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(54) HP PUMP OF A FUEL INJECTION SYSTEM

HP-PUMPE EINES KRAFTSTOFFEINSPRITZSYSTEMS

POMPE HAUTE PRESSION ET SYSTÈME D'INJECTION DE CARBURANT

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Description

TECHNICAL FIELD

[0001] The present invention relates to a high pressure pump of a fuel injection system of an internal combustion engine with a head member configured to reduce internal leakage issues risk.

BACKGROUND OF THE INVENTION

[0002] In a high pressure (HP) pump for a fuel injection system, the fuel enters a compression chamber via an inlet wherein it is compressed from a few bars to thousands of bars then is expelled via an outlet. Each movement of each element of the HP pump has therefore to be very precise for the system to work perfectly. In particular, particles in fuel might strongly disrupt said movements, hence causing malfunctioning of the system. Usually, a fuel filter is provided to protect the injection system. However, particles of small sizes are not stopped by the filter and penetrate into the injection system. Moreover, some particles come from the injection system itself, whether in the case of a brand new car or as a consequence of an aging of the system. Such a high pressure pump is shown for example in document WO2015/010856A.

[0003] Another document DE 10 2009 000 951 A presents a solution for effective separation of particles in the fuel, including the particles that pass through the conventional upstream fuel filter.

SUMMARY OF THE INVENTION

[0004] Accordingly, it is an object of the present invention to resolve the above mentioned problems in providing a high pressure pump of a fuel injection equipment of an internal combustion engine, said pump comprising a head member having a body provided with a bore extending along a pumping axis from an open end to a closed end, said closed end partially defining a compression chamber, a plunger configured to reciprocate within said bore along said pumping axis to alternatively increase and decrease the volume of the compression chamber, a fuel inlet controlled by an inlet valve for allowing, in use, low-pressure fuel into the compression chamber, a fuel outlet controlled by an outlet valve for allowing, in use, high-pressure fuel out of the compression chamber, the body of the high pressure pump head further defining an inlet chamber wherein, in use, fuel at low pressure flows prior to passing through the fuel inlet, said inlet chamber being configured to urge the fuel flows with a rotational movement and, wherein, the body further comprises a particles trap gallery arranged on the outer periphery of said inlet chamber.

[0005] The inlet chamber comprises a conical base and a fuel entrance, said fuel entrance forming an acute angle with said conical base, and, in use, fuel rotationally flows in the conical base from the fuel entrance, the particles being trapped in the particles trap gallery of the outer periphery by action of a centrifugal force of the rotational movement.

[0006] The particles trap gallery may comprise a space wherein, in use, the particles are trapped.

[0007] The particles trap gallery may comprise a groove disposed in said space.

[0008] The particles trap gallery may comprise lips surrounding said groove.

[0009] A lip may be configured to cooperate with a cap of the head member.

[0010] A width of said lip may correspond to a width of said cap, so that, in use, the lip leans on the cap.

[0011] The lips may be rounded.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The present invention is now described by way of example with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a head member of a HP pump as per the invention (a cap not being illustrated).
Figure 2 is an axial view of the head of figure 1.
Figure 3 is a view of a detail of figure 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] A diesel internal combustion engine is provided with a fuel injection equipment arranged to cyclically spray compressed diesel fuel in its cylinders.

[0014] Said equipment comprises a high pressure pump 10, shown on the figures.

[0015] The injection pump is one of the essential parts of the engine. The pump is configured to generate a high pressure so that fuel is transmitted to a combustion chamber of the engine.

[0016] As can be seen from figures 1 to 3, the pump 10 has a head member 12 with a body 14 provided with a bore 16 extending along a pumping axis X from an open end (not shown) to a closed end partially defining a compression chamber 18.

[0017] As shown in figure 2, in the bore 16 is guided a plunger or piston 20 axially X extending from a first end, not shown, to a second end 22 partially defining the compression chamber 18. The first end is configured to cooperate with a rotating cam, not shown.

[0018] As can be seen particularly from figure 1, the body 14 of the head member 12 further defines an inlet chamber 24 for receiving fuel in the HP pump. The inlet chamber 24 is covered by a cap 26 of the head member 11. A sealing 28 is disposed between the cap 26 and the inlet chamber 24. The inlet chamber 24 comprises a base 30 with a conical shape presenting a downward slope from an outer periphery 32 to its center. Hence, the outer periphery 32 is located at the top of the conical base 30

whereas the center is located at the bottom of the conical base 30. In use, the inlet chamber 24 is fully filled with fuel from the base to the cap 26.

[0019] As clear from figure 1, the body 14 also comprises a fuel entrance 34 exiting into the base 30 disposed close to the center of the base 30. The fuel entrance 34 is angled relative to the conical base 30 while not perpendicular to the conical base 30. Preferably, the angle between the conical base 30 and the fuel entrance 34 is strictly acute so that the fuel entering the inlet chamber revolves around an axis line mainly corresponding to the pumping axis X. The arrangement of the conical shape of the base 30 and the angled entrance 34 generates a rotational movement of the fuel entering into the inlet chamber 24 through the fuel entrance 34. In other words, the combination of the downhill conical base with the tilted fuel entrance causes the driving of the fuel around the pumping axis between the fuel entrance 34 and the outer periphery 32.

[0020] The head member 12 further comprises a fuel inlet 36 controlled by an inlet valve 38. As shown in figure 2, the fuel inlet 36 connects the inlet chamber 24 to the compression chamber 18. The head member also comprises a fuel outlet 40 controlled by an outlet valve 42. The valve 42 is provided with a ball 44 and a spring 46 to maintain the outlet 40 in a closed position illustrated on figure 2.

[0021] As can be seen from figure 1, the fuel inlet 36 is disposed opposite to outer periphery 32 holding the particles trap 48, i.e. at the center of the bottom of the inlet chamber 24.

[0022] As particularly detailed on figure 3, the body 14 comprises a particles trap gallery 48 arranged on the outer periphery 32 of the inlet chamber 24. As will be detailed later, thanks to the rotational vortex path of the fuel, the particles are trapped in the particles trap gallery 48 at the outer periphery 32 because of the difference of density of pure fuel on the one hand and of the fuel contaminating particles on the other hand.

[0023] As clearly shown on the figures, the particles trap gallery 48 comprises a groove 50 surrounded by a top rounded lip 52 and a bottom rounded lip 54.

[0024] The width of the bottom lip 54 corresponds to the width of the cap 26 such that the lip 54 leans on the cap 26. The width of the top lip 52 is smaller than the width of the cap 26 so that there is a space 56 between the cap 26 and the trap 48. As will be detailed later, the particles fall in the space 56 to the groove 50.

[0025] The invention is not limited to the illustrated configuration of the particles trap gallery 48. The presence of the space 56 between the outer periphery 32 and the cap 26 might be sufficient for the particles to be trapped. In this case, the outer periphery may present a shoulder. The rounded shape of the lips ensures that assembly is not affected but might not be necessary, in which case the trap 48 can be formed with straight lines.

[0026] The invention is now described when the HP pump is being used.

[0027] In use, the cam rotates and imparts to the piston axial X reciprocal displacements defining a pumping cycle between a top dead center position (TDC) where the volume of the compression chamber 18 is minimum and a bottom dead center position (BDC) where said volume is maximum. In the bore 16, the piston reciprocates between BDC and TDC and it varies cyclically the volume of the compression chamber 18 wherein fuel at low pressure enters via the fuel inlet 36 controlled by the inlet valve 38 and exits after being pressurized, via an fuel outlet 40 controlled by the outlet valve 42.

[0028] When the plunger 18 goes down, the pressure in the compression chamber 18 lowers and the inlet valve 38 opens the fuel inlet 36, and the compression chamber 18 fills up with fuel. When the plunger 18 goes up, the fuel contained in the compression chamber 18 is compressed and pushes the ball 44, such that compressed fuel exits through the fuel outlet 40.

[0029] Each time fuel enters the inlet chamber 24 through the fuel entrance 34, thanks to the rotational movement of the fuel in the conical base 36, the particles are pushed to the outer periphery 32 by action of the centrifugal force and fall in the space 56 to the groove 50, where the particles are trapped.

[0030] In other words, thanks to the trap, there is a separation of the particles and the fuel; the fuel only flows in the fuel inlet 36 whereas the particles stay in the trap 48.

[0031] The trap of the present invention prevents particles from flowing through the head member, reducing the risk of internal leakage issues and protecting the internal combustion engine of the vehicle.

LIST OF REFERENCES

[0032]

X	pumping axis
TDC	top dead centre
BDC	bottom dead centre

10	high pressure pump - HP pump
12	head member
14	body
16	bore
18	compression chamber
20	piston
22	end of piston
24	inlet chamber
26	cap
28	sealing
30	base
32	outer periphery
34	fuel entrance
36	fuel inlet
38	inlet valve
40	fuel outlet
42	outlet valve
44	ball

46 spring
48 particles trap gallery
50 groove
52 top lip
54 bottom lip
56 space

Claims

1. A high pressure pump (10) of a fuel injection equipment of an internal combustion engine, said pump comprising

   a head member (12) having a body (14) provided with a bore (16) extending along a pumping axis (X) from an open end to a closed end, said closed end partially defining a compression chamber (18),
   a plunger (20) configured to reciprocate within said bore (16) along said pumping axis (X) to alternatively increase and decrease the volume of the compression chamber (18),
   a fuel inlet (36) controlled by an inlet valve (38) for allowing, in use, low-pressure fuel into the compression chamber (18),
   a fuel outlet (40) controlled by an outlet valve (42) for allowing, in use, high-pressure fuel out of the compression chamber (18),
   the body (14) of the high pressure pump head further defining an inlet chamber (24) wherein, in use, fuel at low pressure flows prior to passing through the fuel inlet (36), the inlet chamber (24) comprising a conical base (30) and a fuel entrance (34), the high pressure pump is **characterised in that** said fuel entrance (34) is forming an acute angle with said conical base (30), said inlet chamber (24) being configured to urge the fuel flow with a rotational movement and,
   wherein the body (14) further comprises a particles trap gallery (48) arranged on the outer periphery (32) of said inlet chamber (24), and wherein, in use, fuel rotationally flows in the conical base (30) from the fuel entrance (34), the particles being trapped in the particles trap gallery (48) of the outer periphery (32) by action of a centrifugal force of the rotational movement.

2. A high pressure fuel pump (10) as claimed in claim 1, wherein the particles trap gallery comprises a space (56) wherein, in use, the particles are trapped.

3. A high pressure fuel pump (10) as claimed in claim 2, wherein the particles trap gallery comprises a groove (50) disposed in said space (56).

4. A high pressure fuel pump (10) as claimed in claim 3, wherein the particles trap gallery comprises lips (52, 54) surrounding said groove (50).

5. A high pressure fuel pump (10) as claimed in claim 4, wherein a lip (54) is configured to cooperate with a cap (26) of the head member (12).

6. A high pressure fuel pump (10) as claimed in claim 5, wherein a width of said lip (54) corresponds to a width of said cap (26), so that in use the lip (54) leans on the cap (26).

7. A high pressure fuel pump (10) as claimed in any of the claims 4 to 6, wherein the lips (52, 54) are rounded.

Patentansprüche

1. Hochdruckpumpe (10) einer Kraftstoffeinspritzanlage eines Verbrennungsmotors, die Pumpe umfassend

   ein Kopfelement (12), das einen Körper (14) aufweist, der mit einer Bohrung (16), die sich entlang einer Pumpachse (X) von einem offenen Ende zu einem geschlossenen Ende erstreckt, versehen ist, wobei das geschlossene Ende eine Kompressionskammer (18) teilweise definiert,
   einen Plunger (20), der konfiguriert ist, um sich innerhalb der Bohrung (16) entlang der Pumpachse (X) hin- und herzubewegen, um das Volumen der Kompressionskammer (18) alternativ zu steigern und senken,
   einen Kraftstoffeinlass (36), der durch ein Einlassventil (38) gesteuert wird, um, in Verwendung, Niederdruckkraftstoff in die Kompressionskammer (18) zu lassen,
   einen Kraftstoffauslass (40), der durch ein Auslassventil (42) gesteuert wird, um, in Verwendung, Hochdruckkraftstoff aus der Kompressionskammer (18) zu lassen,
   wobei der Körper (14) des Hochdruckpumpenkopfs ferner eine Einlasskammer (24) definiert, wobei, in Verwendung, Kraftstoff bei Niederdruck fließt, vor einem Durchlaufen durch den Kraftstoffeinlass (36),
   die Einlasskammer (24), umfassend eine konische Basis (30) und einen Kraftstoffeingang (34), wobei die Hochdruckpumpe **dadurch gekennzeichnet ist, dass** der Kraftstoffeingang (34) einen spitzen Winkel mit der konischen Basis (30) ausbildet, wobei die Einlasskammer (24) konfiguriert ist, um den Kraftstoffffluss mit einer Drehbewegung zu drängen und
   wobei der Körper (14) ferner eine Partikelfallengalerie (48), die an dem Außenumfang (32) der Einlasskammer (24) angeordnet ist, umfasst

und wobei, in Verwendung, Kraftstoff in der konischen Basis (30) von dem Kraftstoffeingang (34) drehend fließt, wobei die Partikel in der Partikelfallengalerie (48) des Außenumfangs (32) durch Einwirkung einer Zentrifugalkraft der Drehbewegung aufgefangen werden.

2. Hochdruckkraftstoffpumpe (10) nach Anspruch 1, wobei die Partikelfallengalerie einen Raum (56) umfasst, wobei die Partikel, in Verwendung, aufgefangen werden.

3. Hochdruckkraftstoffpumpe (10) nach Anspruch 2, wobei die Partikelfallengalerie eine Kerbe (50), die in dem Raum (56) eingerichtet ist, umfasst.

4. Hochdruckkraftstoffpumpe (10) nach Anspruch 3, wobei die Partikelfallengalerie Lippen (52, 54), die die Kerbe (50) umgeben, umfasst.

5. Hochdruckkraftstoffpumpe (10) nach Anspruch 4, wobei eine Lippe (54) konfiguriert ist, um mit einer Kappe (26) des Kopfelements (12) zusammenzuwirken.

6. Hochdruckkraftstoffpumpe (10) nach Anspruch 5, wobei eine Breite der Lippe (54) einer Breite der Kappe (26) so entspricht, dass sich, in Verwendung, die Lippe (54) an die Kappe (26) lehnt.

7. Hochdruckkraftstoffpumpe (10) nach einem der Ansprüche 4 bis 6, wobei die Lippen (52, 54) abgerundet sind.

Revendications

1. Pompe à haute pression (10) d'un équipement d'injection de carburant d'un moteur à combustion interne, ladite pompe comprenant

un élément de tête (12) ayant un corps (14) pourvu d'un alésage (16) s'étendant le long d'un axe de pompage (X) allant d'une extrémité ouverte à une extrémité fermée, ladite extrémité fermée définissant partiellement une chambre de compression (18),
un piston (20) conçu pour aller et venir au sein dudit alésage (16) le long dudit axe de pompage (X) pour augmenter et diminuer en alternance le volume de la chambre de compression (18),
une entrée de carburant (36) commandée par une soupape d'entrée (38) pour autoriser, en cours d'utilisation, l'entrée d'un carburant basse pression dans la chambre de compression (18),
une sortie de carburant (40) commandée par une soupape de sortie (42) pour autoriser, en cours d'utilisation, la sortie d'un carburant haute pression de la chambre de compression (18),
le corps (14) de la tête de pompe à haute pression définissant en outre une chambre d'entrée (24) dans laquelle, en cours d'utilisation, du carburant à basse pression s'écoule avant de passer à travers l'entrée de carburant (36),
la chambre d'entrée (24) comprenant une base conique (30) et une admission de carburant (34),
la pompe à haute pression est **caractérisée en ce que** ladite admission de carburant (34) forme un angle aigu avec ladite base conique (30), ladite chambre d'entrée (24) étant conçue pour presser l'écoulement de carburant avec un mouvement de rotation et,
dans laquelle le corps (14) comprend en outre une galerie de piégeage de particules (48) agencée sur la périphérie externe (32) de ladite chambre d'entrée (24), et dans laquelle, en cours d'utilisation, le carburant s'écoule en rotation dans la base conique (30) à partir de l'admission de carburant (34), les particules étant piégées dans la galerie de piégeage de particules (48) de la périphérie externe (32) par l'action d'une force centrifuge du mouvement de rotation.

2. Pompe à carburant à haute pression (10) selon la revendication 1, dans laquelle la galerie de piégeage de particules comprend un espace (56) dans lequel, en cours d'utilisation, les particules sont piégées.

3. Pompe à carburant à haute pression (10) selon la revendication 2, dans laquelle la galerie de piégeage de particules comprend une rainure (50) disposée dans ledit espace (56).

4. Pompe à carburant à haute pression (10) selon la revendication 3, dans laquelle la galerie de piégeage de particules comprend des lèvres (52, 54) entourant ladite rainure (50).

5. Pompe à carburant à haute pression (10) selon la revendication 4, dans laquelle une lèvre (54) est conçue pour coopérer avec une coiffe (26) de l'élément de tête (12).

6. Pompe à carburant à haute pression (10) selon la revendication 5, dans laquelle une largeur de ladite lèvre (54) correspond à une largeur de ladite coiffe (26), de sorte qu'en cours d'utilisation la lèvre (54) s'appuie sur la coiffe (26).

7. Pompe à carburant à haute pression (10) selon l'une quelconque des revendications 4 à 6, 10 dans laquelle les lèvres (52, 54) sont arrondies.

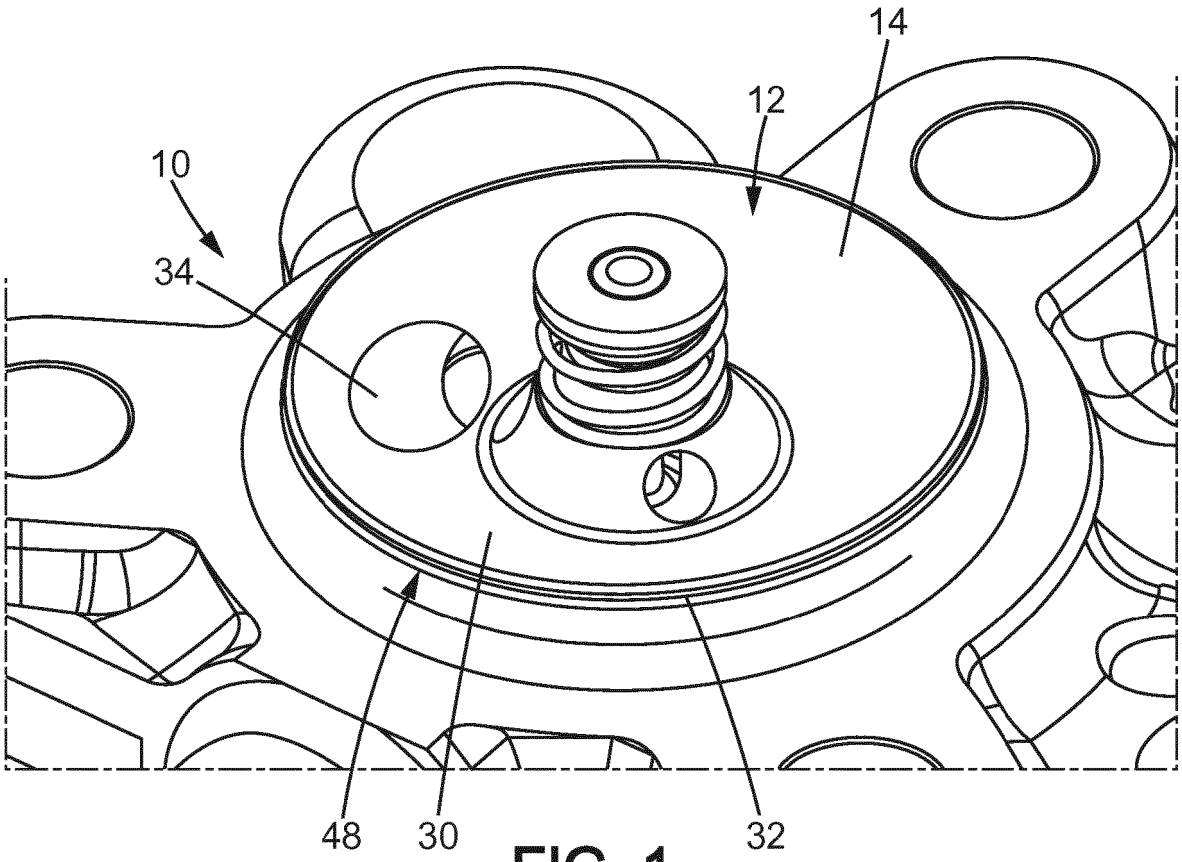
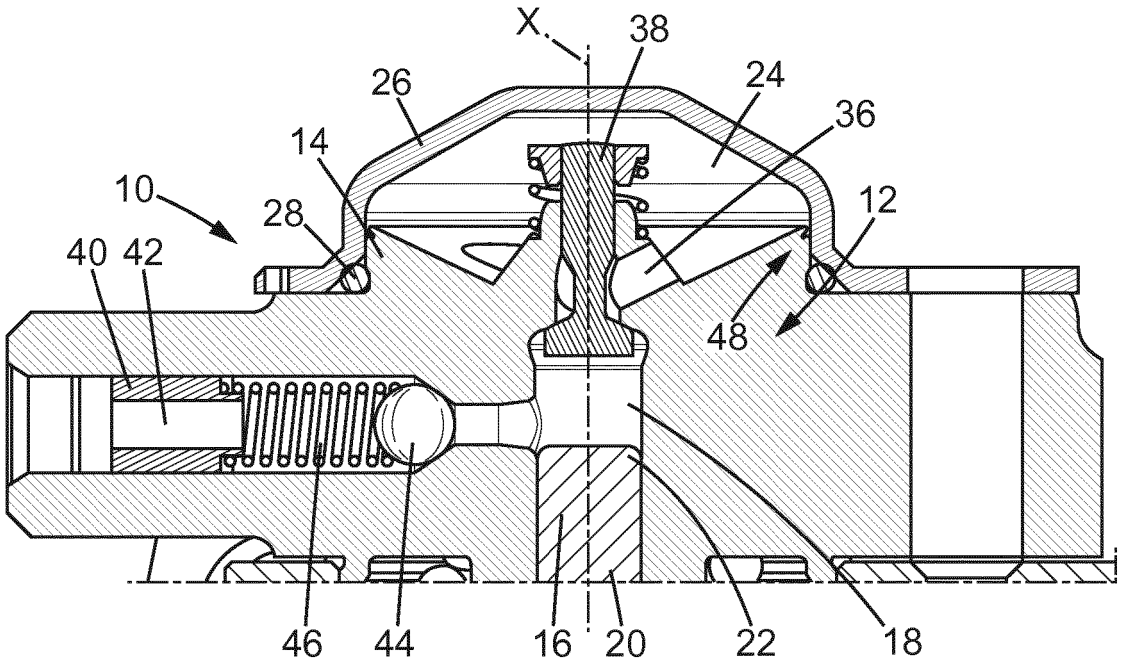


FIG. 1


X
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36
14
10
28
12
40
42
48
46
44
16
20
22
18

FIG. 2

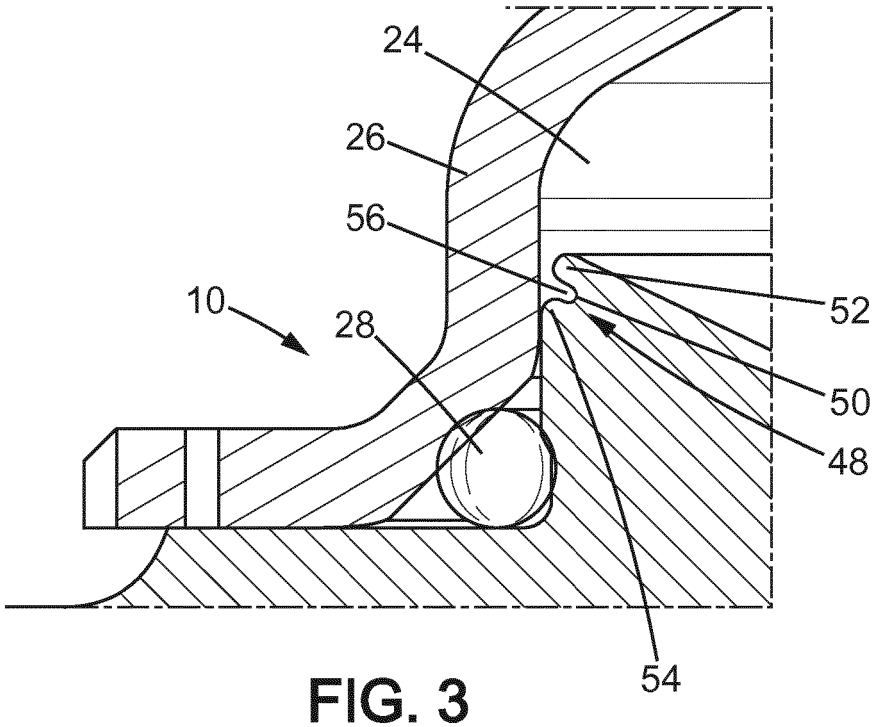
24
26
56
52
10
28
50
48
54

FIG. 3

REFERENCES CITED IN THE DESCRIPTION

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