing position and to permit the fluid injection in further positions,
- an armature (3) being mechanically coupled to the valve needle (6),
- a valve body (4) that comprises a recess (5) which takes in the valve needle (6),
- a first valve spring (9) that is mechanically coupled to the armature (3) with a first end (12) and mechanically coupled to a damping element (11) with an opposed second end (13);
- a second valve spring (10) that is mechanically coupled to the damping element (11) with a first end (14) and mechanically coupled to the valve body (4) with an opposed second end (15).

FIG 2



Description

[0001] The invention relates to an injector for injecting fluid and relates particularly to an injector for injecting fuel into an internal combustion engine.

[0002] Injection valves are in widespread 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 valve needle of the injection valve, which may, for example, be 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] After a desired injection during the injector closing phase a post injection can occur caused by an injector reopening.

[0006] The object of the invention is to provide an injector for injecting fluid that works reliably.

[0007] According to an aspect, the invention is characterized by an injector for injecting fluid. The injector comprises a longitudinal axis and a valve needle that is axially movable. The valve needle is operable to prevent a fluid injection in a closing position and permits the fluid injection in further positions. The fluid injector further comprises an armature that is mechanically coupled to the valve needle. The injector further comprises a valve body that comprises a recess which takes in the valve needle. The valve needle is axially movable with respect to the valve body.

[0008] The injector further comprises a first valve spring that is mechanically coupled to the armature with a first end and mechanically coupled to a damping element with an opposed second end. The injector further comprises a second valve spring that is mechanically coupled to the damping element with a first end and mechanically coupled to the valve body with an opposed second end. The two valve springs are preloaded for keeping the armature in position.

[0009] The damping element provides a mass damping during closing of the fluid injector. According to further embodiments, the damping element provides a hydraulic damping during closing of the fluid injector. The damping element provides a damping of the valve needle during closing of the fluid injector. Due to the damping applied

by the damping element to the valve needle, a reopening during the injector closing phase is reduced or eliminated. Therefore, the injector works reliably.

[0010] In the following, embodiments of the invention are illustrated with reference to the schematic drawings. Elements of same construction or function are provided with the same reference signs throughout the figures.

Figure 1 schematically shows an injection device according to an embodiment, and

Figure 2 schematically shows a first view of a portion of the injector according to Figure 1.

[0011] Figure 1 shows an injector for injecting a fluid. Particularly, the injector is designed for injecting fuel into a cylinder of an internal combustion engine of, for example, a vehicle and particularly an automobile. The fluid injector has a longitudinal axis L and further comprises a housing 1 and a valve body 4. The valve body 4 has a recess 5 in which a valve needle 6 is arranged axially movable.

[0012] The valve needle 6 comprises a closing element at its downstream end arranged for closing the injector in its closed position inhibiting a fluid flow and for allowing the fluid flow otherwise.

[0013] In the closing position of the fluid injector, the valve needle 6, in particular the closing element, sealingly rests on a seat and prevents in this way a fluid flow through at least one injection nozzle. The injection nozzle may, for example, be an injection hole, it may, however, also be of some other type suitable for dosing fluid. The seat may be made as one part with the valve body 4 or may also be made as a separate part. A fluid injection is permitted, if the valve needle 6 is in further positions.

[0014] The injector further comprises a lifting device with an actuator 8 for moving the valve needle 6 in its axial direction for opening and/or closing the injector. The actuator is preferably a solenoid actuator. The actuator may alternatively be a piezo-actuator.

[0015] The housing 1 and an armature 3 form a magnetic circuit. The magnetic circuit guides a magnetic flux of a magnetic field being generated by the solenoid actuator 8.

[0016] The solenoid actuator 8 comprises at least one coil. The coil is preferably overmolded. The solenoid actuator may comprise more than one coil.

[0017] The actuator 8 is arranged to interact with the armature 3. The armature 3 is mechanically coupled with the valve needle 6. The armature 3 cooperates with the valve needle 6 such that at least part of the lift generated by the actuator 8 with respect to the armature 3 is transferred to the valve needle 6, moving the closing element in its open position in which fluid injection is permitted. A needle closing force is provided by a calibration spring that applies a force to the valve needle 6 in the closing direction.

[0018] According to embodiments, the armature is

temporarily coupled to the valve needle, such that a movement of the armature 11 causes a movement of the valve needle 6 to move in the open position. In a different instant of time the valve needle 6 and the armature 3 can move relative to each other, particularly during the closing phase of the valve needle 6.

[0019] Further, the valve springs 9 and 10 are preloaded during assembly of the injector. The two valve springs 9 and 10 are preloaded and thus, keep the armature in position.

[0020] Figure 2 shows a portion of the injector according to the embodiment of figure 1 in more detail.

[0021] The injector comprises a damping element 11. The damping element 11 is arranged between the armature 3 and the closing element along the axis L. The damping element 11 is arranged within the valve body 4.

[0022] The damping element 11 comprises a disk-shaped form. The damping element 11 comprises an opening in a middle portion through which the valve needle 6 is guided. The outer shape of the damping element 11 is preferably round. The outer shape of the damping element 11 depends on the inner shape of the valve body 4 in the region where the two valve springs 9 and 10 are arranged. The damping element 11 comprises a hollow cylindrical form along the axis L. Across the axis L in the sectional view of figure 2, first there is a portion of the valve body 4, then a portion of the damping element 11, then a portion of the valve needle 6, then a further portion of the damping element 11 and then a further portion of the valve body 4. The damping element 11 is designed such that between the valve body 4 and the damping 11 is a free space. The damping element 11 is designed such that the valve body 4 and the damping 11 have no contact with each other. Further, the damping element 11 is designed such that between the valve needle 6 and the damping 11 is a free space. The damping element 11 is designed such that the valve needle 6 and the damping 11 have no contact with each other. The damping element 11 is kept in position by the two valve springs 9 and 10.

[0023] The first valve spring 9 rests on a spring seat of the armature 14 with a first end 12. The first valve spring rests on the damping element 11 with a second end 13, the second end 13 being opposite the first end 12.

[0024] The second valve spring 10 rests on a spring seat of the damping element 11 with a first end 14 and rests on a spring seat of the valve body 4 with a second end 15, the second end 15 being opposite the first end 14.

[0025] The spring seat of the damping element 11 for the first spring 9 is on a first side 16 of the damping element 11. The spring seat for the second valve spring 10 is on a second side 17 of the damping element 11. The first side 16 and the second side 17 are opposed to each other.

[0026] Along the axis L in the sectional view of figure 2, first there is the armature 3, then the first spring 9, then the damping element 11, then the second spring 10 and then the spring seat of the valve body 4.

[0027] A force of the second spring 10 is applied to the damping element 11. A force of the first spring 9 is applied to the damping element 11 and the armature 3. The first spring 9 and the second spring 10 together provide a force from the valve body 4 to the armature 3. The total preloads of the two valve springs 9 and 10 are designed to be together equal to a single ordinary spring used in ordinary injectors for injecting fuel. Therefore, the injector dynamics of the injector with two valve springs 9 and 10 remains equal to the injector dynamics of an ordinary injector with only one single valve spring.

[0028] The damping element 11 acts as a hydraulic and mechanic damper. Due to the hydraulic and mechanic damping of the damping element 11 an undesired movement of the armature is avoided. Due to the hydraulic and mechanic damping of the damping element 11 an undesired opening during the closing of the injector is avoided. The damping element 11 divides the valve body volume into two parts. With proper spring stiffness of each of the valve spring 9 and 10 and mass values, the damping element works as a mass damper. The small volume between the armature 3 and the damping element 11 works as a hydraulic damper during the closing phase of the injector, especially during the armature overshoot.

Claims

1. Injector for injecting fluid, comprising

- a valve needle (6), being axially moveable and being operable to prevent a fluid injection in a closing position and to permit the fluid injection in further positions,
- an armature (3) being mechanically coupled to the valve needle (6),
- a valve body (4) that comprises a recess (5) which takes in the valve needle (6),
- a first valve spring (9) that is mechanically coupled to the armature (3) with a first end (12) and mechanically coupled to a damping element (11) with an opposed second end (13);
- a second valve spring (10) that is mechanically coupled to the damping element (11) with a first end (14) and mechanically coupled to the valve body (4) with an opposed second end (15).

2. Injector according to claim 1, wherein the damping element (11) comprises a disk shape form.

3. Injector according to claim 1 or 2, wherein the damping element (11) comprises a hollow cylindrical form.

4. Injector according to any of claims 1 to 3, wherein the damping element (11) provides a hydraulic damping during closing of the fluid injector.

5. Injector according to any of claims 1 to 4, wherein

the damping element (11) provides a mass damping during closing of the fluid injector.

6. Injector according to any of claims 1 to 5, wherein the damping element (11) is arranged inside the valve body (4). 5
7. Injector according to any of claims 1 to 6, wherein the damping element (11) comprises a spring seat for the first spring (9) on a first side (16) of the damping element (11) and a spring seat for the second valve spring (10) on a second side (17) of the damping element (11), the first side (16) and the second side (17) of the damping element (11) being opposed to each other. 10 15

20

25

30

35

40

45

50

55

FIG 1

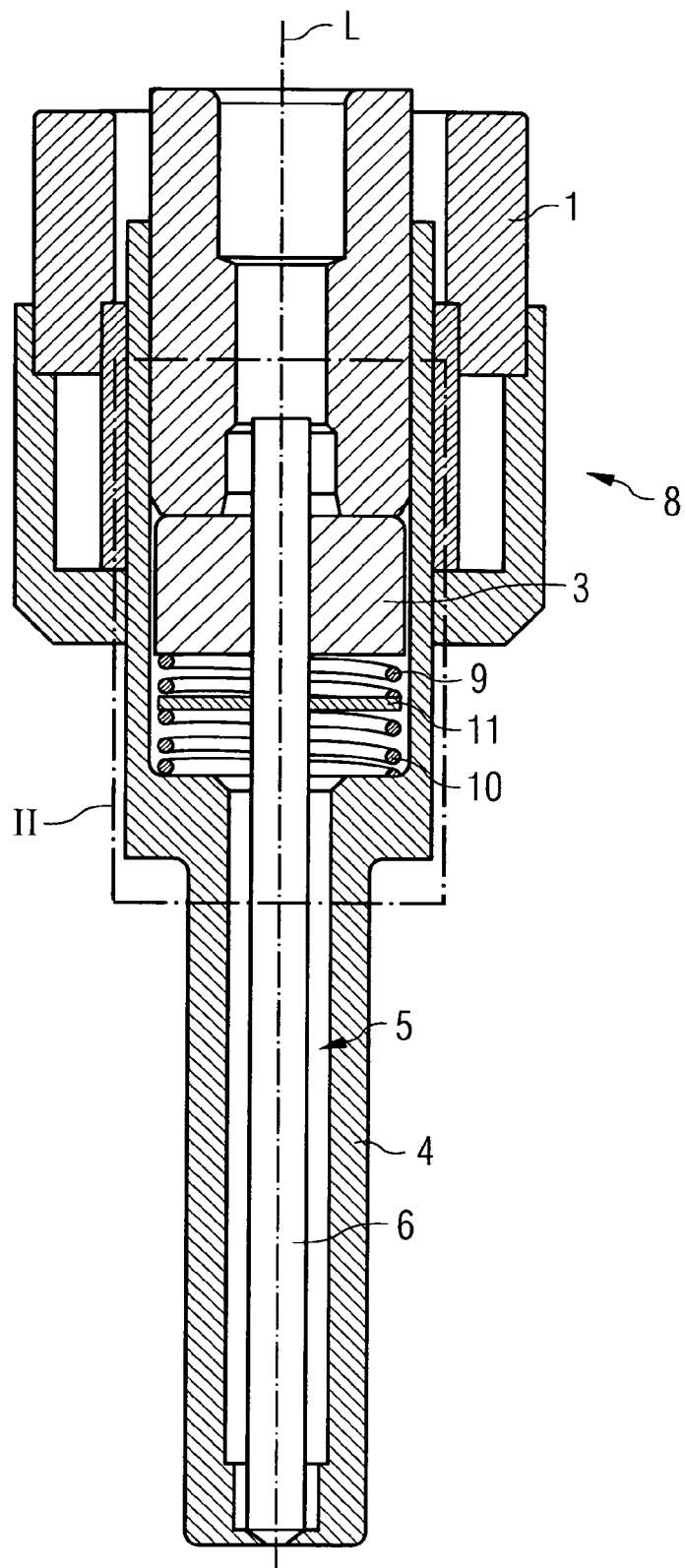
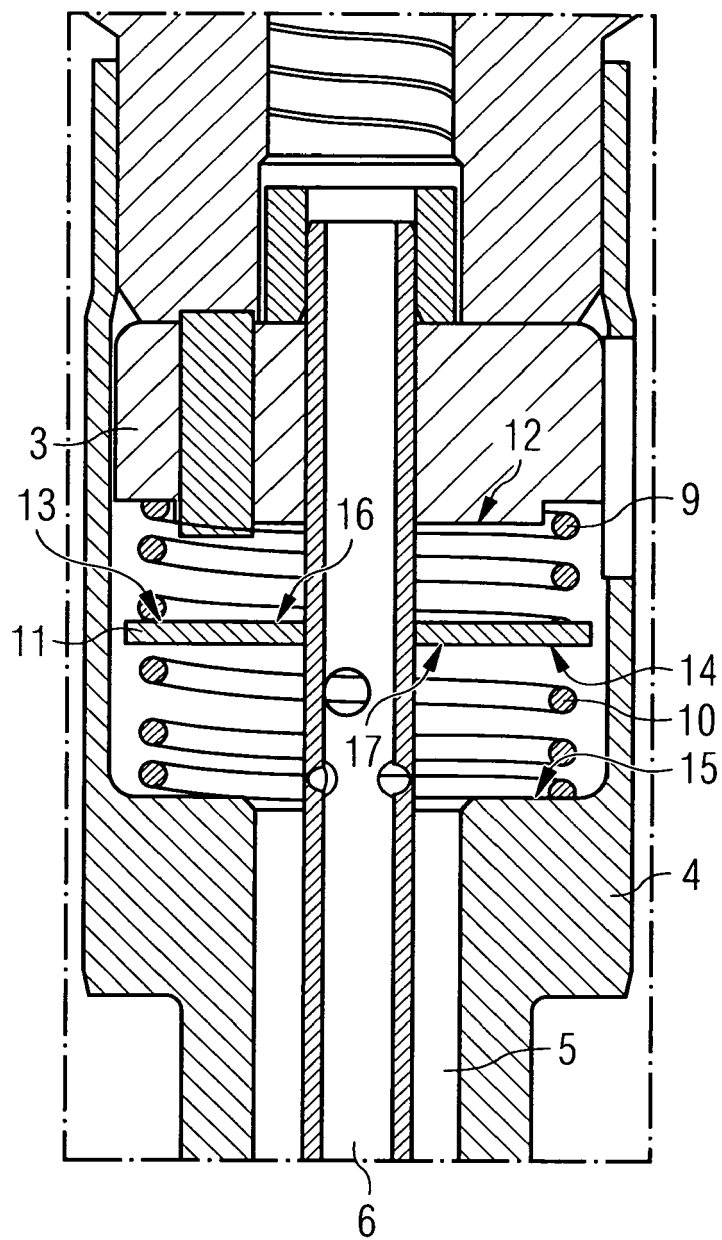


FIG 2





EUROPEAN SEARCH REPORT

Application Number
EP 11 16 2447

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	DE 199 48 238 A1 (BOSCH GMBH ROBERT [DE]) 19 April 2001 (2001-04-19) * column 4, line 21 - column 5, line 29; figures 1,2 * * abstract *	1-7	INV. F02M51/06 ADD. F02M63/00
A	WO 2006/008208 A1 (BOSCH GMBH ROBERT [DE]; HAEBERER RAINER [DE]; BUERKLE FRIEDER [DE]; AM) 26 January 2006 (2006-01-26) * paragraph [0038]; figure 3 * * abstract *	1-7	
A	WO 89/10478 A1 (SIEMENS BENDIX AUTOMOTIVE ELEC [US]) 2 November 1989 (1989-11-02) * page 3, line 15 - page 5, line 27; figure 1 * * abstract *	1-7	
			TECHNICAL FIELDS SEARCHED (IPC)
			F02M
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 6 July 2011	Examiner Hermens, Sjoerd
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 11 16 2447

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.

06-07-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19948238	A1	19-04-2001	BR 0007097 A 16-10-2001
		CZ 20011996 A3 15-05-2002	
		WO 0125614 A1 12-04-2001	
		EP 1137877 A1 04-10-2001	
		ES 2226945 T3 01-04-2005	
		JP 4603749 B2 22-12-2010	
		JP 2003511604 A 25-03-2003	
		US 6510841 B1 28-01-2003	

WO 2006008208	A1	26-01-2006	DE 102004035291 A1 16-03-2006

WO 8910478	A1	02-11-1989	EP 0411041 A1 06-02-1991
		JP 2670874 B2 29-10-1997	
		JP 3502227 T 23-05-1991	
		US 4878650 A 07-11-1989	
