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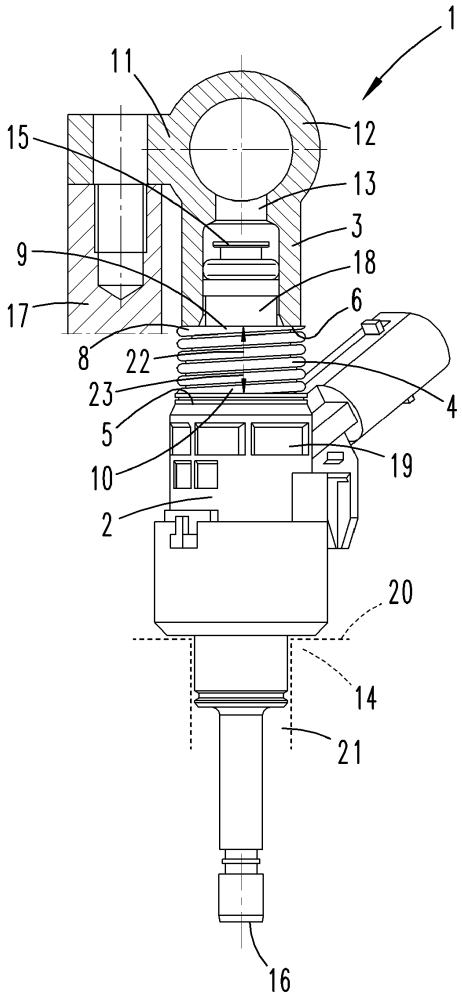
(54) **FLUID INJECTION ASSEMBLY AND COMBINATION OF A SPRING AND A FIXING ELEMENT**

(57) The present invention relates to a fluid injection assembly (1), comprising an injector (2), a fuel cup (3) and a spring (4), wherein the spring (4) is arranged between a supporting surface (5) of the injector (2) and a supporting surface (6) of the fuel cup (3). In order to improve such a fluid injection assembly, the invention suggests that the spring (4) extends along a longitudinal axis (7) of the spring (4) and that the spring (4) comprises a wire (8) wound around the longitudinal axis (7) of the spring (4) between a first longitudinal end (9) of the spring (4) and a second longitudinal end (10) of the spring (4). According to a second aspect the invention refers to a combination, in particular for a fluid injection assembly (1) of an internal combustion engine, wherein the combination (35) includes a spring (4) and a fixing element (24). In order to provide an improved combination (35) the invention suggests that the spring (4) extends along a longitudinal axis (7) of the spring, wherein the spring (4) comprises a wire (8) wound around the longitudinal axis (7) of the spring (4) between a first longitudinal end (9) of the spring (4) and a second longitudinal end (10) of the spring (4), and that the fixing element (24) has a ring section (25) and a sleeve section (26) extending along a longitudinal axis (27) of the fixing element (24), wherein the ring section (25) is formed at or fixed to the sleeve section (26) between a first longitudinal section (28) of the sleeve section and a second longitudinal section (29) of the sleeve section (26) and wherein the ring section (25) extends from an outside of the sleeve section (26) in a radially outward direction.

Fig. 1



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Description

[0001] The present invention relates to a fluid injection assembly, comprising an injector, a fuel cup and a spring, wherein the spring is arranged between a supporting surface of the injector and a supporting surface of the fuel cup.

[0002] Furthermore, according to a second aspect the present invention relates to a combination, in particular for a valve assembly of an internal combustion engine, wherein the combination includes a spring and a fixing element.

[0003] Injection valve assemblies are in wide spread use, in particular for internal combustion engines where they may be arranged in order to dose a fluid to a cylinder. A high pressure injector needs to be clamped on the cylinder head in order to ensure an appropriate position of its tip (outlet) inside the combustion chamber. The injector, in particular if it is an injector for gasoline direct injection (GDI), after its installation on an engine needs to be pushed down on the cavity at the injector seat of a cylinder in order to be maintained in its correct position, even if a counter pressure from the cylinder and if vibration occurs. In order to meet these requirements in the prior art it is known to use a spring which is arranged between a supporting surface of an injector and a supporting surface of a fuel cup in order to press down the injector to the cylinder head by an elastic force. Such a fluid injection assembly is known from EP 1 892 408 B1, where a spring is shown e.g. in Fig. 3. Such a spring is usually obtained by fine blanking and bending in order to have a leaf spring shape. However, such known technology has some disadvantages. In particular, the spring itself is complicate to manufacture and must be specifically adapted to each individual fluid injection assembly. Furthermore, such known spring requires a considerable installation space and the assembly is difficult. Furthermore, there is a risk that the elastic force is not evenly distributed along the entire circumference so that the risk of a bending force exists.

[0004] It is an object of the invention to provide an improved fluid injection assembly. In particular, it is intended to provide a fluid injection assembly which can overcome some or all of the above-described disadvantages.

[0005] Regarding the second aspect of the invention it is an object of the invention to provide an improved combination which includes a spring and a fixing element. In particular, it is an object of the invention that such provided combination can contribute to over-come at least some or all of the above-described dis-advantages.

[0006] According to the first aspect of the invention, in order to overcome the mentioned object the invention suggests that the spring extends along a longitudinal axis of the spring and that the spring comprises a wire wound around the longitudinal axis of the spring between a first longitudinal end of the spring and a second longitudinal end of the spring. Accordingly, the invention suggests to replace the usually used bending spring by a spring of a very different type which enables a number of advantages. In particular, the outline of such component (spring) - compared to the known spring - is minimized in terms of diameter and height. Further, the assembly process step of the proposed design is easier compared to the known technology. Moreover, the force which is provided by the spring is better distributed along the entire circumference at the injector seat which minimizes the risk of a bending force. Furthermore, in the end the costs of the spring and of the fluid injection assembly can be reduced compared to the prior art.

[0007] There are many possibilities for performing preferred modifications:

It is preferred that the spring has a helicoidal shape and in particular is a standard helicoidal shape spring. A standard helicoidal shape spring preferably may be a spring in accordance to technical standard like for example the ISO standard (ISO is the abbreviation for International Organization for Standardization). Especially, it is preferred that the spring is a pressure spring, in particular a cylinder pressure spring.

[0008] In a preferred embodiment it is provided that the first longitudinal end of the spring points in a direction towards the supporting surface of the fuel cup and that the second longitudinal end of the spring points in a direction towards the supporting surface of the injector. Regarding an assembled state it is preferred that the spring at its first longitudinal end is supported directly or indirectly at the fuel cup with regard to a first axial direction and that the spring at its second longitudinal end is supported directly or indirectly at the injector with regard to a second axial direction, which is opposite to the first axial direction.

[0009] It is possible that the fluid injection assembly comprises a fuel rail and that the fuel cup is a fuel rail cup which is integrally formed at the fuel rail or which is fixed at the fuel rail. In such embodiments the fuel cup may also be denoted as a fuel rail cup or as a rail cup. For example, the fuel cup may be integrally formed at or fixed at a main gallery of the fuel rail. Alternatively, it is possible that the fuel cup is an injector cup.

[0010] In order to simplify the mounting of the spring in the fluid injection assembly, it is possible that the fluid injection assembly comprises a fixing element which has a ring section and a sleeve section ex-tending along a longitudinal axis of the fixing element, wherein the ring section is formed at or fixed to the sleeve section between a first longitudinal section of the sleeve section and a second longitudinal section of the sleeve section and wherein the ring section extends from an outside of the sleeve section in a radially outward direction, wherein the fixing element in particular is made of plastic material. It is preferred that the injector comprises an injector tube, wherein the injector tube is inserted into a hollow space within the spring, wherein at the second longitudinal end of the spring an inner diameter of the spring is bigger compared to an outer diameter of the injector tube so that a longitudinal first annular space is provided, and

that the first longitudinal section of the sleeve section is inserted into the first annular space, wherein in particular an outer diameter of the first longitudinal section of the sleeve section corresponds to an inner diameter of the spring and wherein in particular an inner diameter of the first longitudinal sleeve section corresponds to an outer diameter of the injector tube. Further, it is possible that the second longitudinal section of the sleeve section is inserted longitudinally into a longitudinal second annular space which is provided at the injector, wherein in particular an outer diameter of the second longitudinal section of the sleeve section corresponds to an inner diameter of the second annular space and wherein in particular an inner diameter of the second longitudinal section of the sleeve section corresponds to an outer diameter of the injector tube.

[0011] In further detail it is possible that the ring section has a first supporting surface extending transversely with regard to the longitudinal axis of the fixing element and a second supporting surface ex-tending transversely with regard to the longitudinal axis of the fixing element and facing opposite to the first supporting surface, wherein the second longitudinal end of the spring is supported against the first supporting surface of the ring element and wherein the second supporting surface of the ring element is sup-ported against the supporting surface of the injector.

[0012] In an advantageous embodiment it is provided that the fluid injection assembly comprises a fuel rail, wherein the fuel cup is integrally formed at the fuel rail or is fixed at the fuel rail, and that the fluid injection assembly comprises a cylinder head, in particular a cylinder head of an internal combustion engine, wherein the cylinder head comprises an opening and an injector seat surrounding the opening, wherein a fluid outlet of the injector is inserted into the opening of the cylinder head, wherein the injector is supported directly or indirectly at the injector seat with regard to the second axial direction and wherein the spring is assembled in an elastically compressed state between the supporting surface of the fuel cup and the supporting surface of the injector. The fuel rail and the fuel cup may be mounted at the internal combustion engine at a predetermined and fixed distance relative to the injector seat of a cylinder. Preferably at an outside of the injector there is a ring shoulder which has a first annular surface ex-tending at right angles with a longitudinal axis of the injector and facing an outlet of the injector and the annular surface contacts a second annular surface of the injector seat. Preferably, the injector is an injector which is adapted to be used for gasoline direct injection (GDI).

[0013] According to the second aspect in order to solve the underlying object the invention suggests that the spring extends along a longitudinal axis of the spring, wherein the spring comprises a wire wound around the longitudinal axis of the spring between a first longitudinal end of the spring and a second longitudinal end of the spring, and that the fixing element has a ring section and a sleeve section extending along a longitudinal axis of the fixing element, wherein the ring section is formed at or fixed to the sleeve section between a first longitudinal section of the sleeve section and a second longitudinal section of the sleeve section and wherein the ring section ex-tends from an outside of the sleeve section in a radially outward direction. In a purposeful embodiment it may be provided that an outer diameter of the first longitudinal section of the sleeve section corresponds to an inner diameter of the spring.

[0014] From the above description it is clear to a skilled person that an advantage of the present invention is that the injector holding force may be guaranteed e.g. by a standard helicoidal shape spring to be assembled between a fuel cup (in particular a fuel rail cup) and an injector holding surface. In order to fix the spring on the injector a simple fixing element (which could also be denoted by the terms mounting element or aligning element, e.g.) and which e.g. could be a simple plastic component can be mounted in the inner diameter of the modular power group (including the injector and the spring) of the injector.

[0015] Exemplary embodiments of the invention are described with reference to the accompanying drawings. These are as follows:

Fig. 1 shows a preferred embodiment of a fluid injection assembly according to the present invention by a sectional view in the upper section and by a side view in the lower section;

Fig. 2 is a sectional view of a section of the injector of Fig. 1 where a preferred embodiment of a combination in accordance to the invention is mounted; and

Fig. 3 is an intersected perspective view of the preferred embodiment of the combination in accordance to the present invention as al-so shown by Figs. 1 and 2.

[0016] A preferred embodiment of a fluid injection assembly 1 in accordance to the invention is described with regard to Figs. 1 and 2. It comprises an injector 2, a fuel cup 3 and a spring 4, wherein the spring 4 is mounted between a supporting surface 5 of the injector 2 and a supporting surface 6 of the fuel cup 3. As also shown by the increased details of Figs. 2 and 3, the spring 4 extends along a longitudinal axis 7 and the spring 4 comprises a wire 8 which is wound around the longitudinal axis 7 between a first longitudinal end of the spring 4 and a second longitudinal end 10 of the spring 4. In the example, the spring 4 has a helicoidal shape and is a standard helicoidal shape spring.

[0017] In the example, the fluid injection assembly 1 comprises a fuel rail 11 having a main gallery 12. The fuel cup 3 is integrally formed at the main gallery 12 and is in fluid communication with the main gallery 12 by a

via hole 13. The injector 2 is assembled between the fuel rail 3 and a cylinder head 14 of a cylinder as schematically indicated by Fig. 1. The injector 2 has a fluid inlet 15 which in the opened state of the injector 2 is in internal fluid communication with a fluid outlet 16 of the injector 2. In the assembled state, the fuel rail 11 is mounted by means of a screw (not shown in Fig. 1) and by additional components 17 in a predetermined fixed distance from the cylinder head 14. The distance is determined so that the adjacent windings of the spring 4 do not contact each other at least when there are no considerable pressure impulses within the cavity of the cylinder. Further, the distance is determined so that the spring 4 is axially compressed in the assembled state which means that the spring 4 is elastically deformed to a certain degree and hence the spring 4 is axially clamped by its elastic spring force between the fuel cup 3 and the injector 2. Accordingly, the injector 2 by means of this elastic spring force is axially pressed down against an annular injector seat 20 which surrounds an opening 21 which is a fuel inlet of the cylinder head 14. From the description and the figures it follows that in the example the spring 4 is a cylinder pressure spring. The injector 2 comprises an injector tube 18 and an injector body 19 wherein the injector body 19 may e.g. be made of a plastic material or the like.

[0018] From the above it follows that the first longitudinal end 9 of the spring 4 points in direction to-wards the supporting surface 6 of the fuel cup 3 and that the second longitudinal end 10 of the spring 4 points in a direction towards the supporting surface 5 of the injector 2. In the assembled state shown by Fig. 1 the spring 4 at its first longitudinal end is axially supported directly against the fuel cup 3 with regard to a first axial direction 22 and the spring 4 at its second longitudinal end is axially supported indirectly by an intermediate fixing element 24 at the injector 2 with regard to a second axial direction 23 which is opposite to the first axial direction 22.

[0019] As shown by Figs. 2 and 3 in more detail, the fixing element 24 (which could also be denoted by the terms mounting element or aligning element) is integrally formed and comprises a ring section 25 and a sleeve section 26. The sleeve section 26 extends along a longitudinal axis 27 on the fixing element, which - in the assembled state shown in Fig. 3 - corresponds to the longitudinal axis of the spring 4. The ring section 25 is formed at the outside of the sleeve section 26 between a first longitudinal section 28 of the sleeve section 26 and a second longitudinal section 29 of the sleeve section 26 and extends from the outside of the sleeve section 26 in a radially outward direction. In the example, the fixing element is made of plastic material.

[0020] As depicted in Fig. 1 the injector tube is inserted into a hollow space 30 within the spring 4. At the second longitudinal end 10 of the spring 4 an inner diameter 31 of the spring is bigger compared to an outer diameter 32 of the injector tube 18 so that a longitudinal first annular space 33 is provided. The first longitudinal section 28 of the sleeve section 26 is inserted into the first annular space 33.

[0021] The second longitudinal section 29 of the sleeve section 26 is inserted longitudinally into a longitudinal second annular space 34 which is provided at the injector 2. In further detail, as shown by the increased view of Fig. 3, the ring section 25 has a first supporting surface 34 which extends transversely with regard to the longitudinal axis 27 and a second supporting surface 35 also extending transversely with regard to the longitudinal axis 27 and facing opposite to the first supporting surface 34. In the example, the second longitudinal end 10 of the spring 4 is directly supported against the first supporting surface 34 and the second supporting surface 35 of the ring element 25 is directly supported against the supporting surface 5 of the injector 2.

[0022] Furthermore, the components shown by Fig. 3 form part of a preferred embodiment of a combination 35 in accordance to the second aspect of the present application. As also shown by Fig. 3, the outer diameter of the first longitudinal section 28 of the sleeve section corresponds to the inner diameter of the spring 4. In the example, the windings of the spring 4 have a unique diameter. However, it is clear for a skilled person that this is not necessary. Regarding further details, possible effects and advantages reference is made to the above description with regard to the fluid injection assembly 1.

[0023] All disclosed features are (for its own, but also in combination) relevant for the invention. The features of the dependent claims characterize also in-dependent inventive improvements of the prior art, in particular for filing divisional applications on a basis of these claims.

Reference Signs List

[0024]

1	fluid injection assembly
2	injector
3	fuel cup
4	spring
5	supporting surface
6	supporting surface
7	longitudinal axis
8	wire
9	first longitudinal end
10	second longitudinal end
11	fuel rail
12	main gallery
13	via hole
14	cylinder head
15	fluid inlet
16	fluid outlet
17	components
18	injector tube
19	injector body
20	injector seat
21	opening
22	first axial direction

23 second axial direction
24 fixing element
25 ring section
26 sleeve section
27 longitudinal axis
28 first longitudinal section
29 second longitudinal section
30 hollow space
31 inner diameter
32 outer diameter
33 first annular space
34 first supporting surface

Claims

1. Fluid injection assembly (1), comprising an injector (2), a fuel cup (3) and a spring (4), wherein the spring (4) is arranged between a supporting surface (5) of the injector (2) and a supporting surface (6) of the fuel cup (3), **characterized in that** the spring (4) extends along a longitudinal axis (7) of the spring (4) and that the spring (4) comprises a wire (8) wound around the longitudinal axis (7) of the spring (4) between a first longitudinal end (9) of the spring (4) and a second longitudinal end (10) of the spring (4).

2. Fluid injection assembly (1) according to claim 1, **characterized in that** the spring (4) has a helicoidal shape and in particular is a standard helicoidal shape spring.

3. Fluid injection assembly (1) according to any of the preceding claims, **characterized in that** the spring (4) is a pressure spring, in particular a cylinder pressure spring.

4. Fluid injection assembly (1) according to any of the preceding claims, **characterized in that** the first longitudinal end (9) of the spring (4) points in a direction towards the supporting surface (6) of the fuel cup (3) and that the second longitudinal end (10) of the spring (4) points in a direction towards the supporting surface (5) of the injector (2).

5. Fluid injection assembly (1) according to any of the preceding claims, **characterized in that** the spring (4) at its first longitudinal end (9) is supported directly or indirectly at the fuel cup (3) with regard to a first axial direction (22) and that the spring (4) at its second longitudinal end (10) is supported directly or indirectly at the injector with regard to a second axial direction (23), which is opposite to the first axial direction (22).

6. Fluid injection assembly (1) according to any of the preceding claims, **characterized in that** the fluid injection assembly (1) comprises a fuel rail (11) and that the fuel cup (3) is a fuel rail cup which is integrally formed at the fuel rail (11) or which is fixed at the fuel rail (11).

7. Fluid injection assembly (1) according to any of the preceding claims, **characterized in that** the fuel cup (3) is an injector cup.

8. Fluid injection assembly (1) according to any of the preceding claims, **characterized in that** the fluid injection assembly (1) comprises a fixing element (14) which has a ring section (25) and a sleeve section (26) ex-tending along a longitudinal axis (27) of the fixing element (24), wherein the ring section (25) is formed at or fixed to the sleeve section (26) between a first longitudinal section (28) of the sleeve section (26) and a second longitudinal section (29) of the sleeve section (26) and wherein the ring section (25) extends from an outside of the sleeve section (26) in a radially outward direction, wherein the fixing element (24) in particular is made of plastic material.

9. Fluid injection assembly (1) according to any of the preceding claims, **characterized in that** the injector (2) comprises an injector tube (18), wherein the injector tube (18) is inserted into a hollow space (30) within the spring (4), wherein at the second longitudinal end (10) of the spring (4) an inner diameter (31) of the spring (4) is bigger compared to an outer diameter (32) of the injector tube (18) so that a longitudinal first annular space (33) is provided, and that the first longitudinal section (28) of the sleeve section (26) is inserted into the first annular space (33), wherein in particular an outer diameter of the first longitudinal section of the sleeve section corresponds to an inner diameter of the spring and wherein in particular an inner diameter of the first longitudinal sleeve section corresponds to an outer diameter of the injector tube.

10. Fluid injection assembly (1) according to any of the preceding claims, **characterized in that** the second longitudinal section (29) of the sleeve section (26) is inserted longitudinally into a longitudinal second annular space (34) which is provided at the injector (2), where-in in particular an outer diameter of the second longitudinal section of the sleeve section corresponds to an inner diameter of the second annular space and wherein in particular an inner diameter of the second longitudinal section of the sleeve section corresponds to an outer diameter of the injector tube.

11. Fluid injection assembly (1) according to any of the preceding claims, **characterized in that** the ring section (25) has a first supporting surface (34) extending transversely with regard to the longitudinal axis (27) of the fixing element (24) and a second supporting sur-face (35) extending transversely with

regard to the longitudinal axis (27) of the fixing element (24) and facing opposite to the first supporting surface (34), wherein the second longitudinal end (10) of the spring (4) is supported against the first supporting surface (34) of the ring element (25) and wherein the second supporting surface (34) of the ring element (25) is sup-ported against the supporting surface (5) of the injector (2).

12. Fluid injection assembly (1) according to any of the preceding claims, **characterized in that** the fluid injection assembly comprises a fuel rail (11), wherein the fuel cup (3) is integrally formed at the fuel rail (11) or is fixed at the fuel rail (11), and that the fluid injection assembly (1) comprises a cylinder head, in particular a cylinder head of an internal combustion engine, wherein the cylinder head comprises an opening (21) and an injector seat (20) surrounding the opening (21), wherein a fluid outlet (16) of the injector (2) is inserted into the opening (21) of the cylinder head, wherein the injector (2) is supported directly or indirectly at the injector seat (20) with regard to the second axial direction (23) and wherein the spring (4) is assembled in an elastically compressed state between the supporting surface (6) of the fuel cup (3) and the sup-porting surface (5) of the injector (2).

13. Fluid injection assembly (1) according to any of the preceding claims, **characterized in that** the injector (2) is an injector (2) which is adapted to be used for gasoline direct injection (GDI).

14. Combination (35), in particular for a fluid injection assembly (1) of an internal combustion engine, wherein the combination (35) includes a spring (4) and a fixing element (24), **characterized in that** the spring (4) extends along a longitudinal axis (7) of the spring, wherein the spring (4) comprises a wire (8) wound around the longitudinal axis (7) of the spring (4) between a first longitudinal end (9) of the spring (4) and a second longitudinal end (10) of the spring (4), and that the fixing element (24) has a ring section (25) and a sleeve section (26) extending along a longitudinal axis (27) of the fixing element (24), wherein the ring section (25) is formed at or fixed to the sleeve section (26) between a first longitudinal section (28) of the sleeve section and a second longitudinal section (29) of the sleeve section (26) and wherein the ring section (25) extends from an outside of the sleeve section (26) in a radially outward direction.

15. Combination (35) according to claim 14, **characterized in that** an outer diameter of the first longitudinal section (28) of the sleeve section (26) corresponds to an inner diameter of the spring (4).

Fig. 1

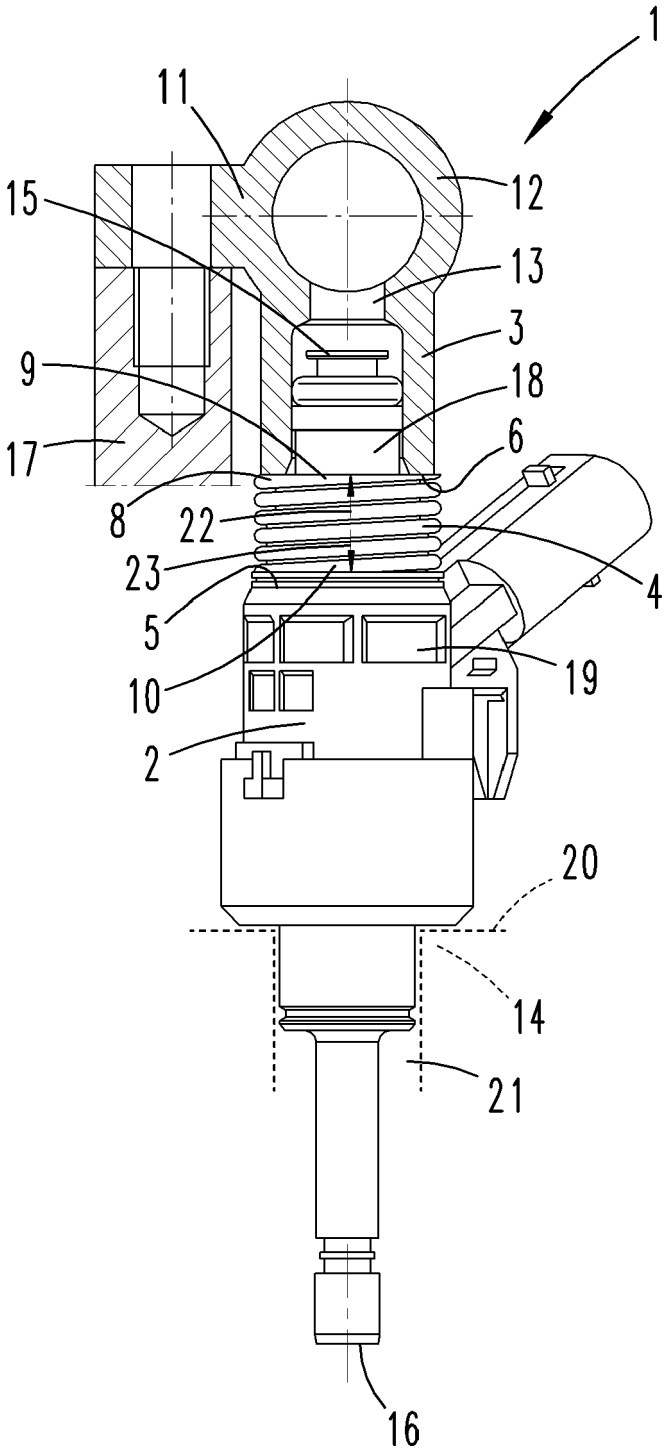

Fig: 2

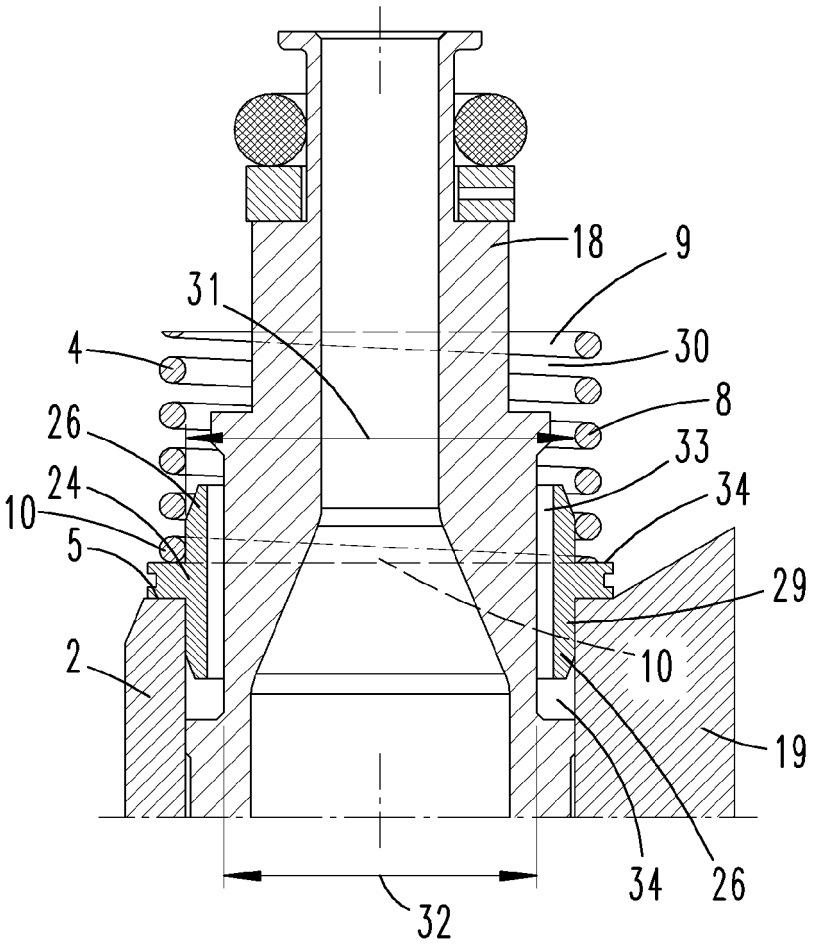
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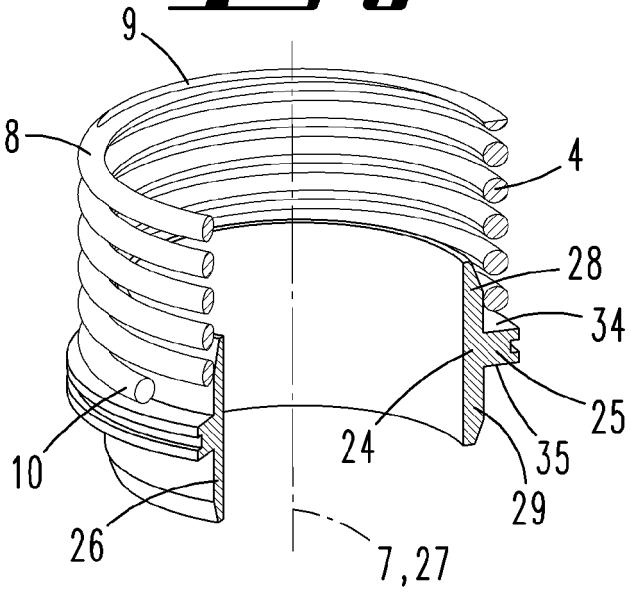
Fig: 3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EUROPEAN SEARCH REPORT

Application Number
EP 18 20 0493

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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
The Hague	5 April 2019	Nobre Correia, S

CATEGORY OF CITED DOCUMENTS

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