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(72) Inventors:
• **PEDLEY, Toby J**
London, SE12 8UX (GB)
• **FAIRBAIRN, Matthew**
Longfield, Kent DA3 8JG (GB)

(74) Representative: **Delphi France SAS**
Patent Department
22, avenue des Nations
CS 65059 Villepinte
95972 Roissy CDG Cedex (FR)

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(71) Applicant: **Delphi International Operations**
Luxembourg S.à r.l.
4940 Bascharage (LU)

(54) **PUMPING ASSEMBLY**

(57) A pumping assembly for a high pressure diesel fuel pump comprises a spring seat member (120) against which a plunger return spring (106) abuts, and a shoulder member (140) which is coupled to the plunger (104); wherein the plunger (104) protrudes through a clearance through hole (134) of the spring seat member (120) such that the plunger is decoupled from the spring seat member (120) so that spring forces do not act on the plunger (104) and it is able to self-centre during operation of the pump. The pumping assembly further comprises a shoe (112), a top face (164) of which being non-orthogonal to a pumping axis (A).

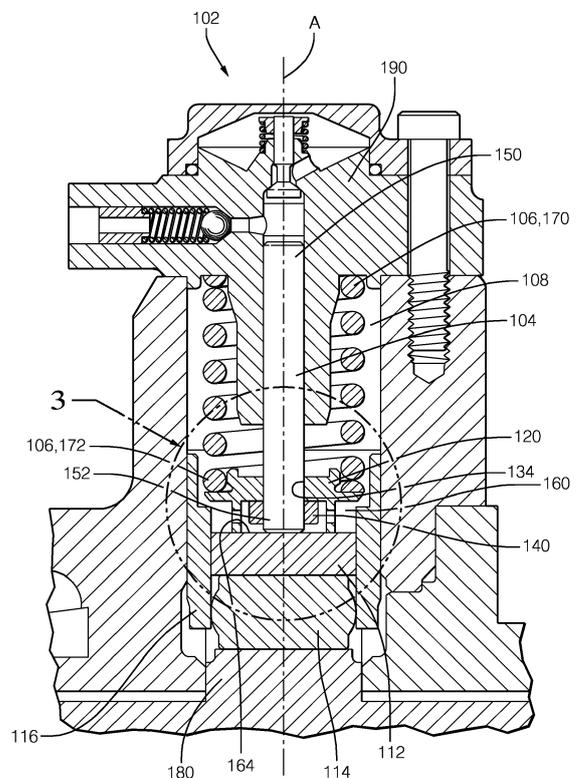


FIG. 2

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Description

TECHNICAL FIELD

[0001] The present invention relates to a pumping assembly for a pump, and specifically to a pumping assembly for a high pressure diesel fuel pump.

BACKGROUND OF THE INVENTION

[0002] A currently known pumping assembly 2 is illustrated in Figure 1, and comprises a pumping element in the form of a plunger 4, and a plunger return spring 6 located in a spring chamber 8. Rotation of a cam lobe 80 of a driveshaft assembly causes force to be transferred to the plunger 4 via a roller 14 and a shoe 12, thereby causing the plunger 4 to move in a reciprocating motion, thereby to pressurise fuel within a control chamber.

[0003] The components which transfer rotational movement of the cam lobe 80 to the plunger 4 must be in contact with each other at all times. The spring 6 maintains contact between the roller 14 and the cam lobe 80 by acting through a spring seat 10, which is rigidly mounted on the plunger 4. A secondary function of the spring seat 10 is to act as a guide for a lower end of the spring 6, maintaining it concentrically with the upper end of the spring 6.

[0004] The spring forces are transferred through the spring seat 10/plunger 4 assembly which thus experiences the spring forces, both axial and radial, during the filling and pumping strokes.

[0005] A disadvantage of this prior art embodiment is that radial spring force / side load applied to the plunger 4 via contact between the spring seat 10 and the plunger 4, can cause wear, and possibly eventual seizure, of the plunger 4.

SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to provide a pumping assembly which at least mitigates the problems encountered with known embodiments.

[0007] Accordingly the present invention provides, in a first aspect, a pumping assembly according to claim 1.

[0008] The pumping assembly may further comprise a shoulder member which is coupled to the plunger at or near the second end of the plunger; wherein the surface against which the end of the spring remote from the housing part abuts is provided on a radial section of the spring seat member; wherein the radial section of the spring seat member is located between the shoulder member and the housing part; wherein the surface of the spring seat member which abuts the shoe comprises a surface of an axial section of the spring seat member; and wherein the shoulder member is located in a void between the axial section of the spring seat member, and the plunger.

[0009] In one embodiment, a top face of the shoe, prox-

imate the plunger and remote from the roller, is non-orthogonal to the pumping axis.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The present invention is now described by way of example with reference to the accompanying drawings in which:

10 Figure 2 is a longitudinal cross-sectional view of a pumping assembly in accordance with a first embodiment of the present invention;

15 Figure 3 is a cross-sectional partial view of the pumping assembly of Figure 2;

20 Figure 4 is an isometric partial cross-sectional view of the pumping assembly of Figure 2 and

25 Figure 5 is a longitudinal cross-sectional view of a pumping assembly in accordance with a second embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] An embodiment of the present invention is described below in relation to the orientation of the figures. Terms such as upper, lower, upwards, downwards, above and below are not intended to be limiting.

30 **[0012]** Referring to Figure 2, the present invention comprises a pumping assembly 102. The pumping assembly 102 comprises a pumping element in the form of a plunger 104, and a spring 106 located in a spring chamber 108.

35 **[0013]** The plunger 104 is located such that a first, upper end 150 thereof is located within a housing part 190, and a second, lower end 152 is located proximate a shoe 112. The shoe 112 is located within a void 160 of a shoe guide 116.

40 **[0014]** Rotation of a cam lobe 180 of a driveshaft assembly causes force to be transmitted to the plunger 104, via a roller 114 and the shoe 112. The transferred force causes the plunger 104 to move in a reciprocating motion along a pumping axis A.

45 **[0015]** The spring 106 comprises a first, upper end 170, proximate the housing part 190, and a second, lower end 172, remote from the housing part 190 and proximate the shoe 112.

50 **[0016]** A spring seat member 120 is located around the plunger 104. A shoulder member 140 is also located around the plunger 104, at or towards the lower end 152 of the plunger 104.

55 **[0017]** Referring to the detailed view of Figure 3, the spring seat member 120 comprises a radial section 122, remote from the shoe 112, which extends radially with respect to the pumping axis A, and an axial section 124, between the radial section 122 and the shoe 112, which

extends axially with respect to the pumping axis A.

[0018] The axial section 124 extends from a junction 136 with the radial section 122, toward the shoe 112, and a void 126 is present between the axial section 124 and the plunger 104.

[0019] The radial section 122 includes an upper surface 128 (i.e. a surface facing the housing part 190), against which the lower end 172 of the spring 106 abuts; the upper surface 128 of the radial section 122 of the spring seat member 120 therefore acts as a spring seat.

[0020] The spring seat member 120 is located directed on the shoe 112, i.e. such that a lower surface 132 of the axial section 124 of the spring seat member 120, remote from the housing part 190, abuts a top surface 164 of the shoe 112 remote from the roller 114.

[0021] The plunger 104 protrudes through a clearance through hole 134 provided in the spring seat member 120. Due to a clearance fit between the spring seat member through hole 134 and the plunger 104, the plunger 104 is not coupled to the spring seat member 120.

[0022] The shoulder member 140 is coupled to the plunger 104 towards the lower end 152 of the plunger 104, for example in an interference fit. The shoulder member 140 is located further away from the housing part 190 than the radial section 122 of the spring seat member 120, such that the radial section 122 of the spring seat member 120 is located between the housing part 190 and the shoulder member 140.

[0023] On a filling stroke of the pumping assembly 102, the spring force of the spring 106 acts on the spring seat member 120, urging it downwardly. Abutment of a lower surface 130 of the radial section 122 of the spring seat member 120, against an upper surface 144 of the shoulder member 140, causes a corresponding downward movement of the shoulder member 140, and therefore also of the plunger 104 to which the shoulder member 140 is coupled.

[0024] A further optional feature of the present invention is illustrated in Figure 5. In this embodiment of a pumping assembly 202, all other components are as the first embodiment, except for the shoe 212. A top surface 264 of the alternative shoe 212, remote from the roller 114, is angled, i.e. is non-orthogonal with respect to the pumping axis A. (The angling of the surface 264 is accentuated in Figure 5 for ease of illustration). In this embodiment, side-loading on the shoe 212 during use of the pumping assembly 202, as spring forces are amplified by the angling of the shoe top surface 264, thereby to counter side loads.

[0025] In the present invention, spring force from the plunger return spring 106 is transferred to the shoe 112 through the spring seat member 120. The spring seat member 120 is not coupled to the plunger 104 as in the prior art embodiment. This is advantageous in that the spring seat member 120 adds a stabilising action on the shoe 112, restricting tilting of the shoe 122 and any resulting side load, due to the radius at which the spring force acts.

[0026] A further advantage of the present invention is that the a fluid film is reestablished around the circumference of the plunger 104. During a pumping stroke, the plunger 104 will have been forced to adopt a certain position/orientation by the pumping forces and plunger return spring forces. If the magnitude and direction of the plunger return spring forces are such that the plunger 104 remains in this position during the filling stroke, then fresh fluid will not have been able to find its way between the plunger 104 and the bore of the housing part 190 in which it is located, at the positions of contact, before the next pumping stroke commences. With the de-coupled plunger 104 of the present invention, spring forces are no longer acting on the plunger 104 during the filling stroke, i.e. the plunger 104 is not restrained radially, and the plunger 104 is therefore able to self-centre during a filling stroke. Fluid is therefore able to find its way between the plunger 104 and the bore.

20 REFERENCES

Prior art

[0027]

pumping assembly 2
plunger 4
spring 6
spring chamber 8
spring seat 10
shoe 12
roller 14
cam lobe 80

35 Invention

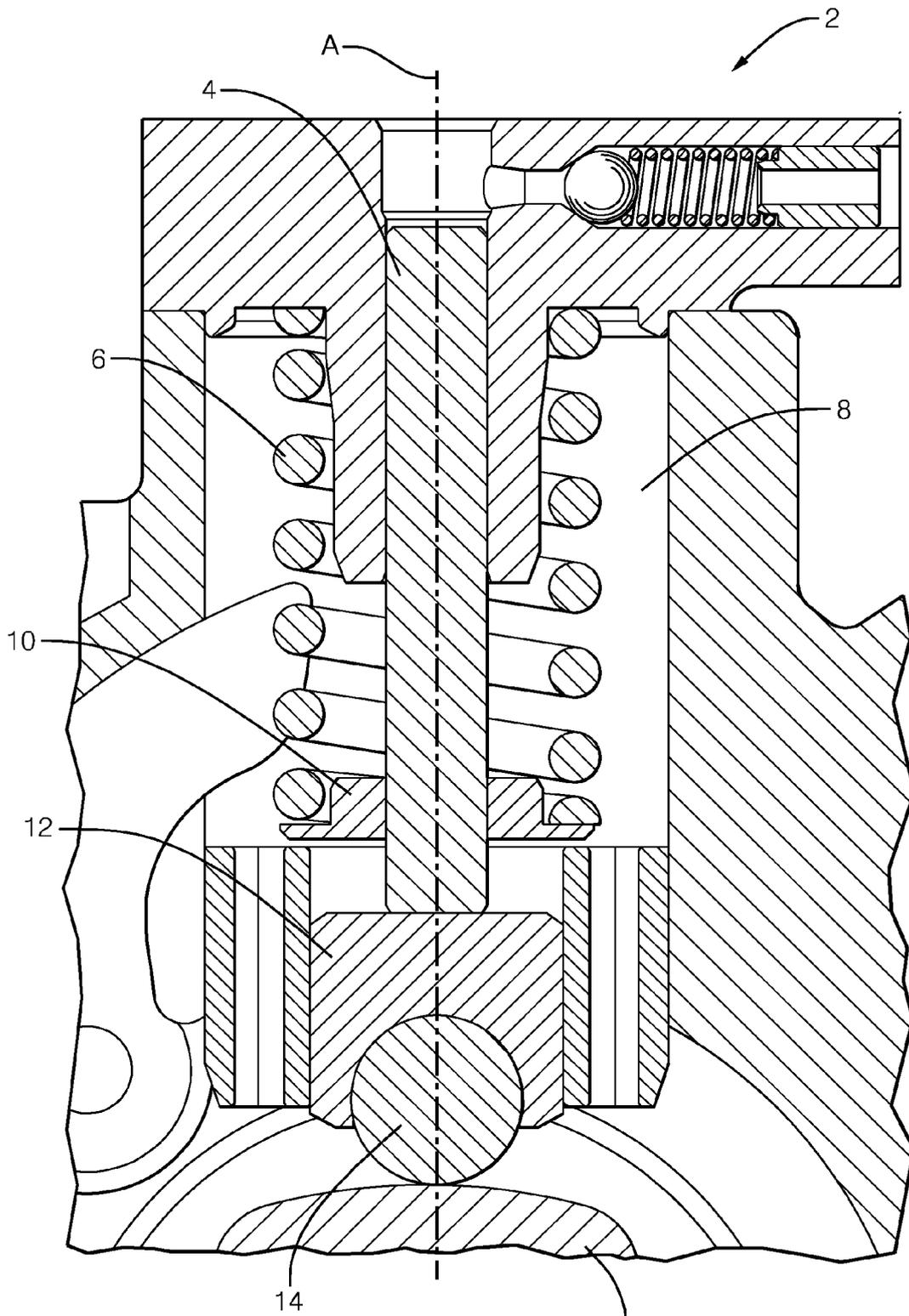
[0028]

pumping assembly 102, 212
plunger 104
spring 106
spring chamber 108
shoe 112
roller 114
spring seat member 120
spring seat member radial section 122
spring seat member axial section 124
axial section void 126
radial section upper surface 128
radial section lower surface 130
axial section lower surface 132
spring seat member clearance through hole 134
spring seat member junction 136
shoulder member 140
plunger first, upper end 150
plunger second, lower end 152
spring seat member void 160
shoe top surface 164, 264

spring upper end 170
 spring lower end 172
 cam lobe 180
 housing part 190
 pumping axis A 5

Claims

1. A pumping assembly (102) comprising a plunger (104) and a spring (106) located within a spring chamber (108), wherein a first end (150) of the plunger (104) is located within a housing part (190), and a second end (152) of the plunger (104) remote from the first end (150) is proximate a shoe (112, 212), and wherein reciprocating movement of the plunger (104) along a pumping axis (A) is caused by force transferred from a rotating cam lobe (180), via a roller (114) and a shoe (112,212); 10
- the pumping assembly (102) further comprising spring seat member (120) comprising a surface (128) against which an end (172) of the spring (106) remote from the housing part (190) abuts; the spring seat member (120) further comprising a surface (132) which abuts the shoe (112, 212); 15
- wherein the plunger (104) is located within a through hole (134) of the spring seat member (120) and wherein a clearance fit exists between the spring seat member through hole (134) and the plunger (104); 20
- the pumping assembly (102) further comprising a shoulder member (140) which is coupled to the plunger (104) at or near the second end (152) of the plunger; 25
- wherein the surface (128) against which the end (172) of the spring (106) remote from the housing part (190) abuts is provided on a radial section (122) of the spring seat member (120); wherein the radial section (122) of the spring seat member (120) is located between the shoulder member (140) and the housing part (190); 30
- wherein the surface (132) of the spring seat member (120) which abuts the shoe (112, 212) comprises a surface (130) of an axial section (124) of the spring seat member (120); and wherein the shoulder member (140) is located in a void (126) between the axial section (122) of the spring seat member (120), and the plunger (104); 35
- wherein the shoe (212) comprises a top face (264), proximate the plunger (104) and remote from the roller (114), and wherein the top face (264) of the shoe (212) is non-orthogonal to the pumping axis (A). 40
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PRIOR ART
FIG. 1

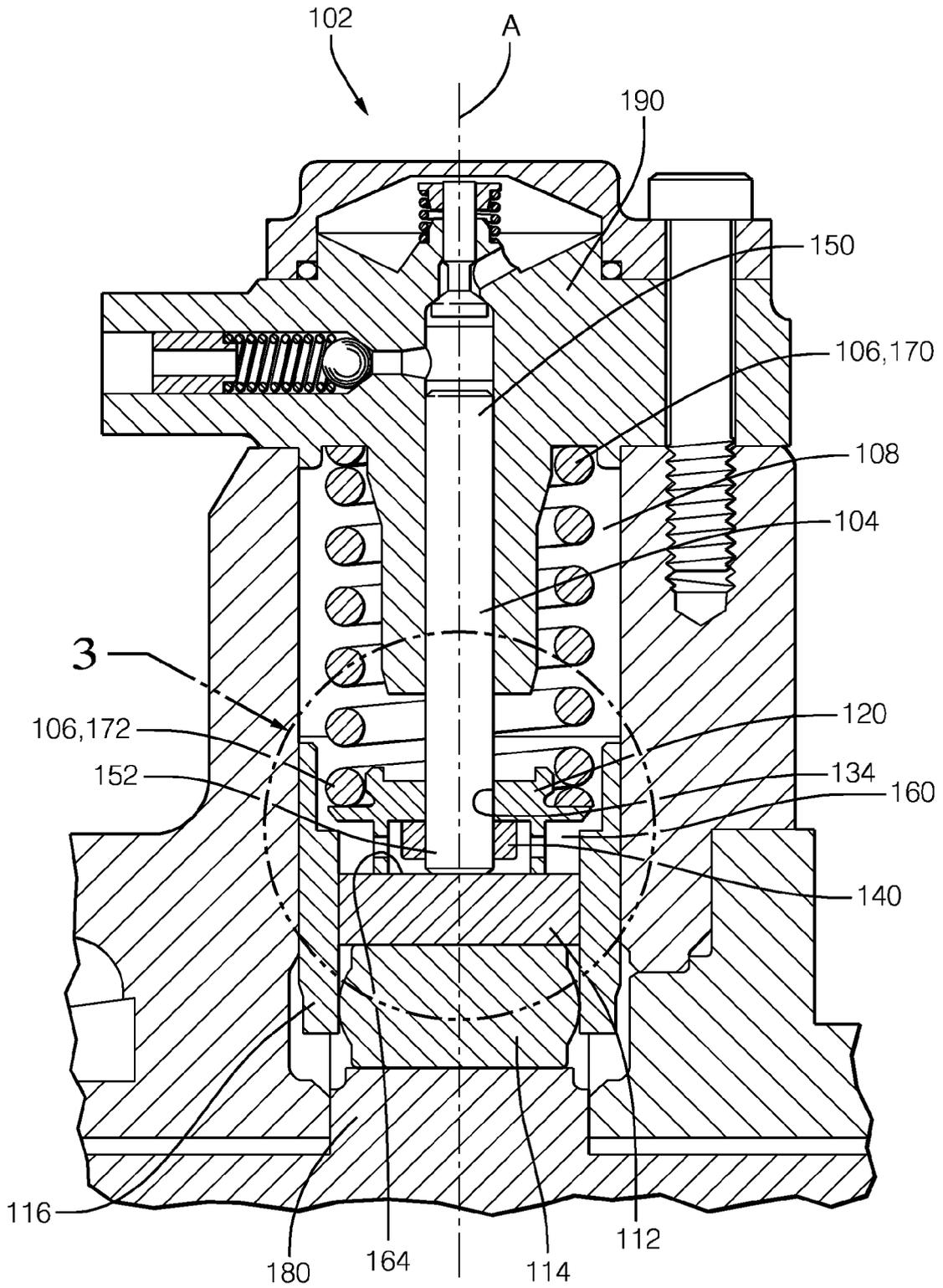


FIG. 2

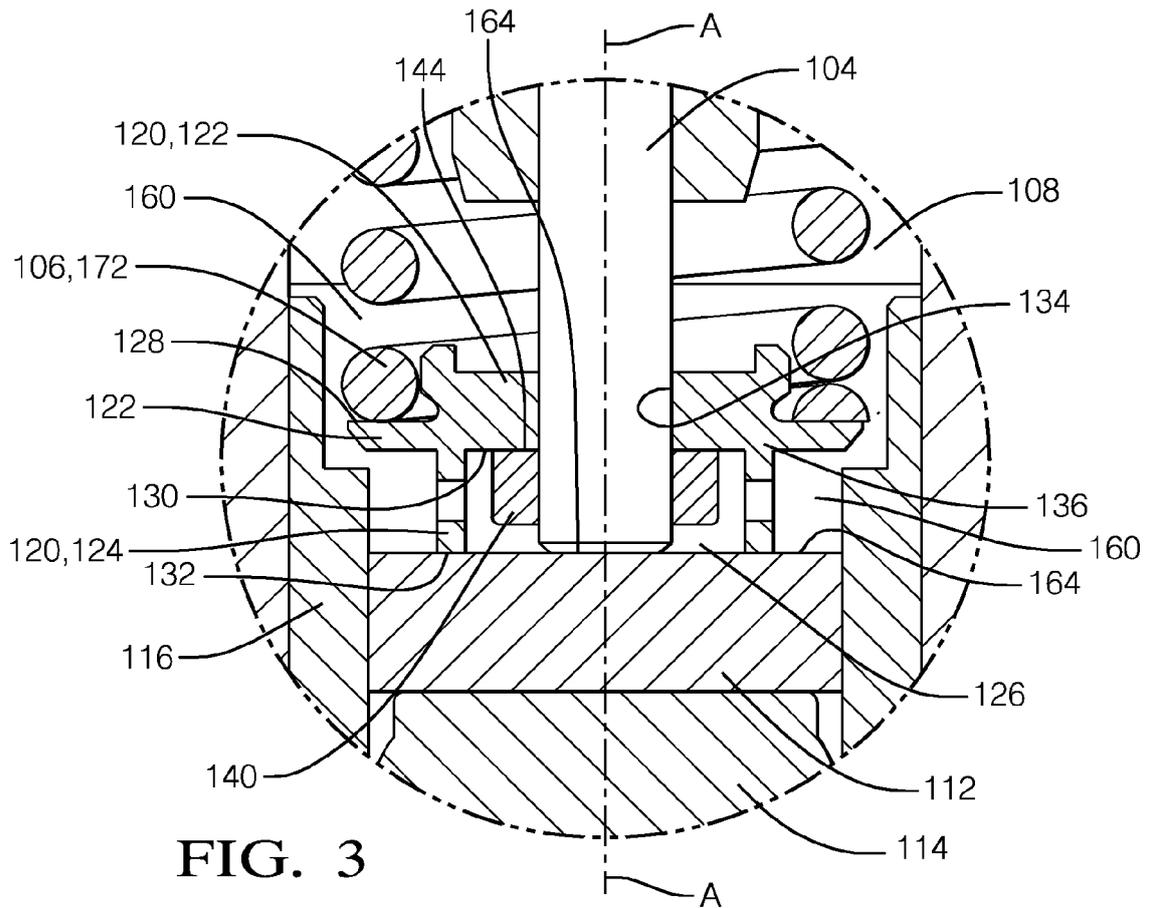


FIG. 3

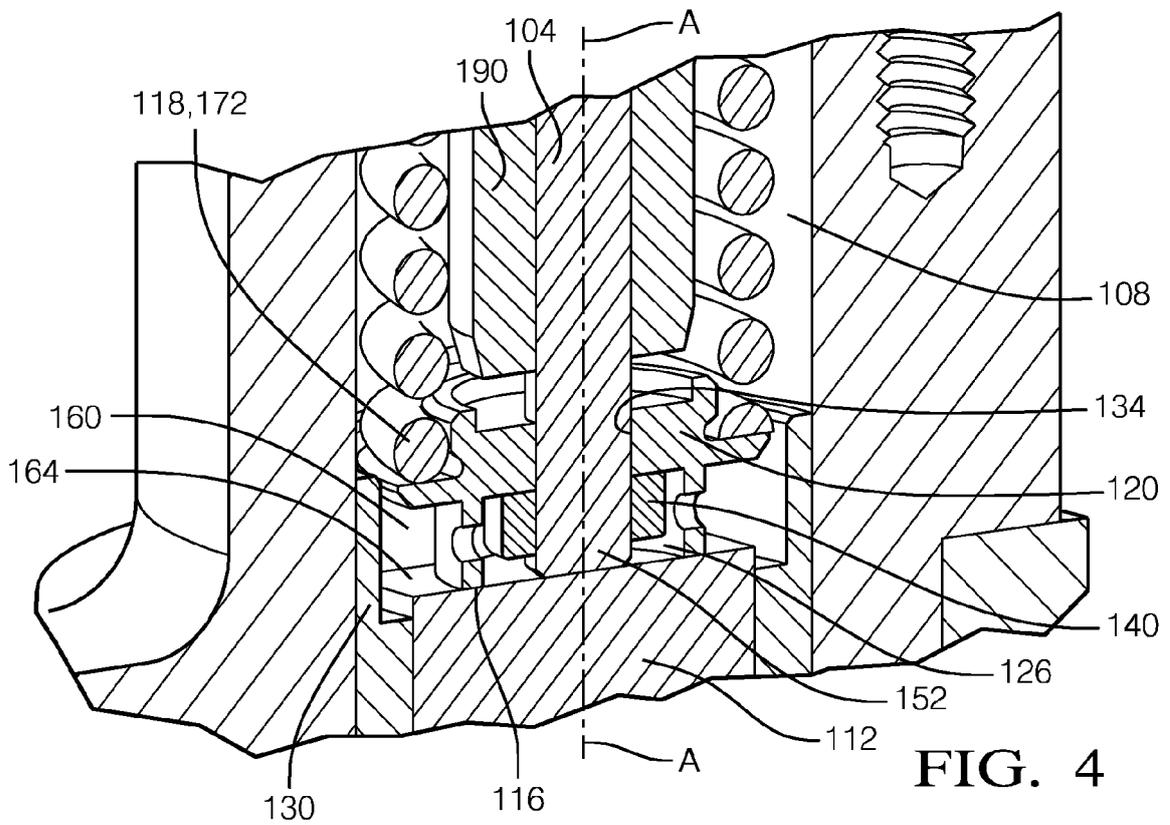


FIG. 4

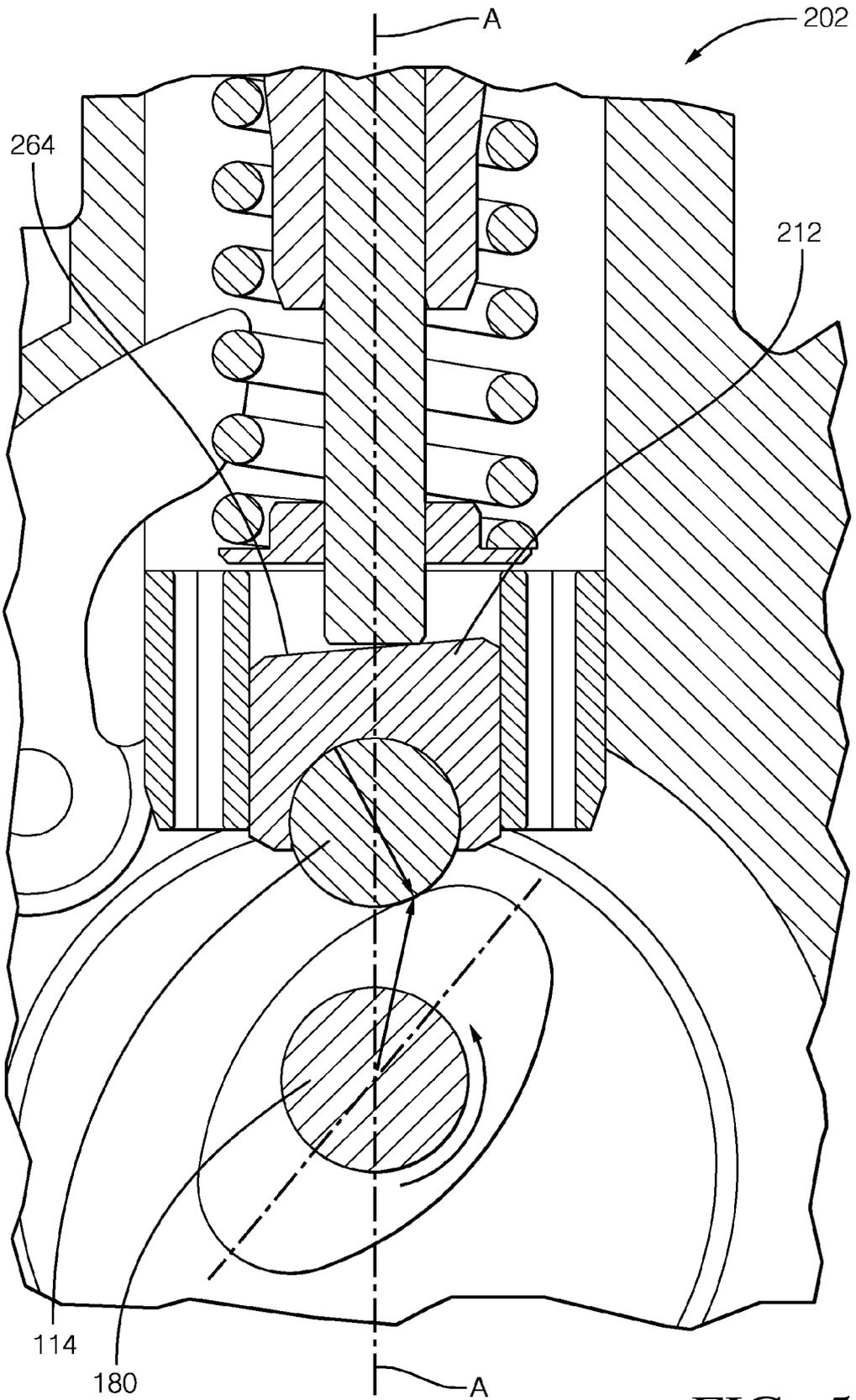


FIG. 5



EUROPEAN SEARCH REPORT

Application Number
EP 16 19 1550

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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			F02M F04B
Place of search		Date of completion of the search	Examiner
Munich		26 January 2017	Olona Laglera, C
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	

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ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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