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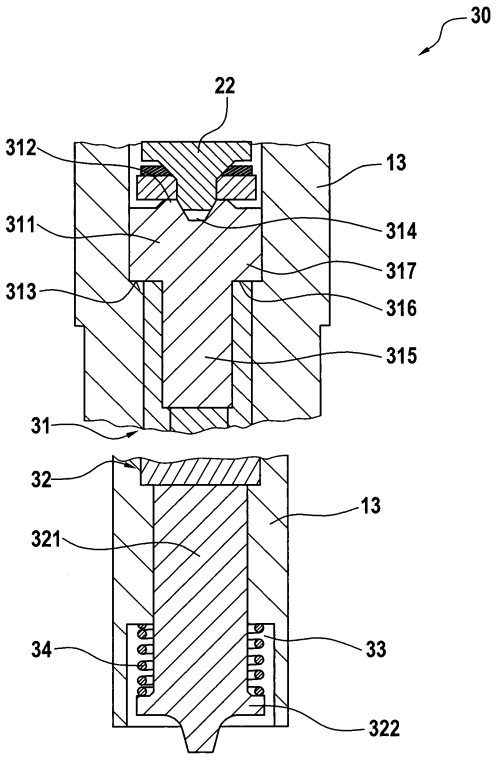
(54) **An injection valve with a new transmission group**

(57) The subject matter invention is an injection valve (10) comprising a body (13); an actuator region (20); and a piston region (30), characterized by comprising at least one drive member (25) which exists in bedded form at a vicinity of said shell (23) and which provides the actuator region (20) to return to the initial position thereof; at least one head (311) which is provided at the first piston (31) and which has at least one recess (314) where the lower shoe (22) can seat; at least one placement part (316) where said head (311) can seat on the body (13); at least one expansion region (317) which is provided on the head (311) towards said placement part (316).

Fig. 3



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Description

TECHNICAL FIELD

[0001] The present invention relates to an injection valve utilized for spraying fuel to the combustion chamber in internal combustion engines in a controlled manner and having a piezo electric member and a piston group.

PRIOR ART

[0002] Said injection valves are used for spraying fuel into the combustion chamber in internal combustion engines. The injection valves are classified according to different operation principles thereof. The injection valves, which have piezo electric members, are called piezo injection valves. Piezo injection valves are essentially described in WO 2005 050003 (A1).

[0003] Piezo injection valves have a piezo electric member which shortens and lengthens with respect to current. Piezo electric members are essentially disclosed in the patent DE 199 46 835 A1. Said piezo electric member is called actuator in the injection valve. The actuators exist in a bedded manner into the silicon inside a cylindrical bushing. This is disclosed in the patent application DE 102 009 046355 (A1). Shoes are placed for transferring the movement at the lower and upper parts of the actuators. The bedding of the actuators inside the shoes is essentially disclosed in the patent application EP 2 031 669 A1. The actuators shorten and lengthen under a certain current, and movement is transferred to the pistons in order for the drive to be transferred to the needle region. The piston, existing in the needle region, increases the movement at a predetermined ratio and it transmits the movement to the valve piston and provides the injection valve to be opened and to begin the spraying process. The pistons, existing at the continuation of the actuator, receive the drive from the actuator and they transmit the drive to the needle region. Two pistons, which have different diameters and lengths, increase the drive produced by the actuator and they transfer axial movement to the needle region. In order to transmit the drive between the two pistons, the liquid compressing characteristic is utilized. The liquid, which is compressed by means of pressure by the first piston, forces the second piston to move axially and thus, the second piston is moved. The injection valves having this system are essentially described in the patent FR 2819021 (A1). There is spring bearing and spring on the pistons and thus, the backward movements of the pistons and of the actuator are facilitated. There is a washer at the actuator side of the first piston and said washer helps in providing the sealing.

[0004] Since the actuator is connected firstly to a lower shoe and since the drive, produced by the actuator, is transferred to the piston by the additional members existing between the lower shoe and the first piston, damages may occur in the lower shoe and in the additional members and this makes the injection valve useless. Since there is excessive number of members, rigidity is deteriorated during operation. The spring bearing, existing on the piston, can be broken under pressure during operation and because of this, the injection valve becomes useless. Since there are additional members between the pieces which transmit the drive inside the injection valve, the voltage requirement of the injection valve increases. Because of the abovementioned reasons, the production costs of the injection valve increase and moreover, the usage lifetime is shortened.

[0005] As a result, because of the abovementioned problems, an improvement is required in the related technical field.

RIEF DESCRIPTION OF THE INVENTION

[0006] The present invention relates to an injection valve which is used for spraying fuel to the combustion chamber in internal combustion engines and which has a piezo electric member and which has a piston group, in order to eliminate the abovementioned problems and to bring new advantages to the related technical field.

[0007] The main object of the present invention is to provide an injection valve which has a single piece spring bearing on the piston.

[0008] Another object of the present invention is to provide an injection valve where the pre-tensioned spring is provided on the actuator.

[0009] Another object of the present invention is to provide an injection valve whose rigidity is increased and whose voltage requirement is decreased.

[0010] In order to realize all of the abovementioned objects and the objects which are to be obtained from the detailed description below, the present invention relates to an injection valve comprising a body; an actuator region having an upper shoe provided in said body, a lower shoe which is provided at a certain distance from said upper shoe, a shell which is provided between said lower shoe and upper shoe; and a piston region having a first piston which is provided so as to receive drive from the lower shoe at the continuation of said actuator region, a second piston which is provided so as to receive drive from said first piston, a chamber which is provided on the body at a vicinity of said second piston, a piston spring which is bedded to the second piston at a vicinity of said chamber. Said injection valve is characterized by comprising at least one drive member which exists in bedded form at a vicinity of said shell and which provides the actuator region to return to the initial position thereof; at least one head which is provided at the first piston and which has at least one recess where the lower shoe can seat; at least one placement part where said head can seat on the body; at least one expansion region which is provided on the head towards said placement part.

[0011] In a preferred embodiment of the subject matter invention, there is a bearing tab which is provided on the second piston at a vicinity of the chamber and whereon said piston spring can be bedded.

[0012] In another preferred embodiment of the subject matter invention, said drive member is a spring.

[0013] In another preferred embodiment of the subject matter invention, said spring is bedded in a pre-tensioned manner.

[0014] In another preferred embodiment of the subject matter invention, there is at least one sealing edge which is provided on said expansion region and which is provided between the expansion region and the placement part.

[0015] In another preferred embodiment of the subject matter invention, said sealing edge comprises a substantially smooth surface by being subject to a mechanical process.

[0016] In order for the embodiment and the advantages of the subject matter invention to be understood in the best manner with the additional elements, it has to be evaluated with the detailed description and with the figures explained below.

BRIEF DESCRIPTION OF THE FIGURES

[0017] In Figure 1, the cross sectional view of an injection valve is given.

[0018] In Figure 2, the zoomed cross sectional view belonging to an actuator region of an injection valve is given.

[0019] In Figure 3, the zoomed cross sectional view belonging to the piston region of an injection valve is given.

REFERENCE NUMBERS

[0020]

10 Injection Valve

- 11 Input Region
- 12 Needle Region
- 13 Body

20 Actuator Region

- 21 Upper Shoe
- 22 Lower Shoe
  - 221 Tab
- 23 Shell
- 24 Actuator
- 25 Spring
  - 251 Welding Connection

30 Piston Region

- 31 First Piston
  - 311 Head
  - 312 Seating Part
  - 313 Sealing Edge
  - 314 Recess
  - 315 Lower Part
  - 316 Placement Part
  - 317 Expansion Region
- 32 Second Piston
  - 321 Upper Part
  - 322 Bearing Tab
- 33 Chamber
- 34 Piston Spring

+ X : Movement Direction
- X : Second Movement Direction

THE DETAILED DESCRIPTION OF THE INVENTION

[0021] In this detailed description, the subject matter improvement is explained with references to examples without forming any restrictive effect in order to make the subject more understandable. Accordingly, in the detailed description and in the figures below, an injection valve (10) is disclosed which has a piezo electric member and which has a piston.

[0022] With reference to Figure 1, an injection valve (10) can be seen. Said injection valve (10) essentially comprises an input region (11) through which the fuel enters into the injection valve (10); a needle region (12) where the fuel in sprayed to the combustion chamber (not illustrated in the figure) by the injection valve (10); an actuator region (20) which is provided between said needle region (12) and said input region (11); a piston region (30). Said actuator region (20), said piston region (30), the needle region (12) and the input region (11) generally exist on a body (13) which has a circular cross section.

[0023] With reference to Figure 2, the zoomed view of the actuator region (20) is given. An upper shoe (21) exists in connected form at the continuation of the input region (11). Said upper shoe (21) has a circular cross section. There is a lower shoe (22) which is connected in connected form at a certain distance in +X direction from the upper shoe (21). Said lower shoe (22) has a circular cross section and the upper shoe (21) and the lower shoe (22) are positioned so as to be coaxial. There is a piezo electric member (24), which is in connection between the upper shoe (21) and the lower shoe (22). Said piezo electric member (24) is defined as the actuator. Said actuator (24) has a circular cross section and it is embodied so as to elongate and shorten in X direction under a certain electrical current. The actuator (24) is positioned so as to be coaxial with the shoes (21, 22). There is a shell (23) which is in connection with the actuator (24). Said shell (23) has a hollow circular cross

section. The shell (23) is positioned at a vicinity of the outer wall of the actuator (24) so that there is a silicon layer (not illustrated in the figure) between the shell (23) and the actuator (24). The electrical conduction between the actuator (24) and the shell (23) is prevented by said silicon. The actuator (24) and the shell (23) are coaxial. There is a drive member (25) in connection with the shell (23). Said drive member (25) is a spring. Said spring (25) is positioned so as to be adjacent to the outer wall of the shell (23). The spring (25) is placed to the actuator region (20) in a pre-tensioned manner together with the welding connections (251). There is one tab (221) which is embodied on the lower shoe (22). Said tab (221) exists in +X direction of the lower shoe (22).

[0024] With reference to Figure 3, there is the piston region (30) at the continuation of the actuator region (20) in the +X direction. There is a first piston (31) which is in connected form at the continuation of the lower shoe (22). Said first piston (31) is positioned so as to be coaxial with the lower shoe (22). The first piston (31) has a circular cross section with two different diameters. The part where the first piston (31) is in connection with the lower shoe (22) is defined as the head (311). A seating part (312) is embodied at the edge of said head (311) in the - X direction. A recess (314) is embodied so as to correspond to the tab (221) of the lower shoe (22) on said seating part (312). The lower part (315) of the first piston (31) is in connection at the continuation of the head (311) in +X direction. Said lower part (315) is coaxial with the head (311). The diameter of the lower part (315) is embodied so as to be smaller than the head (311) diameter. The narrowing in the diameter is provided by means of a sealing edge (313). Said sealing edge (313) has a right angle with the wall of the head (311) and with the lower part (315). The sealing edge (313) is passed through the stoning process and it has a substantially smooth surface. An expansion region (317) is defined in -X direction of the sealing edge (313). Moreover, the region, where the sealing edge (313) seats on the body (13), is called the placement part (316). There is a second piston (32) which is in connection at the continuation of the first piston (31). Said second piston (32) has a circular cross section. The second piston (32) is positioned so as to be coaxial with the first piston (31). The second piston (32) has a smaller diameter than the first piston (31). There is a bearing tab (322) which is in connected form to the upper part (321) at the continuation of the second piston (32) in +X direction. Said bearing tab (322) is positioned so as to be adjacent to the wall of the second piston (32), and when viewed from the cross section, it is observed as diameter expansion. On the bearing tab (322), there is a piston spring (34) in connection in -X direction and which is connected so as to be adjacent to said upper part (321) of the second piston (32). A chamber (33) is embodied in the piston region (30) so as to form a movement area to the piston spring (34) and to the bearing tab (322). When viewed from the cross section, said chamber (33) has a rectangular view.

[0025] Injection valves (10) are essentially used in spraying fuel to the combustion chamber (not illustrated in the figure) in internal combustion engines (not illustrated in the figure). The fuel, provided by the different members (not illustrated in the figure) of the vehicle, enters into the injection valve (10) through the input region (11) and the pressurized fuel is sprayed to said combustion chamber through the needle region (12) in a controlled manner. Meanwhile, in order to control the spraying of the fuel, complex members (not illustrated in the figure) function together. The three shoes (21) form a connection surface in order for the actuator (24) to stand in a fixed axis. Moreover while the upper shoe (21) forms a connection surface to the shell (23) and to the spring (25), it facilitates the interruption of the contact of the actuator (24) with the fuel through the -X region. The actuator (24) elongates and shortens under a certain electrical current, and it forms the mechanical drive inside the injection valve (10). The lower shoe (22) provides the drive, produced by the actuator (24), to be transmitted to the piston region (30); and at the same time, it forms a holding surface for the actuator (24), the shell (23) and the spring (25). The shell (23) prevents the contact of the actuator (24) with the fuel and it provides a bearing for the actuator (24). The spring (25) provides the required drive in order for the elongated actuator (24) to return to the initial position thereof. The piston region (30) starts the fuel spraying process by means of the drive received by the actuator region (20) and at the same time, it increases the drive produced by the actuator (24). The first piston (31) takes the drive from the lower shoe (22) from the seating part (312) side. The head (311) provides sealing between itself and the lower part (315). Since the sealing edge (313) is stoned, there is no sealing problem in this part. The lower part (315) provides the drive to be transmitted to the second piston (32). The second piston (32) provides the movement to be transmitted to the needle region (12) and provides the spraying process to be started. The bearing tab (322), existing on the second piston (32), provides bearing for the piston spring (34). The piston spring (34) provides drive formation during the movement of the piston (32) and provides the piston (32) to be drawn to the initial position. The chamber (33) provides the required movement area for the bearing tab (322) and for the piston spring (34) in the piston region (30).

[0026] In cases where fuel is to be sprayed to the combustion chamber, electrical current is applied to the actuator (24). Under current, the actuator (24) extends in + X direction and it produces a mechanical drive. The lower shoe (22) moves towards +X direction and it seats to the recess (314) in the seating part (312) of the first piston (31) from the tab and it moves the first piston (31) in + X direction. The first piston (31) seats to the correspondent part (not illustrated in the figure) existing on the body (13) by means of the sealing edge (313). The first piston (31) drives the second piston (32) in a hydraulic manner by means of the lower part (315) thereof and the second piston (32) moves in +X direction. The second piston (32)

transmits the drive to the needle region (12) and provides the spraying process to begin. In case the spraying process will end, the electrical current applied to the actuator (34) is interrupted and the actuator (24) is shortened in -X direction by means of the spring (25) and it returns to the initial position thereof. Since the drive existing on the pistons (31, 32) is eliminated, the pistons (31, 32) return in -X direction and the drive existing in the needle region (12) is interrupted and the spraying process is ended.

[0027] In the present invention, in the prior art, the pre-tensioned spring, existing in the piston region (30), is taken onto the actuator (24), and in the piston region (30), the shapes of the body (13) and of the pistons (31, 32) are simplified. The sealing edge (313), provided at a vicinity of the first piston (31) so as to be adjacent to the head (311), takes the place of the washer used in the prior art and as a result of this, the number of pieces inside the injection valve (10) decreases. Since the lower shoe (22) and the seating part (312) of the first piston (31) are embodied so as to correspond to each other geometrically, the number of pieces is decreased by eliminating the members existing in between in the prior art. The spring bearing, which is engaged onto the second piston (32) for the piston spring (34) by means of the nailing method in the prior art, is eliminated, and the spring bearing, which is embodied by means of the bearing tab (322) provided on the upper part (321) to the second piston (32), eliminates the rigidity problems which may occur during operation.

[0028] Since the number of pieces, which are in continuous mechanical contact with each other, is high, the general rigidity of the injection valve may decrease and problems may occur during operation. As the number of the pieces decreases, the rigidity of the injection valve (10) is increased and at the same time, the amount of voltage requirement is decreased.

[0029] The protection scope of the present invention is set forth in the annexed Claims and cannot be restricted to the illustrative disclosures given above, under the detailed description. It is because a person skilled in the relevant art can obviously produce similar embodiments under the light of the foregoing disclosures, without departing from the main principles of the present invention.

Claims

1. An injection valve (10) comprising a body (13); an actuator region (20) having an upper shoe (21) provided in said body (13), a lower shoe (22) which is provided at a certain distance from said upper shoe (21), a shell (23) which is provided between said lower shoe (22) and upper shoe (21); and a piston region (30) having a first piston (31) which is provided so as to receive drive from the lower shoe (22) at the continuation of said actuator region (20), a second piston (32) which is provided so as to receive drive from said first piston (31), a chamber (33) which is provided on the body (13) at a vicinity of said second piston (32), a piston spring (34) which is bedded to the second piston (32) at a vicinity of said chamber (33), **characterized by** comprising at least one drive member (25) which exists in bedded form at a vicinity of said shell (23) and which provides the actuator region (20) to return to the initial position thereof; at least one head (311) which is provided at the first piston (31) and which has at least one recess (314) where the lower shoe (22) can seat; at least one placement part (316) where said head (311) can seat on the body (13); at least one expansion region (317) which is provided on the head (311) towards said placement part (316).

2. An injection valve (10) according to Claim 1, **characterized in that** there is a bearing tab (322) which is provided on the second piston (32) at a vicinity of the chamber (33) and whereon said piston spring (34) can be bedded.

3. An injection valve (10) according to Claim 1 or 2, **characterized in that** said drive member (25) is a spring.

4. An injection valve (10) according to Claim 3, **characterized in that** said spring (25) is bedded in a pre-tensioned manner.

5. An injection valve (10) according to any one of the preceding claims, **characterized in that** there is at least one sealing edge (313) which is provided on said expansion region (317) and which is provided between the expansion region (317) and the placement part (316).

6. An injection valve (10) according to Claim 5, **characterized in that** said sealing edge (313) comprises a substantially smooth surface by being subject to a mechanical process.

Fig. 1

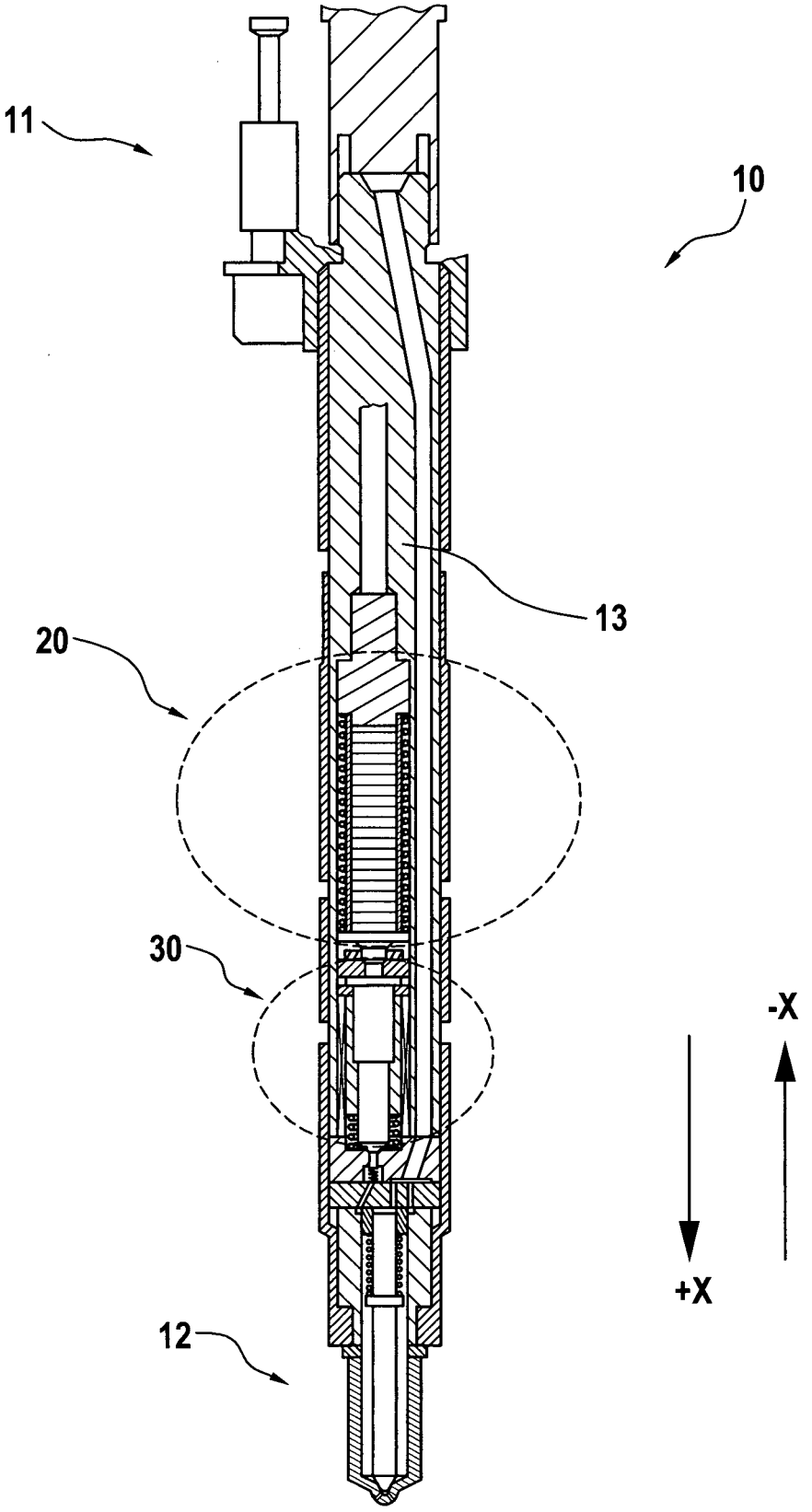


Fig. 2

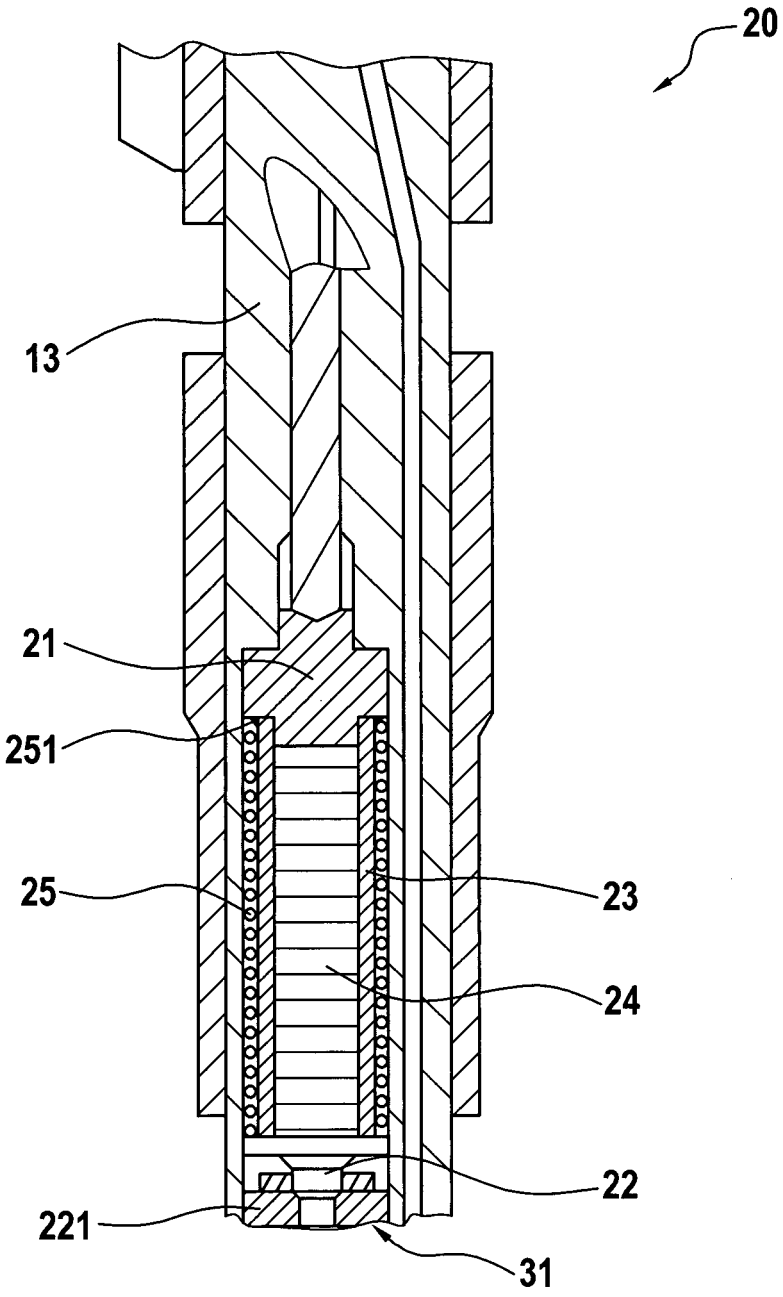
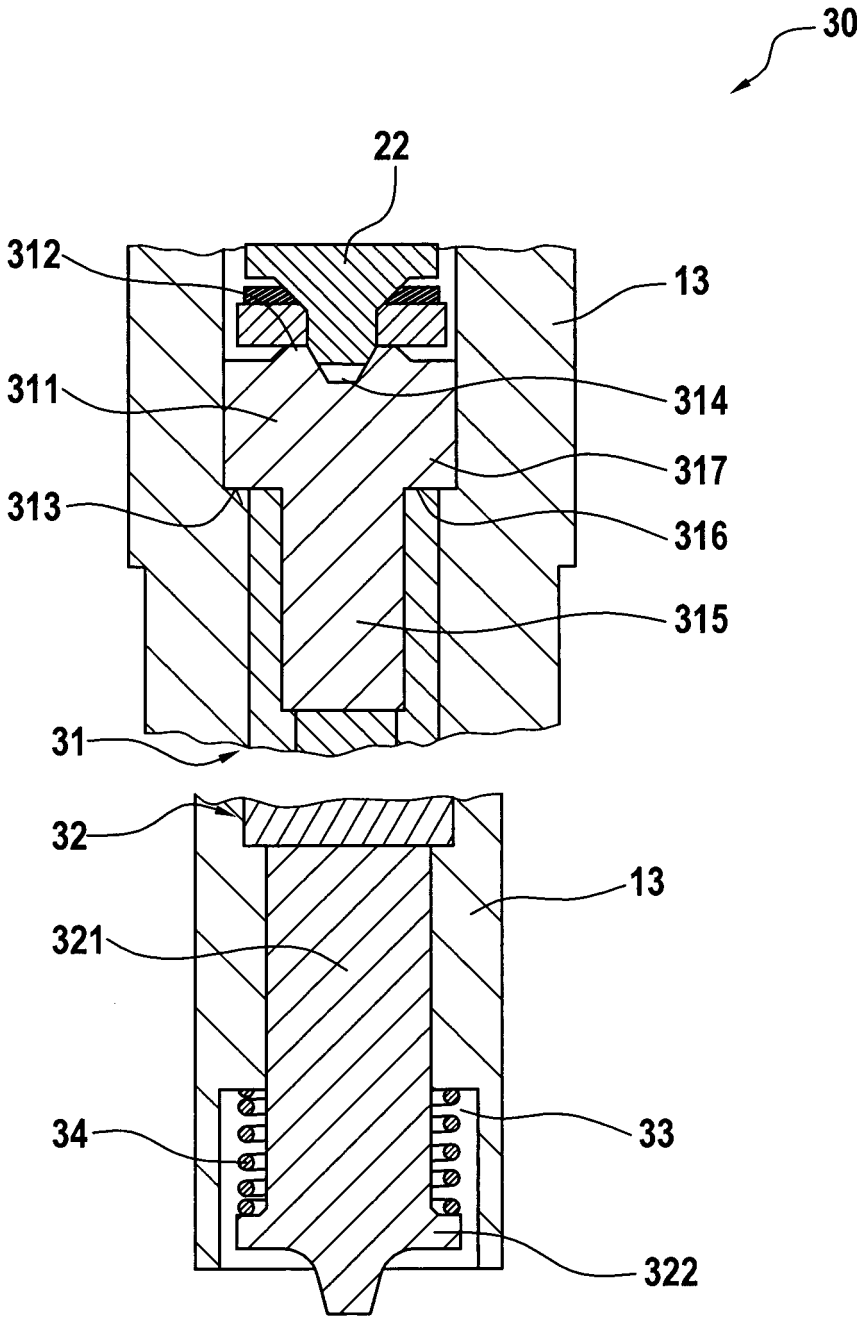


Fig. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 12 18 7876

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	DE 101 64 284 A1 (DENSO CORP [JP]) 18 July 2002 (2002-07-18) * paragraphs [0035] - [0037]; figure 1 *	1-6	INV. F02M51/06 F02M63/00
Y	DE 10 2009 045556 A1 (BOSCH GMBH ROBERT [DE]) 14 April 2011 (2011-04-14) * paragraphs [0019] - [0021]; figure 1 *	1-6	
A	DE 10 2009 029489 A1 (BOSCH GMBH ROBERT [DE]) 24 March 2011 (2011-03-24) * paragraphs [0014] - [0016]; figures 1,2 *	1	
A	DE 10 2007 006942 A1 (BOSCH GMBH ROBERT [DE]) 14 August 2008 (2008-08-14) * paragraph [0034]; figure 2 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 April 2013	Kolland, Ulrich

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

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25-04-2013

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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