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(54) **PUMPING ASSEMBLY**

(57) A pumping assembly comprising a reciprocating plunger, and a spring in a spring chamber, wherein an end of the spring abuts a spring seat which is not in contact with the plunger, thereby avoiding wear and tear of the plunger by the spring seat; the spring seat being provided by a surface of a first member located around the plunger, and wherein a second member is fixedly attached to the plunger, wherein first member location means, comprising for example a surface of a recess or spigot of a shoe, locates, and preferably centres, the first member with respect to the plunger.

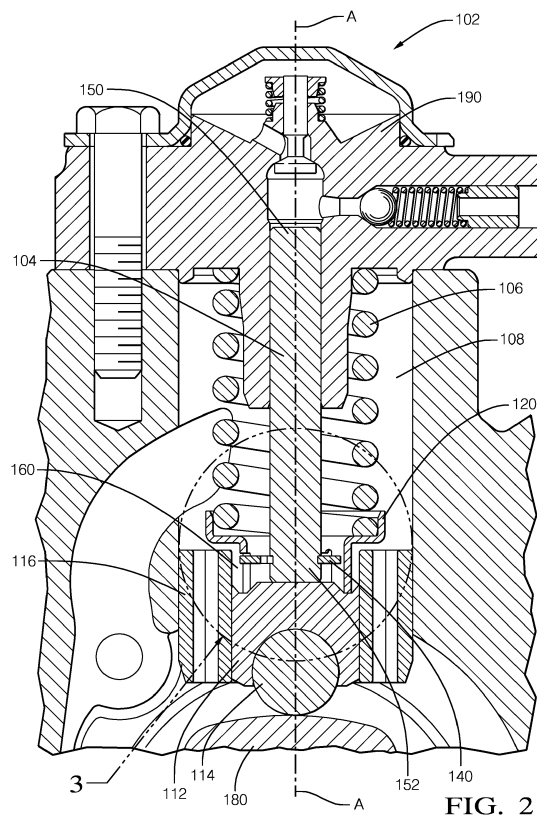


FIG. 2

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. The spring force must be sufficiently high to maintain constant contact between the roller 14 and the cam lobe 80.

[0004] 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.

[0005] A disadvantage of this prior art embodiment is that in addition to axial forces, the spring 6 may apply a side load, i.e. radial force, to the plunger 4, via contact between the spring seat 10 and the plunger 4. Radial forces applied to 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 comprise a first member and a second member, wherein the spring seat is provided on the first member, and wherein the second member is fixedly attached to the plunger.

[0009] The second member may be clipped into a groove provided in the plunger, and wherein arms of second member are located and free to move within longitudinally extending apertures provided in the first member.

[0010] The first member may comprise a radial section which extends radially with respect to the pumping axis A; wherein the radial section is located between the second member and the housing part; and wherein the spring seat is provided by a surface of the radial section.

[0011] The first member may further comprise an axial

section which extends axially with respect to the pumping axis from a junction with the radial section, and wherein a surface of the axial section constrains the end of the spring in a radial direction.

[0012] The pumping assembly may further comprise first member location means, for locating the first member with respect to the plunger.

[0013] The first member location means may comprise walls or surfaces of a groove recess or a spigot provided on the shoe.

[0014] The walls or surfaces of the groove recess or spigot may comprise walls or surfaces which are orthogonal to an upper surface of the shoe.

[0015] The first member location means may comprise an annular groove recess provided in a top face of the shoe, remote from the roller, wherein the groove recess comprises tapered faces which act to centre the first member with respect to the plunger.

[0016] In an alternative embodiment, the first member location means comprises a counter feature provided in a top face of the shoe, the counter feature comprising a tapered wall which acts to centre the first member with respect to the plunger.

[0017] In a further alternative embodiment, the first member location means comprises a raised spigot provided on a top face of the shoe, wherein an outer face of the spigot acts to centre the first member with respect to the plunger.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The present invention is now described by way of example with reference to the accompanying drawings in which:

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

Figures 3 and 4 are detailed partial longitudinal cross-sectional views of the pumping assembly of Figure 2;

Figure 5 is a top view of a first member and a second member of the pumping assembly of Figure 2;

Figure 6 is a side view of the first and second members of Figure 5;

Figure 7 is an isometric view of a shoe in accordance with the first embodiment of the present invention;

Figure 8 is an isometric view of a shoe in accordance with a second embodiment of the present invention;

and

Figure 9 is an isometric view of a shoe in accordance

with a third embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] An embodiment of the present invention is described below in relation to the orientation of the figures. Terms such as upper, lower, above, below, top, bottom, horizontal and vertical are not intended to be limiting.

[0020] A pumping assembly 102 according to a first embodiment of the present invention is illustrated in Figure 2, and detailed views are provided in Figures 3 and 4. 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. 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. Rotation of a cam lobe 180 of a driveshaft assembly causes force to be transmitted to the plunger 104, via a roller 114 and a shoe 112. The transferred force causes the plunger 104 to move in a reciprocating motion along a pumping axis A.

[0021] The shoe 112 is located within a void 160 of a shoe guide 116.

[0022] A seat guide, or first member 120, and a plunger return clip, or second member 140, are located around, and towards the second, lower end 152 of the plunger 104.

[0023] The first and second members 120, 140 can be formed from sheet metal. The first member 120 can be formed by deep drawing, with piercings to form side apertures (described below) and a lower opening. The second member 140 can be a fine blanked component.

[0024] Referring to the detailed views of Figures 3 and 4, the first member 120 comprises a first, upper part 122 and a second, lower part 136. In the embodiment illustrated in Figures 2 to 4, the first, upper part 122 is located in the spring chamber 108, and the second, lower part 136 is located at least partially within the void 160 of the shoe guide 116.

[0025] The first part 122 of the first member 120 comprises an axial section 124 and a radial section 126. The axial section 124 is remote from the shoe 112 and extends axially with respect to the plunging axis A. The radial section 126 is closer to the shoe 112 than the axial section 124, and extends radially between a junction 128 with the axial section, and a junction 128 with the second part 136.

[0026] An upper surface 130 of the radial section 126, acts as a spring seat for the spring 106. An end 118 of the spring 106, remote from the housing part 190, abuts the upper surface 130 of the radial section 126; the end 118 of the spring 106 is therefore constrained in an axial direction by the radial section 126. The radial section 126, and therefore the upper surface 130, are of a radial width greater than that the coils of the spring 106, thereby providing a full spring seat.

[0027] An inner surface 132 of the axial section 124 constrains, in a radial direction, an outer diameter of the

spring 106 towards the lower end 118.

[0028] The second, lower part 136 of the first member 120 comprises an axial member which extends in the direction of the pumping axis A, from the junction 134 with the first, upper part 122.

[0029] Towards the second, lower end 152 of the plunger 104, proximate the shoe 112, is provided a second member location means, to fixedly attach the second member 140 to the plunger 104. In the illustrated embodiment, the locating means comprises a radial groove 162, into which the second member 140 is clipped. Accordingly, during operation of the pumping assembly 102, the plunger 104 and the second member 140 move together.

[0030] A first member location means is also provided, for locating the first member 120. In the illustrated embodiment, the first member location means comprises an annular groove recess 166 provided in a top face 164 of the shoe 112, remote from the roller 114. The groove recess 166 can be added at a milling stage of production of the shoe 112.

[0031] Referring to Figure 4, the groove recess 166 has a 'V' form, comprising tapered surfaces 170, 172, and a flat lower face 168 at the bottom of the V between the tapered surfaces 170, 172. A lower end face 138 of the second, lower part 136 of the first member 120 abuts against the lower face 168 of the groove recess 166.

[0032] The tapered sides 170, 172 of the groove recess 166 act to centre the first member 120 with respect to the plunger 104 during assembly.

[0033] The design of the groove recess 166 is such that it has minimal effect on the structural and functional integrity of the shoe 112.

[0034] Figures 5 and 6 illustrate the first member 120 and the second member 140. As illustrated in Figure 5, a clearance 174 is provided between a main outer diameter 154 of the second member 140, and an inner diameter 156 of the first member 120.

[0035] The second member 140 is provided with three arms 142, each of which are located within a corresponding aperture 138 (two of which are indicated on Figure 6), provided in the second, lower part 136 of the first member 120.

[0036] The apertures 138 of the first member 120 extend longitudinally with respect to the pumping axis A, and each have a closed, upper end 146 proximate to the first part 122, and an open, lower end 144 remote from the first part 122.

[0037] A circumferential clearance 176 is provided between each of the arms and a side wall 148 of the apertures 138. A minimum, axial clearance 178 is also present between a top surface 158 of each arm 142 and the upper, closed end 146 of the 138 aperture in which it is located.

[0038] The clearances 174, 176, 178, allow the second member 140 and the plunger 104, on a filling stroke, to separate from the shoe 112 and float on the arms 142 within the apertures 138.

[0039] Any area of contact between the top face 158

of the arms 142 of the second member 140, and the blind end 146 of the apertures 138, is minimised by radii 182 provided at the blind end 146 of the apertures 138. Accordingly, frictional force as a result of contact between the arms 142 of the second member 140 and the blind ends 146 of the apertures 138, is also minimised, thus minimising any side forces transmitted by the spring 106 to the plunger 104 to an absolute minimum.

[0040] The 'C' clip design of the second member 140 utilises the elasticity of the material such that it is in an interference fit in the plunger annular groove 162 on assembly only; when installed it is in a clearance fit, partly to reduce stresses, and partly to prevent transmission of torque between the first member 120 and the plunger 104 via the second member 140.

[0041] In the shoe 112 of the first embodiment of the present invention, as illustrated separately in Figure 7, the first member location means is provided by the annular groove recess 166. Alternative embodiments can comprise alternative first member location means as discussed below.

[0042] A second, alternative embodiment of shoe for use in the present invention is illustrated in Figure 8. The alternative shoe 212, which is assembled into a pumping assembly in the same manner as the first embodiment, has a tapered body, i.e. the walls 292 taper towards the top surface 264 of the shoe 212, to assist assembly. Additional material may be added to the top of the shoe 212 to ensure structural integrity.

[0043] The alternative shoe 212 has a counter feature comprising a flat countersunk face 294 and a tapered wall 296. On assembly, the first member 140 is located within the counter feature 294, the tapered wall 296 acting as a first member location means, and also acts to centre the first member 120 with respect to the plunger 104, in the same manner as the groove recess of the first embodiment.

[0044] A third embodiment of shoe for use in the present invention is illustrated in Figure 9. The third embodiment of shoe 312, which is assembled into a pumping assembly in the same manner as the first and second embodiments, also has a tapered body, with walls 392 tapering towards the top surface 364 of the shoe 312 to assist assembly. Additional material again may be added to the top of the shoe 312 to ensure structural integrity. The further alternative shoe 312 is provided with a raised spigot 384. On assembly, the first member 120 locates around the raised spigot 384. An outer, tapered face 398 of the spigot 384 acts as a first member location means, and also acts to centre the first member 120 with respect to the plunger 104.

[0045] In an alternative embodiment of shoe in accordance with the present invention, the first member location means may comprise a recess or a spigot having surfaces which are orthogonal to the upper surface of the shoe, rather than being tapered. For example, in the first embodiment, either or both of the surfaces 170 and 172 of the groove recess 166 could comprise a surface which

is orthogonal to the upper surface 164 of the shoe 112.

[0046] Similarly, the tapered wall 296 of the counter feature of the second embodiment of shoe 212 could be orthogonal to the upper surface 264 of the shoe 212, and the outer face 398 of the spigot 384 of the third embodiment could be orthogonal to the upper surface 364 of the shoe 312.

[0047] In the present invention, the spring seat is located on top of the shoe, and is not in contact with the plunger, and therefore the prior art problem of wear and tear of the plunger caused by contact with the spring seat is avoided.

[0048] In all embodiments of the present invention, the first member location means acts to centre the first member 120 with respect to the plunger 104, therefore, contact between the plunger 104 and the first member 120 is not necessary to maintain the first member 120 concentrically.

[0049] The present invention is also considerably more cost effective to produce than prior art embodiments.

[0050] A further advantage of the present invention is that a longer head turret can be fitted into a pump than could be for a pump including certain prior art spring seats, as the spring is guided on its outside diameter, thereby freeing up space on the inside of the spring. Additionally, apertures which are necessary for circulation of fuel and lubrication of contact faces are much easier to manufacture in the present invention.

REFERENCES

Prior art

[0051]

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

Invention

[0052]

pump assembly 102
plunger 104
spring 106
spring chamber 108
shoe 112,212,312
roller 114
shoe guide 116
spring end 118
first member 120
first member first, upper part 122

first member first part axial section 124
 first member first part radial section 126
 junction axial/radial sections 128
 radial section upper surface 130
 axial section inner surface 132
 junction /second part 134
 first member second, lower part 136
 apertures 138
 second member 140
 second member arms 142
 lower open ends of apertures 144
 upper closed ends of apertures 146
 aperture side walls 148
 plunger first, upper end 150
 plunger second, lower end 152
 second member main outer diameter 154
 first member inner diameter 156
 top surface second member arm 158
 shoe guide void 160
 plunger radial groove 162
 shoe top face 164, 264, 364
 shoe top face annular groove recess 166
 groove recess flat lower face 168
 groove recess tapered surfaces 170, 172
 clearance 174
 clearance 176
 clearance 178
 cam lobe 180
 radii 182
 housing part 190
 alternative shoes tapered walls 292, 392
 alternative shoe countersunk face 294
 alternative shoe counter tapered wall 296
 further alternative shoe spigot 384
 spigot outer face 398
 pumping axis A

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, 312), and wherein reciprocating movement of the plunger (104) is caused by force transferred from a rotating cam lobe (180), via a roller (114) and a shoe (112, 212, 312);
 the pumping assembly (102) further comprising spring seat against which an end (118) of the spring (106) remote from the housing part (190) abuts, wherein the spring seat is not in contact with the plunger (104);
 the pumping assembly (102) comprising a first member (120) and a second member (140), wherein the spring seat is provided on the first member (120),

and wherein the second member (140) is fixedly attached to the plunger (104);
 wherein the second member (120) is clipped into a groove (162) provided in the plunger (104), and wherein arms (142) of second member (140) are located and free to move within longitudinally extending apertures (138) provided in the first member (120).

2. A pumping assembly (102) as claimed in claim 1 wherein the first member (120) comprises a radial section (126) which extends radially with respect to the pumping axis (A); wherein the radial section (126) is located between the second member (140) and the housing part (190); and wherein the spring seat is provided by a surface (130) of the radial section (126).
3. A pumping assembly (102) as claimed in claim 2 wherein the first member (120) further comprises an axial section (124) which extends axially with respect to the pumping axis (A) from a junction (128) with the radial section (126), and wherein a surface (132) of the axial section (124) constrains the end (118) of the spring (106) in a radial direction.
4. A pumping assembly (102) as claimed in any one of the preceding claims further comprising first member location means, for locating the first member (120) with respect to the plunger (104).
5. A pumping assembly (102) as claimed in claim 4 wherein the first member location means comprises walls or surfaces of a groove recess or a spigot provided on the shoe (112, 212, 312).
6. A pumping assembly (102) as claimed in claim 4 wherein the walls or surfaces of the groove recess or spigot comprise walls or surfaces which are orthogonal to an upper surface (164, 264, 364) of the shoe (112, 212, 312).
7. A pumping assembly (102) as claimed in claim 5 wherein the first member location means comprises an annular groove recess (166) provided in a top face (164) of the shoe (112), remote from the roller (114), wherein the groove recess (166) comprises tapered faces (170, 172) which act to centre the first member (120) with respect to the plunger (104).
8. A pumping assembly (102) as claimed in claim 5 wherein the first member location means comprises a counter feature provided in a top face (264) of the shoe (212), the counter feature comprising a tapered wall (296) which acts to centre the first member (120) with respect to the plunger (104).
9. A pumping assembly (102) as claimed in claim 5

wherein the first member location means comprises a raised spigot (384) provided on a top face (364) of the shoe (312), wherein an outer face (398) of the spigot (384) acts to centre the first member (120) with respect to the plunger (104).

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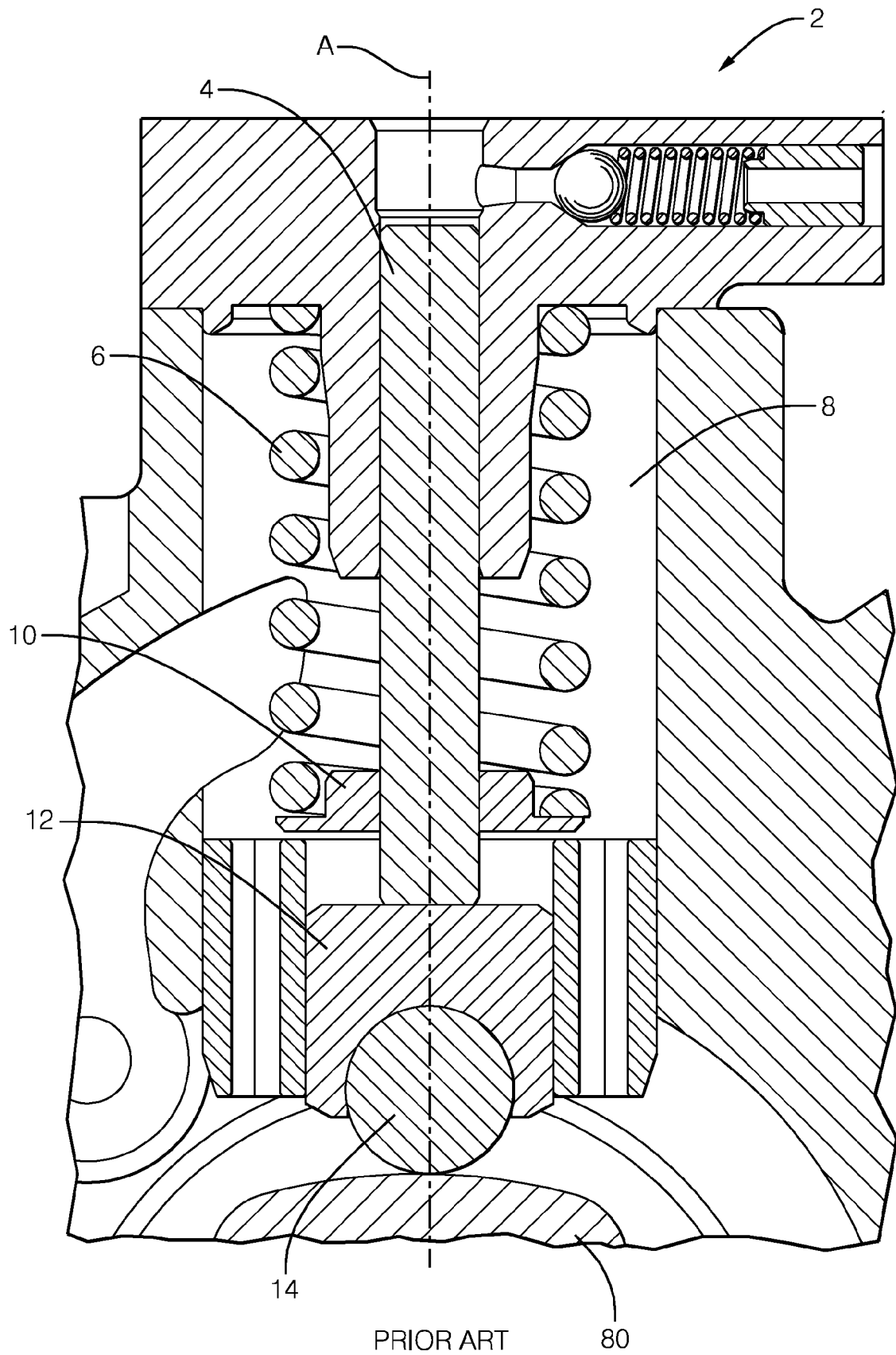
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PRIOR ART
FIG. 1

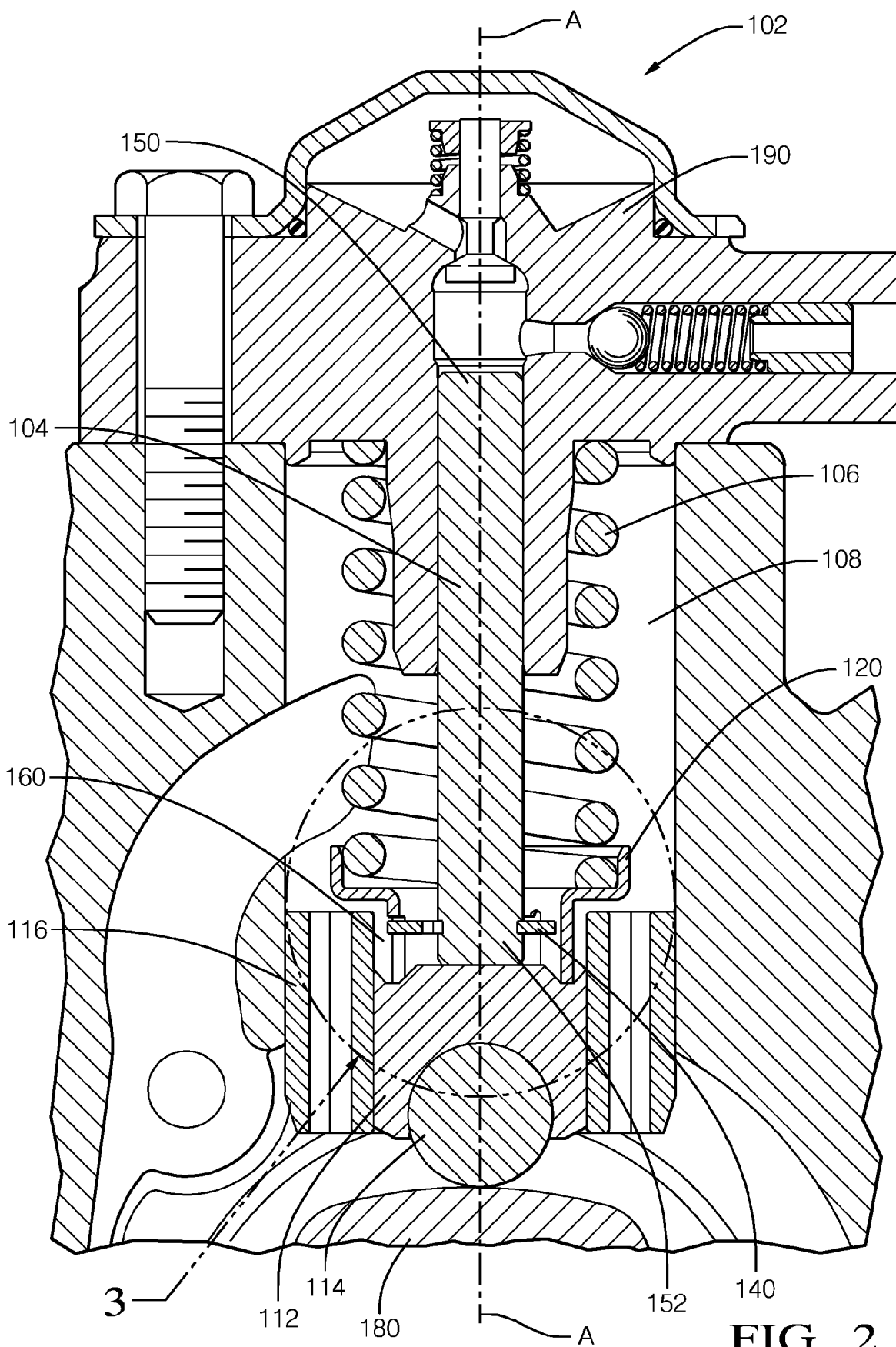
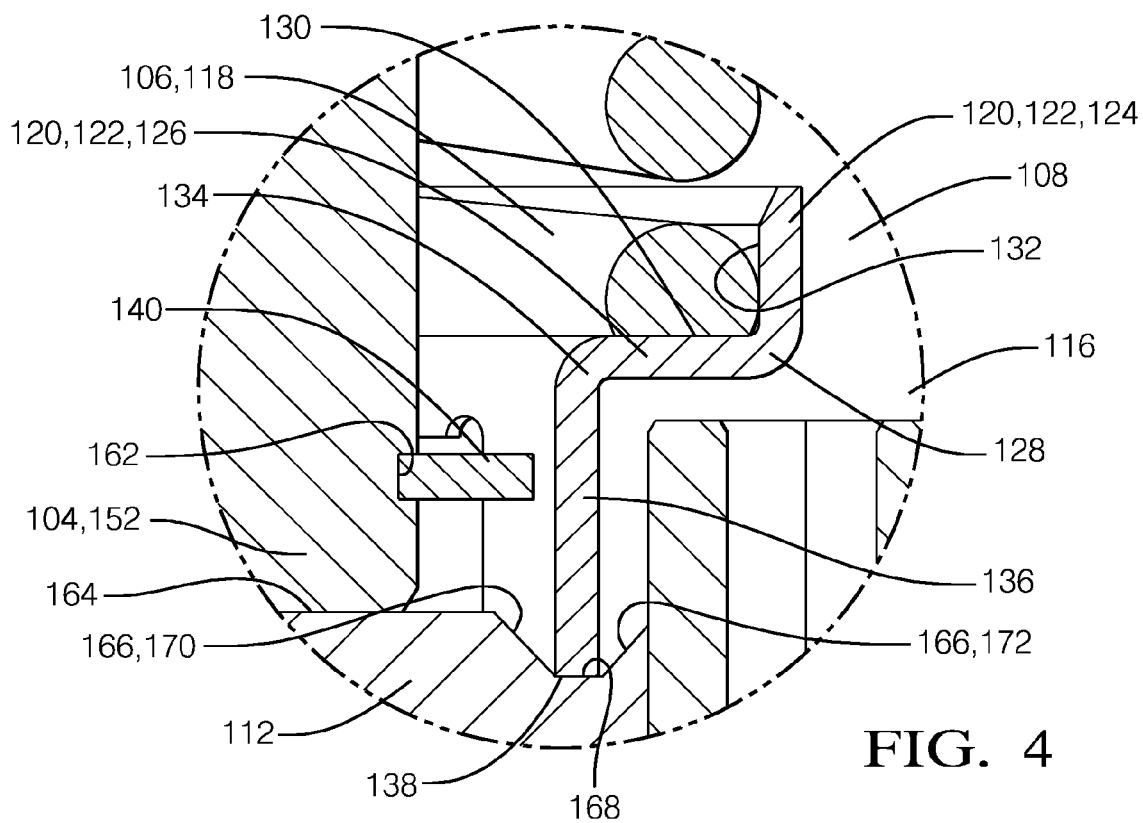
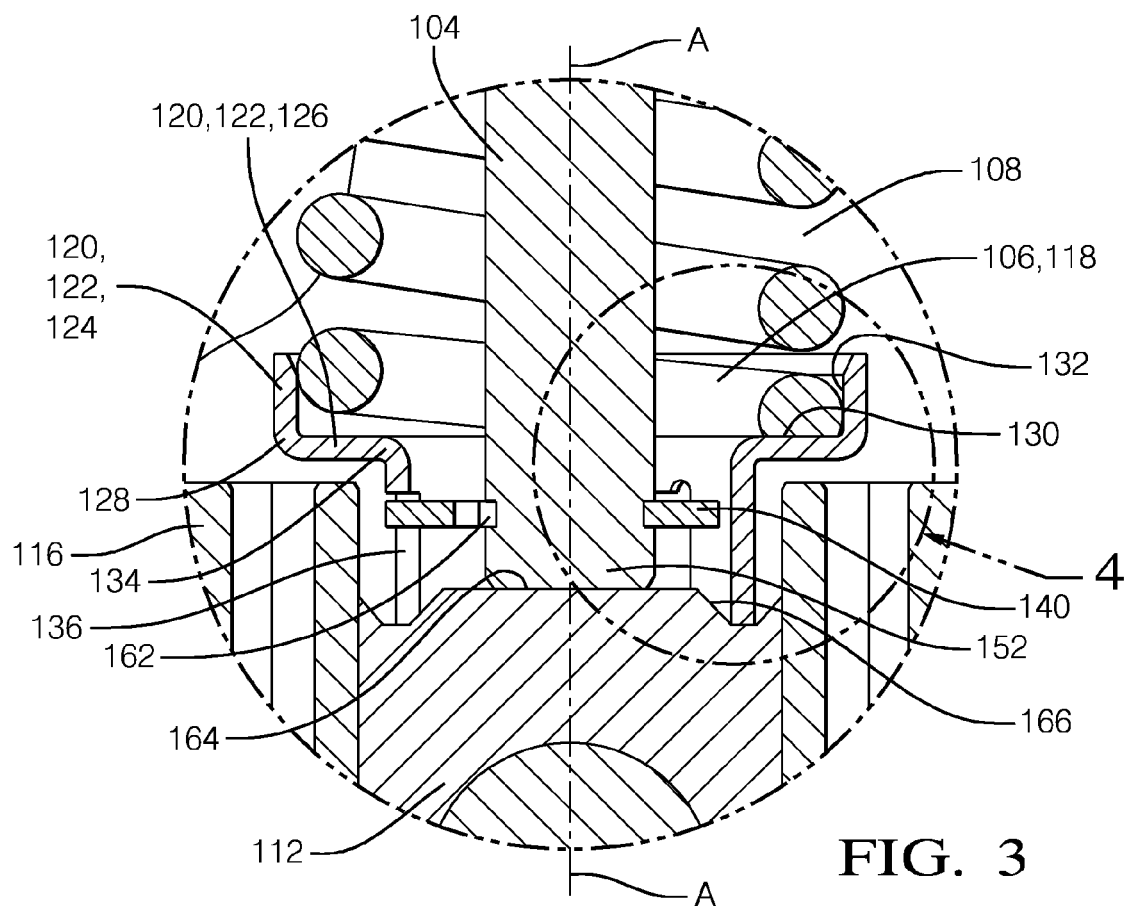


FIG. 2



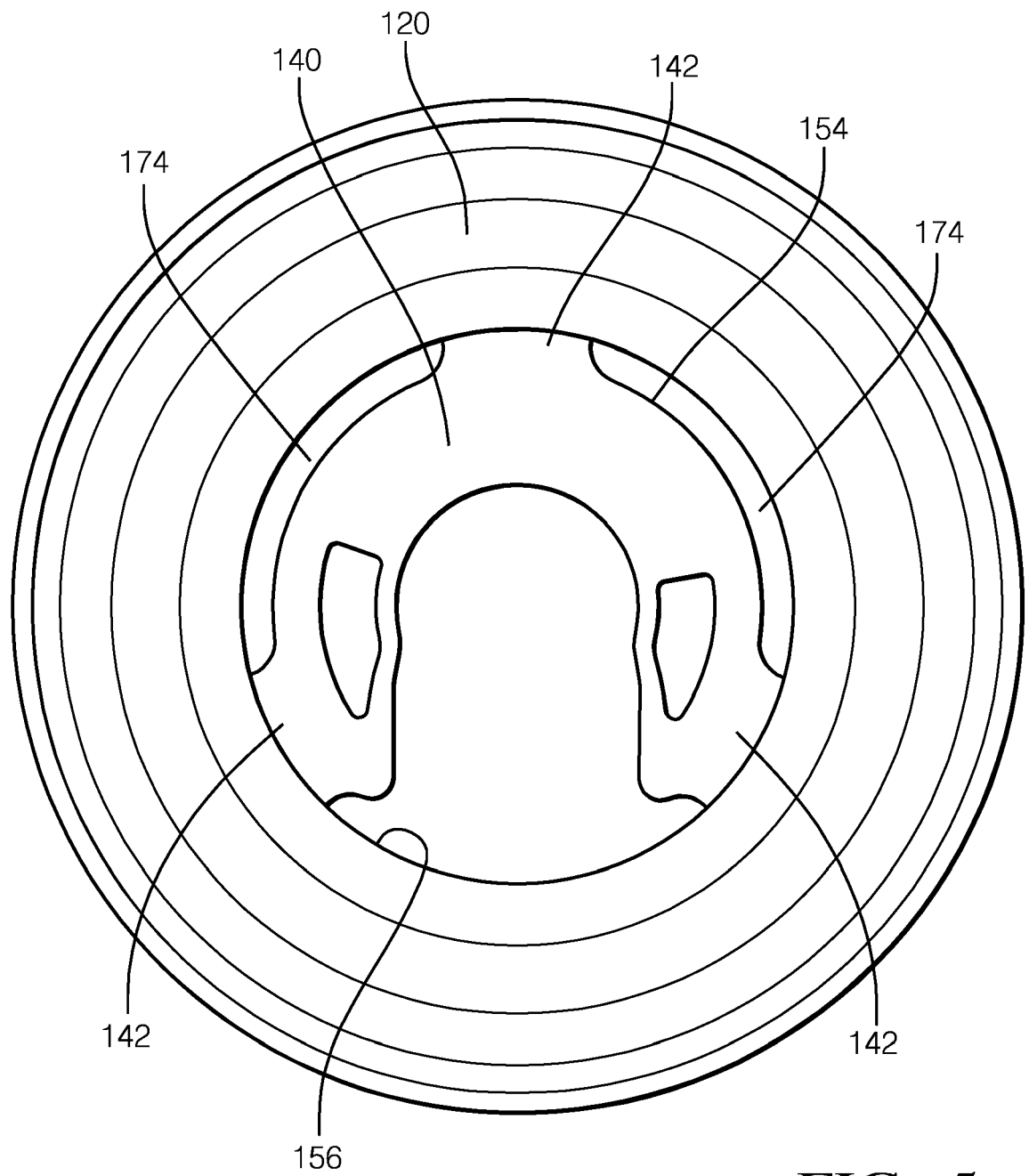


FIG. 5

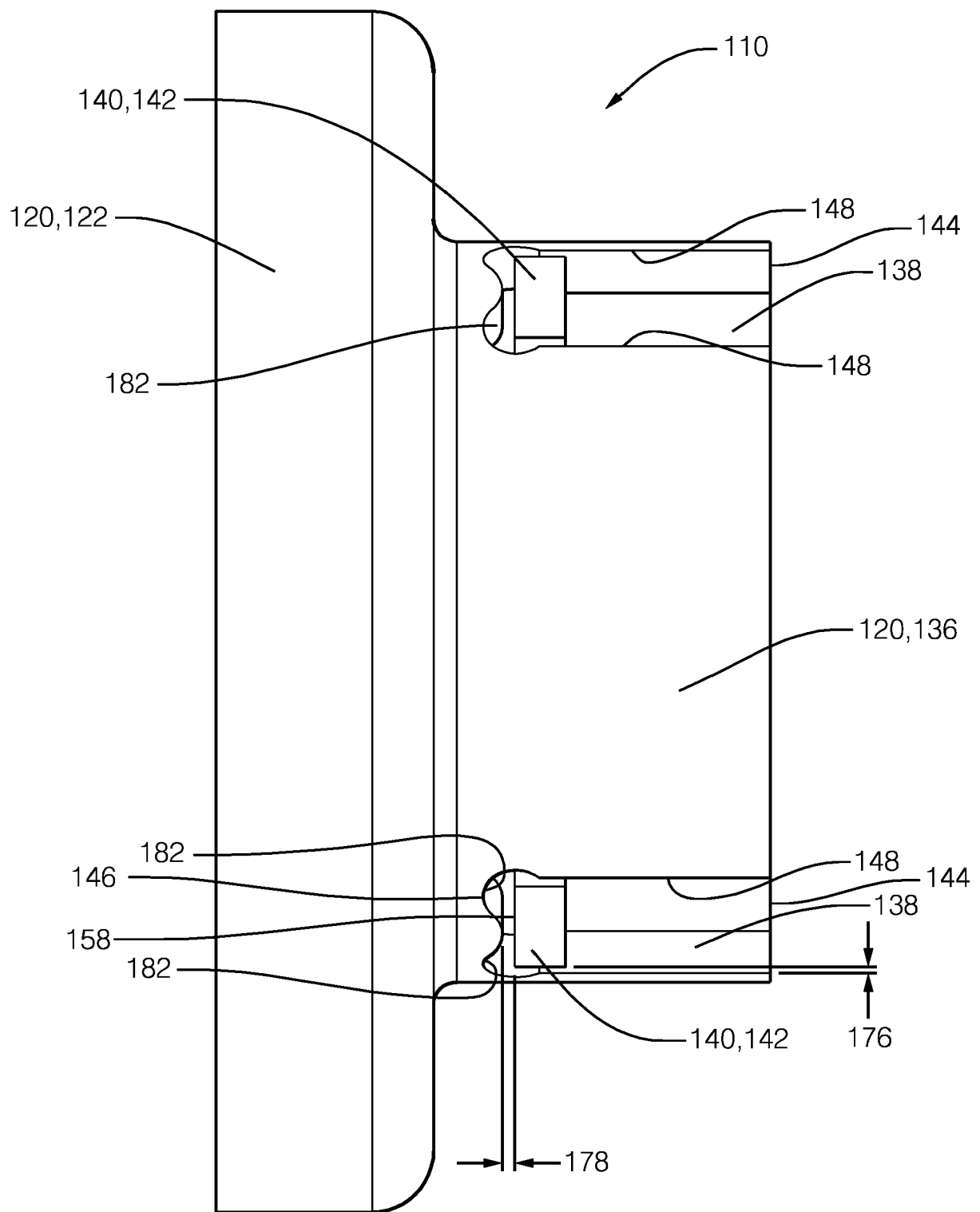


FIG. 6

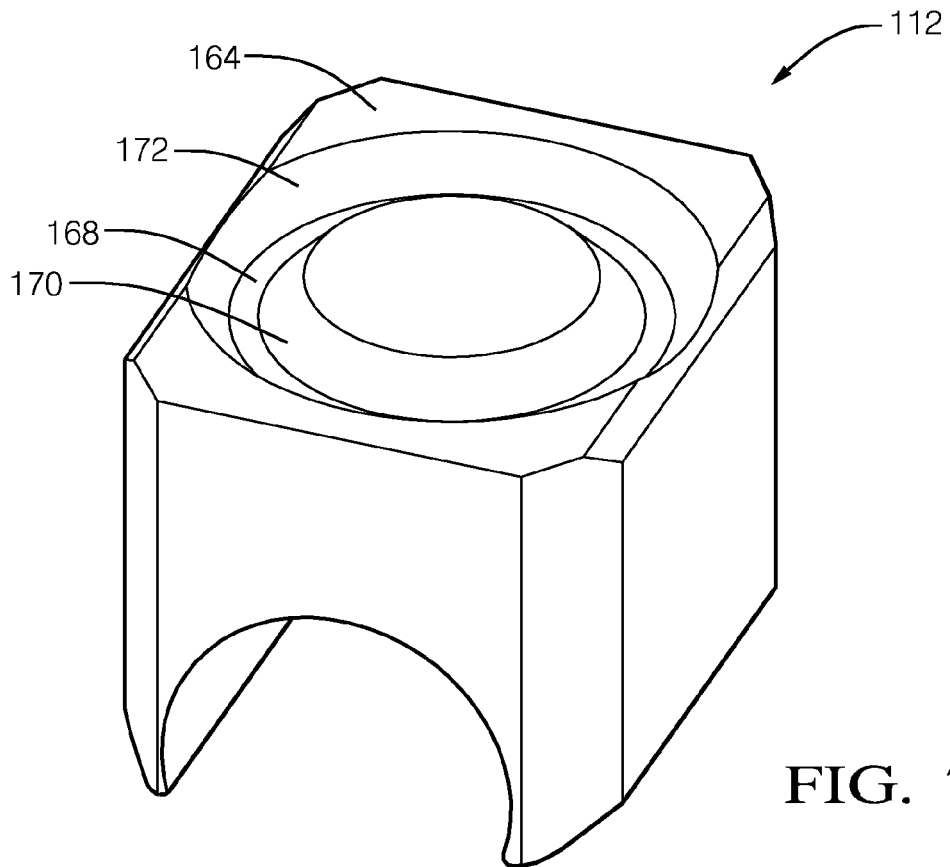


FIG. 7

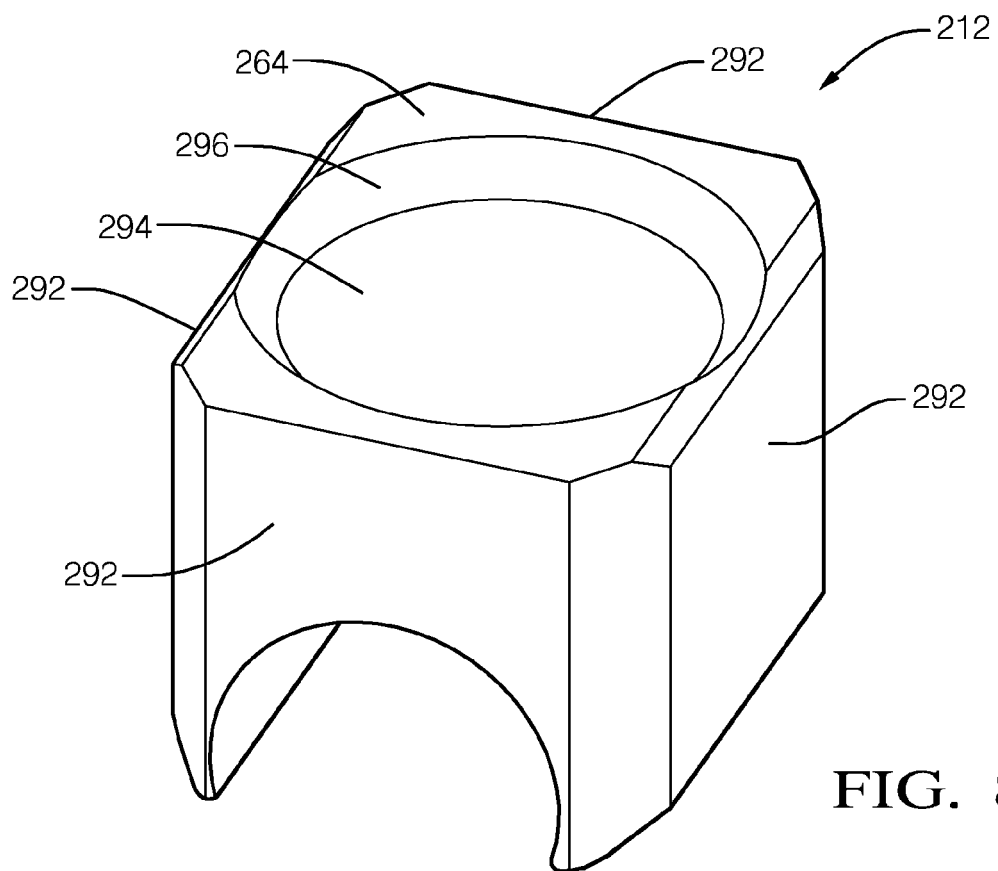
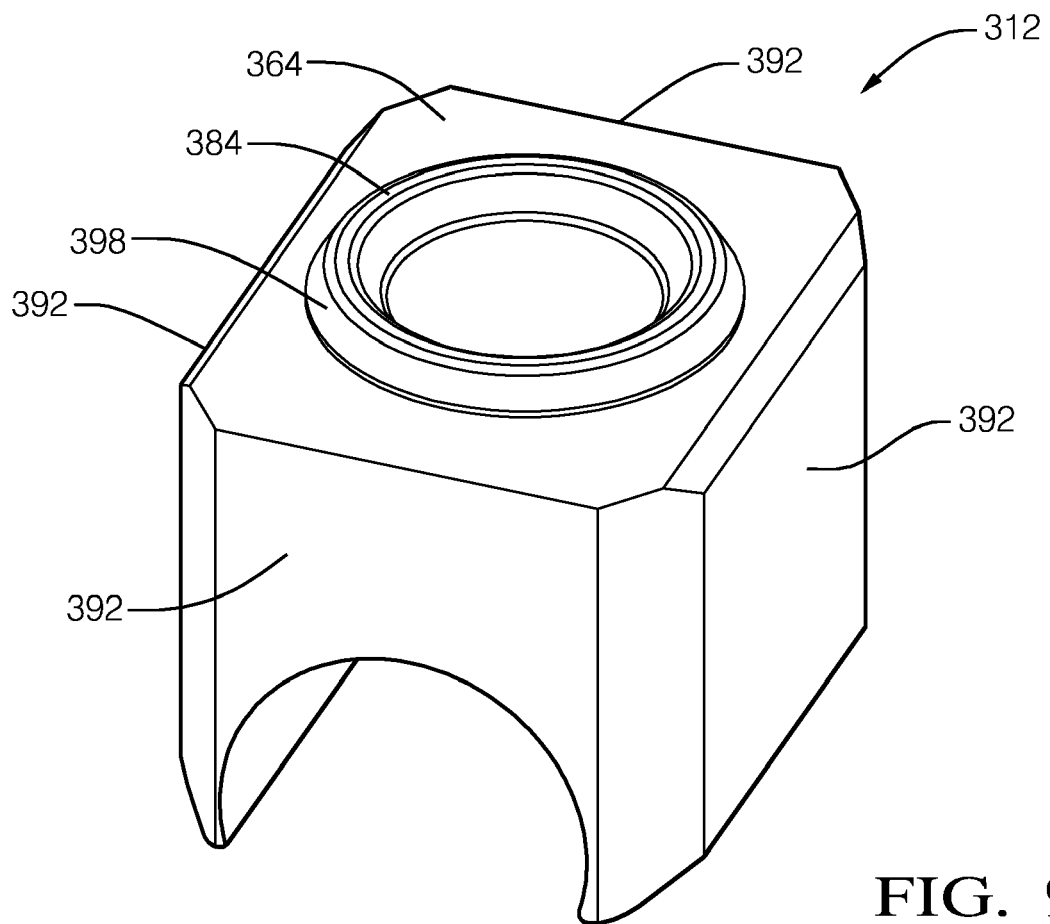


FIG. 8





EUROPEAN SEARCH REPORT

Application Number
EP 16 19 1554

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			TECHNICAL FIELDS SEARCHED (IPC)
			F04B F02M
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 1 March 2017	Examiner Pinna, Stefano
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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EPO FORM 1503 03/02 (P04C01)

**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.
The members are as contained in the European Patent Office EDP file on
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