



(51) International Patent Classification:

F16J 15/3228 (2016.01) *F16J 15/3284* (2016.01)
F02M 59/12 (2006.01) *F02M 59/10* (2006.01)
F16J 15/3268 (2016.01)

(21) International Application Number:

PCT/EP2017/061217

(22) International Filing Date:

10 May 2017 (10.05.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1608273.7 11 May 2016 (11.05.2016) GB

(71) Applicant: **DELPHI INTERNATIONAL OPERATIONS LUXEMBOURG S.À R.L.** [LU/LU]; Avenue de Luxembourg, 4940 Bascharage (LU).

(72) Inventor: **MCHATTIE, James**; 20 School Lane, Bean, Kent DA2 8AL (GB).

(74) Agent: **DELPHI FRANCE SAS**; Bâtiment le Raspail - ZAC Paris Nord 2, 22, avenue des Nations CS65059 Villepinte, 95972 Roissy CDG Cedex (FR).

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

(54) Title: SEAL

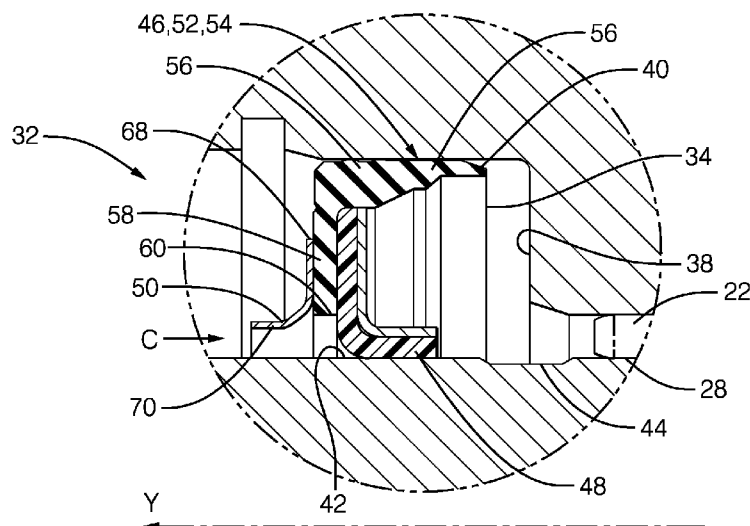


FIG. 2

(57) Abstract: A seal (32) adapted to seal the opening (20) of a housing (14) through which extends a shaft (16) rotating, in use, between bearings, the seal integrating a main body, a sealing lip and a dust lip both lips adapted, in use, to slide against a journal face of the shaft. When arranged in the opening (20), the dust lip is raised away from the journal face of the shaft.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

SEAL

5 TECHNICAL FIELD

The present invention relates to a seal sealing the opening of a housing through which extends a shaft rotating, in use, between bearings, the seal preventing, in use, fluid to get out of the housing and dust particles to get in the housing.

10

BACKGROUND OF THE INVENTION

A high pressure fuel pump generally comprises a cambox housing wherein a camshaft is adapted to rotate about a main axis between aligned bearings.

15

A lip seal arranged close to the bearing prevents lubricant fluid to exit the housing and dust to enter and get in the bearing area generating damages. The dust lip is to stop dust interfering with the sealing effort from the main lip seal, causing a leak.

20

The seals typically comprises a metallic core overmoulded with elastomer material, the core enabling insertion with press-fit and the elastomer defining a first outer lip for static contact against a face of the housing, a second sealing lip for dynamic sliding against a journal face of the shaft, said sealing lip preventing exit of lubricant and, a third dust lip for dynamic sliding against the journal face of the shaft, said dust lip protecting the sealing lip from dust since, dust would disturb the very delicate sealing environment and create a leak.

25

Perfect positioning of the seal must be verified during process but unfortunately, twisting, bending or even inverting of said sealing lip cannot be detected as the dust seal prevents visual inspection of the sealing lip.

30 SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to resolve the above mentioned problems in providing a seal adapted to seal the opening of a housing through which extends a shaft rotating, in use, between bearings, said seal preventing, in use, fluid to get out of the housing and dust particles to get in the housing, the seal integrating a main body having outer dimensions adapted to the

35

seal insertion with press-fit into the opening and, extending from said main body member, a sealing lip and a dust lip both lips adapted, in use, to slide against a journal face of the shaft.

Advantageously, when arranged in the opening, the dust lip is raised
5 away from the journal face of the shaft.

Also, the dust lip is individually brought in contact to the journal face of the shaft and is made operational.

Also, the dust lip comprises heat shrink material.

In another embodiment, the dust lip is made of UV sensitive material.

10 The invention further extends to a high pressure diesel fuel pump having a cambox housing wherein are arranged aligned bearings enabling a camshaft to rotate, in use, about a camshaft axis, a sealing function between the cambox and the camshaft being ensured by a seal as previously described.

The invention further extends to a method for manufacturing a seal as
15 previously described. The method comprising the steps:

- providing a seal main body having a peripheral wall with specific dimensions and a sealing lip adapted to slide on a shaft journal face;
- providing a dust lip made of shrinkable material, said dust lip having a fixing portion and a dust sealing portion ;
- 20 - bonding, or crimping said fixing portion onto the seal main body so that the dust sealing portion has a larger diameter than the sealing lip.

Also, the dust lip is made of heat shrink material such as, but exclusively, PTFE or PEEK.

Alternatively, the dust lip is made of UV shrink materials.

25 The invention further extends to a method of sealing the opening of a housing through which extends a shaft rotating, in use, between bearings, the method comprising the steps:

- providing a housing defining an opening in which is arranged a bearing through which extends a shaft;
- 30 - providing a seal as previously described;
- inserting the seal in the opening, the dust lip being raised relative to a journal face of the shaft;
- inspecting that the seal is correctly positioned;

- deforming the dust lip so that it contacts the journal face of the shaft.

Also, the inspecting step comprises a visual inspection of the sealing lip through the annular opening between the dust lip and the shaft.

Also, the seal being as described previously and the deforming step
5 comprising applying heat to the dust lip.

Alternatively, the seal provided is UV shrinkable and, the deforming step comprises applying UV to the dust lip.

BRIEF DESCRIPTION OF THE DRAWINGS

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

Figure 1 is a section of a high pressure pump provided with a seal as per the invention.

Figure 2 is a magnified area of figure 1, presenting the seal before being
15 made operational, the lip seal being operational but not the dust seal.

Figure 3 is similar to figure 2, the seal being operational.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Although the invention can be implemented in many different technical
20 fields, a diesel high pressure fuel pump 10 represented on figure 1 is a base of the description.

The high pressure pump 10 is adapted to be in a fuel injection equipment between a low pressure system, arranged downstream, and a high pressure reservoir and injectors arranged upstream.

25 The pump 10 comprises a pumping unit 12, for pressurizing fuel, and a cambox 14 wherein a camshaft 16 rotates about a camshaft axis Y, a cam 18 of said camshaft cooperating with the pumping unit 12.

The cambox 14 has peripheral walls defining an inner space S wherein lubricant fluid, such as oil or diesel fuel, is and also having a front opening
30 wherein is arranged a front bearing 22, on the left of the figure and, a rear housing 24 wherein is arranged a rear bearing 26, right of the figure, the camshaft 16 being provided with a front journal face 28 and a rear journal face 30 respectively

cooperating with said front 22 and rear 26 bearings in order to enable rotation of the camshaft.

As visible on the figure, the camshaft 16 axially Y extends outside the cambox 12 and protrudes via the front bearing 22, a seal 32 arranged in a seal housing 34 provided in a flange 36 fixed to the wall of the cambox preventing, in use, lubricant fluid to leak out the cambox and dust to damage the seal.

An embodiment of the seal 32 is now detailed in reference to figures 2 and 3 wherein is magnified a section of the region of the seal.

The seal housing 34 is a recess having a transverse bottom face 38 at the centre of which opens the front opening 20, said bottom face 38 being therefore limited to the annular area peripheral to said opening and, an peripheral cylindrical face 40 axially extending from said bottom face 38.

Locally, the camshaft 16 is provided with a seal journal face 42 having a slightly smaller diameter than the front journal face 28, said two journal faces 28, 42, being axially Y separated by a shallow groove 44.

The seal 32 comprises a main body 46 to which are integrally bonded or crimped a sealing lip 48 and a dust lip 50, both said lips cooperating with the seal journal face 42.

The main body 46 has a L-shape section having a metallic core 52 overmolded with elastomeric materials 54, said main body 46 defining a peripheral cylindrical wall 56 press-fitted with interference against the peripheral face 40 of the seal housing and, an annular transverse wall 58 radially extending from the peripheral wall 56 to a distant an inner extremity 60 which remains at a distance from the camshaft 16, defining there between an annular clearance C.

The metallic core 52 enables press-fitting of the seal 32 in its housing 34 and, the elastomeric overmold 54 ensuring static sealing between the main body 46 and the wall of the cambox.

The sealing lip 48 is a resilient elastomeric member having a fixing portion 62 bonded to an inner face of said transverse wall 58 and a sealing portion 64, extending to a distant extremity 66 and being in contact against the seal journal face 42 of the camshaft. The specific geometry of the embodiment presented on the figures imposes to said sealing lip 48 a L-shape section, the vertical branch of the L, or fixing portion 62, being bonded to the main body and,

the horizontal branch of the L, or sealing portion 64, extending to the distant extremity 66 and being inwardly oriented to slide against the seal journal face 42 of the camshaft. The two portions 62, 64, of the sealing lip join in smooth radius area and, should the camshaft 16 be thinner or larger, the resilient properties of the sealing lip would urge the sealing portion 64 in contact with the camshaft.

From an oil leakage sealing stand point, it is now clear that the seal 32 prevents fluid flowing through the front bearing area to exit the cambox as being stopped by the sealing lip 48 and by the main body 46.

In an alternative not represented, the sealing lip 48, instead of being bonded to the main body can be integrally moulded with the overmold 54 covering the metallic core 52.

The dust lip 50 is a skirt-like member comprising a fixing portion 68 bonded to an outer face of said transverse wall 58, the outer face being opposed to the inner face where is bonded the sealing lip 48 and, a sealing portion 70 outwardly extending relative to the cambox toward a distal end 72, the two portions 68, 70, joining in a large smooth radius area. As visible on the figures, the dust lip 50 is much thinner than the sealing lip 48 and, the only difference between figures 2 and 3 being the configuration of the dust lip 50.

The dust lip 50 comprises heat shrink material, such as PTFE and, figure 2 represents the configuration when the seal 32 is just inserted, the sealing portion 70 of the dust lip 50 being lifted distant from the camshaft 14. In this initial configuration, visual inspection of the sealing lip 48 is possible since said sealing lip 48 can be directly observed below the dust lip 50 and through the clearance C. Thanks to this configuration correct positioning of the sealing lip 48 is ensured, or immediately corrected.

Once the seal 32 is in place as shown in figure 2, by applying heat, via a heat gun for instance, the dust lip 50 shrinks and, the large smooth radius area extends the sealing portion 70 of the dust lip coming in contact against the seal journal face 42. In the configuration of figure 3, the seal 32 is operational and ready to protect the pump from lubricant exit and dust intrusion.

In another alternative, the dust lip 50 can comprise UV shrink materials, the operational configuration of the seal 32 being obtained by applying UV, via a UV gun source for instance, to the seal 32.

A method 100 for manufacturing the seal is now presented. Said method 100 comprising the steps:

- 110) providing a seal main body 46 having a peripheral wall 56 with specific dimensions and a sealing lip 48 adapted to slide on a shaft journal face 42;

In this providing step 110, the sealing lip 48 can be moulded integral to the main body 46 or can be made separately then bonded afterward.

- 120) providing a dust lip 50 made of shrinkable material, said dust lip 50 having a fixing portion 68 and a dust sealing portion 70;

- 130) bonding, or crimping, said fixing portion 68 onto the seal main body 46 so that the dust sealing portion 70 has a larger diameter than the sealing lip 48.

More precisely, the dust lip 50 provided at step 120 can be made of PTFE or PEEK or other material having heat shrinking properties.

- In an alternative, the dust lip 50 is made of UV shrink materials.

A further method 200 is presented for assembling the seal 32 for sealing the opening of a housing, a cambox 14 in the example described, through which extends a shaft 16 rotating, in use, between bearings 22, 26, the method 200 comprising the steps:

- 210) providing a housing 14 defining an opening 20 in which is arranged a bearing 22 through which extends a shaft 16;

- 220) providing a seal 32 as described above, or as manufactured as per the manufacturing method 100.

- 230) inserting the seal 32 in the opening 20, the dust lip 50 being raised relative to a seal journal face 42 of the shaft;

- 240) inspecting that the seal 32 is correctly positioned and, in particular the sealing lip 48;

- 250) deforming the dust lip 50 so that it contacts the seal journal face 42 of the shaft.

- Particularly, the inspecting step 240 may comprise a visual inspection of the sealing lip 48 through the annular clearance C and the opening between the dust lip 50 and the shaft 16.

If the dust lip 50 comprises heat shrink materials, the deforming step 250 is performed by applying heat to the dust lip 50. This can be done via a heat gun.

In the alternative where the dust lip 50 comprises UV shrink materials, the deforming step 250 is performed by applying UV to the dust lip 50. This can
5 be done via a UV gun.

LIST OF REFERENCES

	10	pump
	12	pumping unit
10	14	cambox - housing
	16	camshaft
	18	cam
	20	front opening
	22	front bearing
15	24	rear housing
	26	rear bearing
	28	front journal face
	30	rear journal face
	32	seal
20	34	seal housing
	36	flange
	38	bottom face of the seal housing
	40	peripheral face of the seal housing
	42	seal journal face
25	44	shallow groove
	46	main body of the seal
	48	sealing lip
	50	dust lip
	52	metallic core
30	54	elastomeric overmold
	56	peripheral wall of the main body
	58	transverse wall
	60	inner extremity

	62	fixing portion of the sealing lip
	64	sealing portion of the sealing lip
	66	extremity of the sealing portion
	68	fixing portion of the dust lip
5	70	sealing portion of the dust lip
	100	Method of manufacturing the seal
	110	providing the main body step
	120	providing dust seal step
	130	bonding step
10	200	assembling method
	210	providing step
	220	providing a seal
	230	inserting step
	240	inspecting step
15	250	deforming step
	Y	camshaft axis
	C	clearance

CLAIMS:

1. Seal (32) adapted to seal the opening (20) of a housing (14) through which extends a shaft (16) rotating, in use, between bearings, said seal (32) preventing, in use, fluid to get out of the housing (34) and dust particles to get in the housing, the seal integrating a main body (46) having outer dimensions adapted to the seal insertion with press-fit into the opening and, extending from said main body member (46), a sealing lip (48) and a dust lip (50) both lips adapted, in use, to slide against a journal face (42) of the shaft,
- 10 characterized in that,
- when arranged in the opening (20), the dust lip (50) is raised away from the journal face of the shaft and wherein the dust lip (50) is individually brought in contact to the journal face (42) of the shaft and is made operational and wherein the dust lip (50) comprises heat shrink material.
- 15
2. Seal (32) as claimed in claim 1 wherein the dust lip (50) is made of UV sensitive material.
3. High pressure diesel fuel pump (10) having a cambox housing (14) wherein are arranged aligned bearings enabling a camshaft (16) to rotate, in use, about a camshaft axis (Y), a sealing function between the cambox (14) and the camshaft (16) being ensured by a seal (32) as claimed in any one of the preceding claims.
- 20
4. Method (100) for manufacturing a seal as claimed in any one of the claims 1 to 2, the method comprising the steps:
- providing (110) a seal main body having a peripheral wall (56) with specific dimensions and a sealing lip (48) adapted to slide on a shaft journal face;
 - providing (120) a dust lip (50) made of shrinkable material, said dust lip
 - 30 having a fixing portion (68) and a dust sealing portion (70);
 - bonding (130), or crimping said fixing portion (68) onto the seal main body (46) so that the dust sealing portion (70) has a larger diameter than the sealing lip (48).

5. Method (100) as claimed in claim 4 wherein the dust lip (50) is made of heat shrink material such as PTFE or PEEK.

6. Method (100) as claimed in claim 4 wherein the dust lip is made of UV
5 shrink materials.

7. Method (200) of sealing the opening of a housing through which extends a shaft rotating, in use, between bearings, the method comprising the steps:
- providing (210) a housing defining an opening in which is arranged a
10 bearing through which extends a shaft;
- providing (220) a seal as claimed in any one of the claims 1 to 2;
- inserting (230) the seal (32) in the opening, the dust lip (50) being raised relative to a journal face of the shaft;
- inspecting (240) that the seal (32) is correctly positioned;
15 - deforming (250) the dust lip (50) so that it contacts the journal face of the shaft.

8. Method (200) as claimed in claim 7 wherein inspecting step (230) comprises a visual inspection of the sealing lip (48) through the annular opening
20 between the dust lip (50) and the shaft.

9. Method (200) as claimed in any one of the claims 7 or 8 wherein the seal (32) provided at step (210) is as in claim 3 and wherein deforming step comprises applying heat to the dust lip (50).
25

10. Method (200) as claimed in any one of the claims 7 or 8 wherein the seal (32) provided at step (210) is as in claim 4 and wherein deforming step comprises applying UV to the dust lip (50).

1 / 2

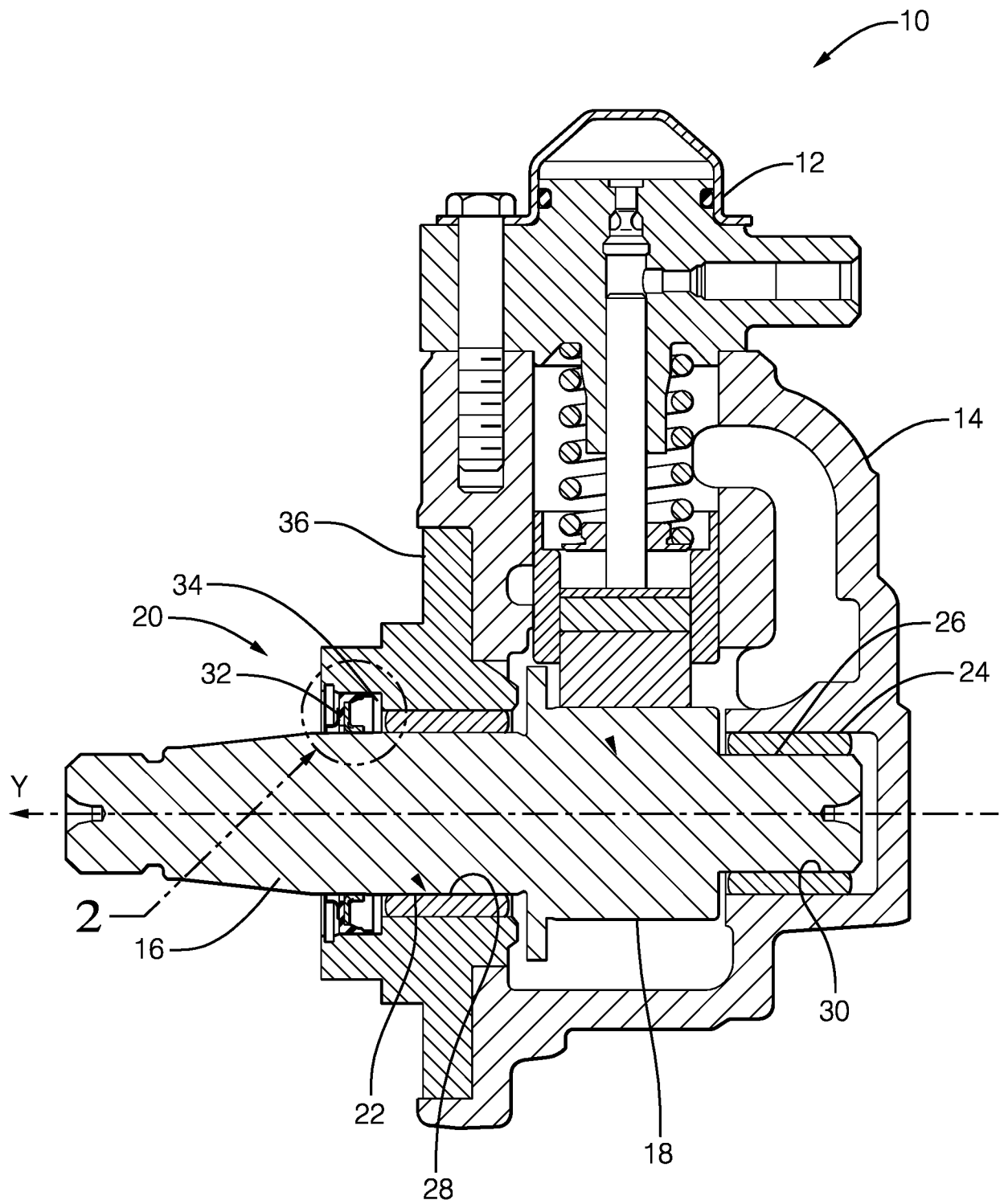


FIG. 1

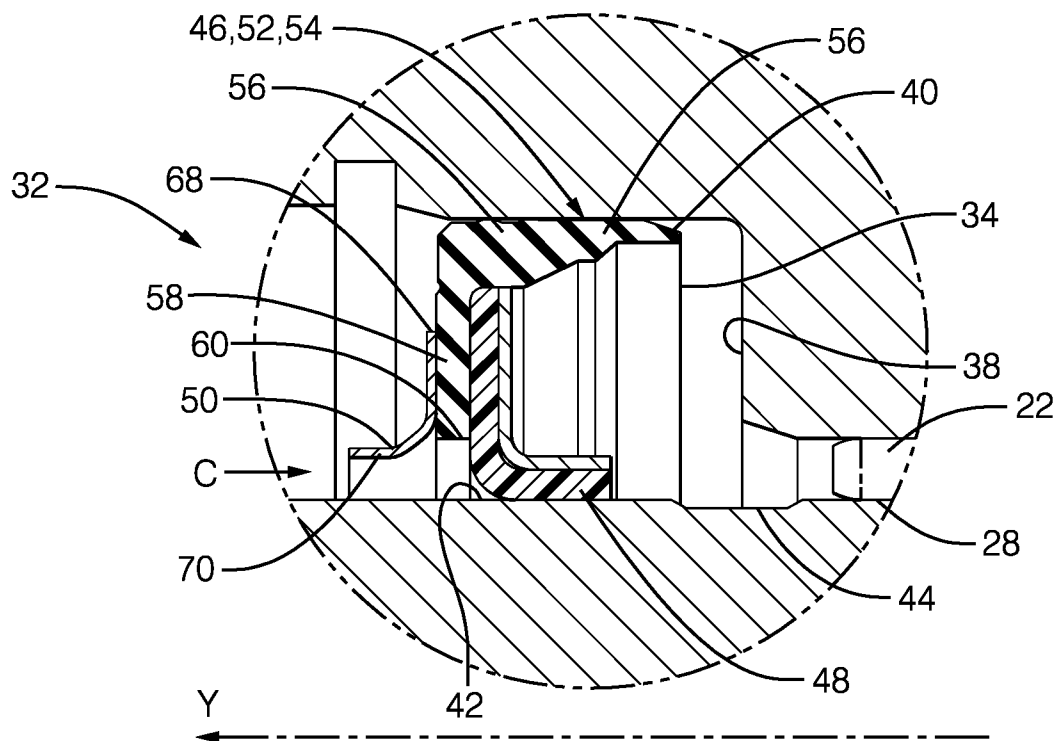


FIG. 2

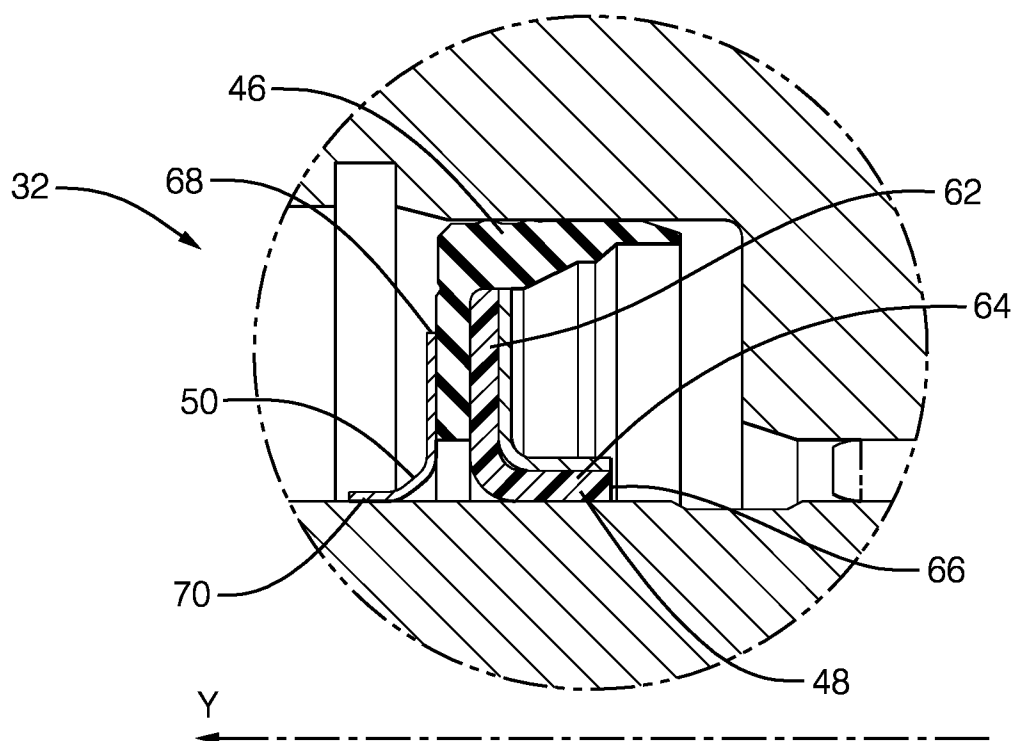


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/061217

A. CLASSIFICATION OF SUBJECT MATTER

INV. F16J15/3228 F02M59/12 F16J15/3268 F16J15/3284 F02M59/10
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F16J F02M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015/219219 A1 (FEI NEOH KAH [MY] ET AL) 6 August 2015 (2015-08-06)	1,2,4,5,7,8
Y	paragraph [0019] - paragraph [0026]; figures 1-3	3
Y	----- EP 2 657 505 A1 (DELPHI TECH HOLDING SARL [LU]) 30 October 2013 (2013-10-30)	3
A	paragraph [0022] - paragraph [0025]; figure 1	1
A	----- DE 20 2012 101447 U1 (RIVAPLAN AG [CH]) 25 July 2012 (2012-07-25)	1,3,4,7,9
	paragraph [0054] - paragraph [0071]; figures 1A-4B	
	----- -/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

7 August 2017

Date of mailing of the international search report

14/08/2017

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Grunfeld, David

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2017/061217

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2013/154644 A2 (FLOWSERVE MAN CO [US]; SAUCERMAN JAMES D [US]; YOUNG LIONEL A [US]; GR) 17 October 2013 (2013-10-17) paragraph [0055] - paragraph [0057]; figures 1-5 -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/061217

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015219219 A1	06-08-2015	CN 105179699 A JP 2015148337 A KR 20150091991 A US 2015219219 A1	23-12-2015 20-08-2015 12-08-2015 06-08-2015
EP 2657505 A1	30-10-2013	CN 103423045 A EP 2657505 A1 ES 2545122 T3 HU E025332 T2 JP 2013231430 A KR 20130120401 A	04-12-2013 30-10-2013 08-09-2015 29-02-2016 14-11-2013 04-11-2013
DE 202012101447 U1	25-07-2012	AT 13061 U1 CH 705103 A2 DE 202012101447 U1	15-05-2013 14-12-2012 25-07-2012
WO 2013154644 A2	17-10-2013	CA 2861913 A1 EP 2805086 A2 ES 2602907 T3 KR 20140146581 A MX 343428 B TW 201340118 A US 2014027984 A1 WO 2013154644 A2	17-10-2013 26-11-2014 22-02-2017 26-12-2014 04-11-2016 01-10-2013 30-01-2014 17-10-2013