



(51) International Patent Classification:
B60G 15/06 (2006.01) **F16C 21/00** (2006.01)

(21) International Application Number:
PCT/EP2010/058080

(22) International Filing Date:
9 June 2010 (09.06.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0954026 16 June 2009 (16.06.2009) FR

(71) Applicant (for all designated States except US): **AK-TIEBOLAGET SKF** [SE/SE]; S-415 50 Goteborg (SE).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **HOUDAYER, Christophe** [FR/FR]; 3 Impasse Pantagruel, F-37360 Semblancay (FR). **CORBETT, Richard** [GB/FR]; 11 rue du Verger, F-37230 Fondettes (FR). **VIAULT, Samuel** [FR/FR]; 3 Allée Pissaro, Bât 3, Appt 97, F-37100 Tours (FR). **DUBUS, Jérôme** [FR/FR]; 39 rue du Grand Carroi, F-37520 La Riche (FR). **MONTBOEUF, Bruno** [FR/FR]; 14 rue des Commaillères, F-37390 Cerelles (FR). **VIDOT, Désiré** [FR/FR]; 11 Place du Général Leclerc, Appartement n° 15, F-37300 Joue-les-Tours (FR).

(74) Agent: **CASALONGA, Axel**; Bureau D.A. Casalonga-Josse, 8 Avenue Percier, F-75008 Paris (FR).

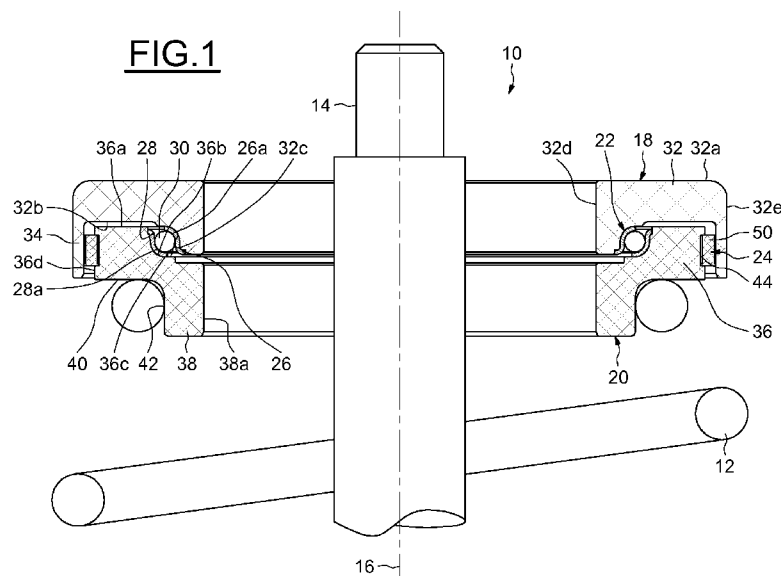
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, 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, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, 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, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

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

(54) Title: THRUST BEARING AND SUSPENSION FOR VEHICLE



(57) Abstract: Suspension thrust bearing device and strut. The suspension thrust bearing device comprises a rolling bearing (22) forming an axial thrust bearing and provided with an upper ring (26), a lower ring (28) and at least one row of rolling elements (30) arranged between the rings, a seating cup (20) in contact with the lower ring and a retaining cup (18) in contact with the upper ring. The device further comprises a sliding bearing (24) forming a radial thrust bearing arranged radially between an exterior surface 36d of the seating cup (20) and a skirt (34) of the retaining cup (18).

THRUST BEARING AND SUSPENSION FOR VEHICLE

5 The present invention relates to the field of suspension thrust bearing devices used in particular in motor vehicles in the suspension struts of the steered wheels.

10 The invention relates more specifically to a suspension thrust bearing device comprising a contact rolling bearing forming an axial thrust bearing and provided with an upper ring and a lower ring between which rings there is arranged at least one row of rolling elements, for example balls or rollers. The upper and lower rings are generally mounted in contact with upper and lower seating or retaining components, such as retainers or cups. The upper and lower cups form a housing for the rings of the rolling bearing and provide the interface between the said rings and the surrounding elements.

15 The suspension thrust bearing device is arranged in the upper part of the suspension strut, between the vehicle body shell and a suspension spring. The spring is installed around a shock absorber piston rod the end of which is connected to the vehicle body shell via an elastic mount that filters out vibration. The suspension spring bears axially, either directly or indirectly, on the lower cup. The lower cup for its part is fixed relative to the vehicle body shell. For further details reference may, for example, be made to patent application FR-A1-2 901 737.

25 Such a suspension thrust bearing device allows a rotational movement between the lower cup and the filtering elastic mount resulting from a turning of the steered wheels of the vehicle and/or as a result of the compression of the suspension spring, while at the same time transmitting axial load between the spring and the vehicle body shell.

30 However, the axis of extension of the suspension spring is generally inclined with respect to the axis of the rolling bearing of the thrust bearing device.

As a result, radial load is also applied by the suspension spring to the lower cup. This may cause the said cup to deform and may result in an increase in the torque that the driver of the vehicle has to apply in order to turn the steered wheels.

5 It is an object of the present invention to address these disadvantages.

More specifically, the present invention aims to provide a suspension thrust bearing device that is robust, that is able to withstand the axial and radial load applied by the suspension spring,
10 that is of simple design and that is economical.

In one embodiment, the suspension thrust bearing device comprises a contact rolling bearing forming an axial thrust bearing and provided with an upper ring, a lower ring and at least one row of rolling elements arranged between the rings, a seating cup in contact
15 with the lower ring and a retaining cup in contact with the upper ring. The device further comprises a sliding-contact bearing forming a radial thrust bearing arranged radially between an exterior surface of the seating cup and a skirt of the retaining cup.

The frictional torque arising out of friction between the seating
20 cup and the retaining cup is thus limited, making it possible to keep the torque that the driver of the vehicle has to apply when turning the steered wheels substantially constant even when radial load is applied by the suspension spring to the seating cup.

The sliding bearing may be arranged axially substantially at the
25 level of the rolling bearing.

The sliding bearing may be in sliding contact with the exterior surface of the skirt.

Preferably, the sliding bearing consists of an annular body. The sliding bearing may comprise axial grooves that can be filled with
30 lubricant. This bearing may be made of thermoplastic.

Advantageously, the seating cup comprises a bearing surface for a suspension spring. The bearing surface may extend radially. Alternatively, the surface may be inclined with respect to an upper mounting surface of the retaining cup, which surface is intended to

bear against an exterior element. An axis orthogonal to the bearing surface is inclined with respect to the axis of the sliding and rolling bearings which coincides with the axis of the device.

5 The seating cup has an upper bearing surface for the lower ring. The bearing surface may be inclined with respect to an upper mounting surface of the retaining cup. An axis orthogonal to the bearing surface is inclined with respect to the axis of the rolling bearing which coincides with the axis of the device. As an alternative, this surface may extend radially.

10 The invention also relates to a strut comprising a shock absorber and a suspension thrust bearing device as defined hereinabove.

15 The present invention will be better understood from studying the detailed description of some embodiments considered by way of entirely nonlimiting examples and illustrated by the attached drawings in which:

- Figure 1 is a view in axial section of a suspension thrust bearing device according to a first embodiment of the invention;
- Figure 2 is a perspective view of a sliding bearing of the device of Figure 1; and
- 20 - Figures 3 and 4 are views in axial section of suspension thrust bearing devices according to second and third embodiments of the invention.

25 Figure 1 depicts a suspension thrust bearing device denoted by the overall numerical reference 10, designed to be mounted between a bearing seat (not depicted) that comes into contact with an element of the chassis of a motor vehicle and a suspension spring 12 of the helical type. The device 10 is arranged around a shock absorber rod 14, of substantially vertical axis 16, the said rod being axially elongate in the form of a cylinder of revolution. The suspension spring 12 is mounted
30 around the shock absorber rod 14.

As will be described in greater detail hereinafter, the device 10 is notably designed to withstand the axial and radial load applied by the suspension spring 12.

The device 10, of axis 16, comprises an upper retaining cup 18, a lower seating cup 20 forming a bearing means for the spring 12, and a contact rolling bearing 22 and a sliding-contact bearing 24 arranged between the said cups.

5 The rolling bearing 22, of axis 16, is arranged axially overall between the retaining cup 18 and the seating cup 20 and forms an axial thrust bearing. The said bearing comprises an upper ring 26 and a lower ring 28 between which there is housed a row of rolling elements 30, here produced in the form of balls. A cage could also be provided
10 to maintain a uniform circumferential spacing between the rolling elements 30. The rolling elements 30 are arranged between raceways formed by the upper 26 and lower 28 rings. Advantageously, the said rings are obtained from one and the same sheet metal blank by cutting and pressing, by virtue of the fact that the outside diameter of the
15 upper ring 26 is substantially equal to the inside diameter of the lower ring 28.

 The upper ring 26 has a toroidal portion 26a which, in cross section, has a concave internal profile in the form of a quarter of a circle and is able to form a toric raceway for the rolling elements 30,
20 the said toroidal portion 26a being extended inwards by a radial portion extending from a lower edge of the toroidal portion 26a.

 The lower ring 28 also comprises a toroidal portion 28a which, in cross section, has a concave internal profile in the form of a quarter of a circle and is able to form a toric raceway for the rolling elements
25 30, the said toroidal portion 28a being extended outwards by a radial portion extending from an upper edge of the toroidal portion 28a.

 The upper retaining cup 18, of axis 16, advantageously consists of a one-piece part made by moulding a thermoplastic, for example a polyamide PA-6,6 which may or may not be glass fibre reinforced. The
30 retaining cup 18 has a solid annular upper part 32 provided with a radial upper surface 32a intended to come into contact with the bearing seat, an annular lower surface 32b of substantially radial shape but which on its interior end has a toroidal zone 32c of a shape that conforms to that of the toroidal portion 26a of the upper ring 26, an

axial bore 32d and an axial exterior surface 32e. The upper surface 32a acts as a reference surface for mounting the retaining cup 18 against the bearing seat of the motor vehicle chassis. The axis 16 is orthogonal to the upper surface 32a.

5 The retaining cup 18 also has an external annular axial skirt 34 of small thickness situated in the continuation of the exterior surface 32e of the solid part 32 and running axially downwards. The axial skirt 34 radially partially surrounds the seating cup 20.

10 The seating cup 20, of axis 16, may also consist of a one-piece part made by moulding a thermoplastic, for example a polyamide PA-6,6 which may or may not be glass fibre reinforced. The seating cup 20 comprises an annular solid radial portion 36 of an outside diameter smaller than that of the skirt 34 of the retaining cup 18. The radial portion 36 has an upper surface 36a facing and some distance away from the lower surface 32b of the retaining cup and extending axially downwards from a small-diameter edge in the form of a toroidal surface 36b the shape of which conforms to that of the toroidal portion 28a of the lower ring 28. The toroidal surface 36b is extended inwards by a stepped surface 36c extending radially. The radial portion 36 also comprises an axial exterior surface 36d the diameter of which is reduced by comparison with the internal diameter of the skirt 34 of the retaining cup 18 so as to leave an annular radial space between the exterior surface 36d and the bore of the skirt 34.

20 The radial portion 36 of the seating cup 20 is extended, from a small-diameter internal edge, by an annular axial portion 38 extending axially downwards. The axial portion 38 comprises an axial bore 38a with the same diameter as the bore 32c of the retaining cup 18. The upper end of the bore 38a joins onto the small-diameter edge of the stepped surface 36c. The radial portion 36 forms a bearing surface 40 for the top end turn of the suspension spring 12 in the form of a lower radial surface which extends inwards in the form of a toroidal portion in the shape of a quarter of a circle then an axial surface 42 that centres the said spring 12. The axial surface 42 is formed by the exterior surface of the axial portion 38.

The sliding bearing 24, of axis 16, is arranged radially between the seating cup 20 and the retaining cup 18. More specifically, the said bearing is arranged radially between the exterior surface 36d of the seating cup and the bore of the skirt 34 of the retaining cup coming into contact radially with these two elements. The sliding bearing 24 is mounted inside an annular groove or channel 44 formed on the exterior surface 36d of the seating cup. The groove 44 has an axial dimension smaller than the axial dimension of the exterior surface 36d so that it is axially delineated by two opposite radial edges. The sliding bearing 24 comes to bear against these radial edges and is thus axially retained inside the groove 44 without there being any need to provide additional means to achieve this.

As illustrated more clearly in Figure 2, the sliding bearing 24 comprises an intermediate sliding ring or body 50, of annular overall shape, which is housed in the groove 44 and respectively comprises, on its interior and exterior surfaces, a plurality of axial grooves 52 and 54. The axial grooves 52 and 54 are formed on the interior and exterior surfaces of the body 50, being spaced apart from one another uniformly in the circumferential direction. Each exterior groove 54 is aligned with an interior groove 52 when considering the circumferential direction.

In the exemplary embodiment illustrated, the grooves 52, 54 are each twenty-four in number. Of course, it is possible to provide a different number of these and for the grooves 52 to be arranged differently with respect to the grooves 54. Alternatively, it might also be possible to provide grooves only on the exterior surface or only on the interior surface of the body 50. As a variation, the body 50 could also be produced in the form of an annulus open at some point on its circumference to make it easier to fit inside the groove 44 in the seating body 20.

The grooves 52, 54 extend axially from an upper radial surface of the body 50 as far as the vicinity of an opposite lower radial surface of the said body. The grooves 52, 54 are advantageously filled with lubricant, such as grease. Providing grooves 52, 54 which do not open

out at the lower end of the body 50 encourages the retention of lubricant in the body 50 and thus limits the friction between the bearing 24 and the retaining 18 and seating 20 cups. In one embodiment, it might also be possible to provide, on the exterior surface 36d of the seating cup 20 and the skirt 34 of the retaining cup 18 at the region of contact with the body 50, recesses or grooves similar to the grooves 52, 54. Such grooves might also be able to store and progressively distribute lubricant in the region of sliding in order to reduce friction.

10 The interior surface of the body 50 is in contact with the bottom of the groove 44 formed on the exterior surface 36d of the seating cup 20, the exterior surface of the said body coming to bear against the bore of the skirt 34 of the retaining cup 18. There is sliding contact on the one hand between the interior surface of the sliding bearing 24 and the seating cup 20 and, on the other hand, between the exterior surface of the said bearing and the retaining cup 18.

15 The sliding bearing 24 may advantageously be made by moulding a rigid thermoplastic, for example a polyamide (PA), a polyester such as polybutylene terephthalate (PBT) or alternatively a polyolefin such as polyethylene (PE) or polypropylene (PP).

20 Arranging the sliding bearing 24 radially between the retaining 18 and seating 20 cups means that the radial load applied by the suspension spring 12 can be borne without appreciably increasing the frictional torque arising out of friction between the said cups, this being so as to keep the torque that the driver has to apply in order to turn the steered wheels of the motor vehicle substantially constant.

25 Otherwise, arranging the sliding bearing 24 between the exterior surface 36d of the seating cup 20 and the skirt 34 of the retaining cup 18 makes it possible to limit the ingress of external contaminants into this region and which could then migrate towards the rolling bearing 22. In other words, the sliding bearing 24 also acts as a sealing means for the rolling bearing 22. The functions of sealing or protecting the rolling bearing 22 and of reacting the radial load

30

applied by the suspension spring 12 are therefore performed by one single component.

5 The alternative form of embodiment illustrated in Figure 3, in which elements that are identical bear the same references, differs only in that the bearing surface 40 of the seating cup 20 for the upper
10 end turn of the suspension spring 12 is inclined with respect to the radial upper surface 32a of the retaining cup 18. An axis orthogonal to the bearing surface 40 is secant and inclined with respect to the axis 16 of the bearings 22, 24. The angle formed by these two axes may, for
15 example, be of the order of 10 to 30°. Inclining the bearing surface 40 with respect to the upper surface 32a makes it possible to reduce the radial load that can be applied by the suspension spring 12 while at the same time maintaining a good distribution of axial load applied by the
20 said spring at the rolling bearing 22.

15 The embodiment illustrated in Figure 4, in which elements which are identical bear the same references, differs mainly from the alternative form of embodiment previously described in that the surfaces 36a and 36c of the seating cup 20 are inclined with respect to
20 the radial upper surface 32a of the retaining cup 18 so that an axis 60 of the rolling bearing 22 is inclined with respect to the axis 16 of the sliding bearing 24. The angle formed by these two axes may, for example, be of the order of 10 to 30°. The lower surface 32b of the retaining cup 18 is also inclined with respect to the upper surface 32a
25 so as to face the surface 36a of the seating cup 20 with a constant spacing. In this embodiment, the sliding bearing 24 is arranged radially against the exterior surface 36d of the seating cup 20 and bears axially against a radial shoulder 62 formed on the said exterior surface.

30 Providing on the seating cup 20 an upper bearing surface for the rolling bearing 22 that is inclined with respect to the upper surface 32a of the retaining cup 18 combined with the inclining of the bearing surface 40 for the suspension spring 12 makes it possible to reduce the radial load applied by the said spring. The angles by which these

surfaces are inclined with respect to the bearing surface 40 are the same.

5 In all of the embodiments described hereinabove it might be possible, without departing from the scope of the invention, to provide a stiffening reinforcement of L-shaped overall cross section interposed between the suspension spring 12 and the seating cup 20 so as to increase the ability of the said cup to withstand the load applied by the said spring. Alternatively, it might be possible to embed this reinforcement inside the cup 20. It might also be possible to
10 incorporate into the seating cup 20 other functions, for example by providing an inwardly directed projection or radial rib at the lower end of the bore 38a to form a means of axially retaining a shock-absorbing pad arranged around the shock absorber rod 14.

CLAIMS

1. Suspension thrust bearing device comprising a rolling bearing (22) forming an axial thrust bearing and provided with an upper ring (26), a lower ring (28) and at least one row of rolling elements (30) arranged between the rings, a seating cup (20) in contact with the lower ring and a retaining cup (18) in contact with the upper ring, characterized in that it further comprises a sliding bearing (24) forming a radial thrust bearing arranged radially between an exterior surface (36d) of the seating cup (20) and a skirt (34) of the retaining cup (18).
2. Device according to Claim 1, in which the sliding bearing (24) is arranged axially substantially at the level of the rolling bearing (22).
3. Device according to Claims 1 or 2, in which the sliding bearing (24) is in sliding contact with the exterior surface (36d) and the skirt (34).
4. Device according to any one of the preceding claims, in which the sliding bearing (24) consists of an annular body (50).
5. Device according to any one of the preceding claims, in which the sliding bearing (24) comprises axial grooves (52, 54) that can be filled with lubricant.
6. Device according to any one of the preceding claims, in which the sliding bearing (24) is made of thermoplastic.
7. Device according to any one of the preceding claims, in which the seating cup (20) comprises a bearing surface (40) for a suspension spring.
8. Device according to Claim 7, in which the bearing surface (40) of the seating cup extends radially.
9. Device according to Claim 7, in which the bearing surface (40) of the seating cup is inclined with respect to an upper mounting surface (32a) of the retaining cup (18).
10. Device according to any one of the preceding claims, in which the seating cup (20) has an upper bearing surface for the lower

ring (28) of the rolling bearing, the said bearing surface being inclined with respect to an upper mounting surface (32a) of the retaining cup (18).

- 5 11. Strut comprising a shock absorber and a suspension thrust bearing device according to any one of the preceding claims.

FIG.1

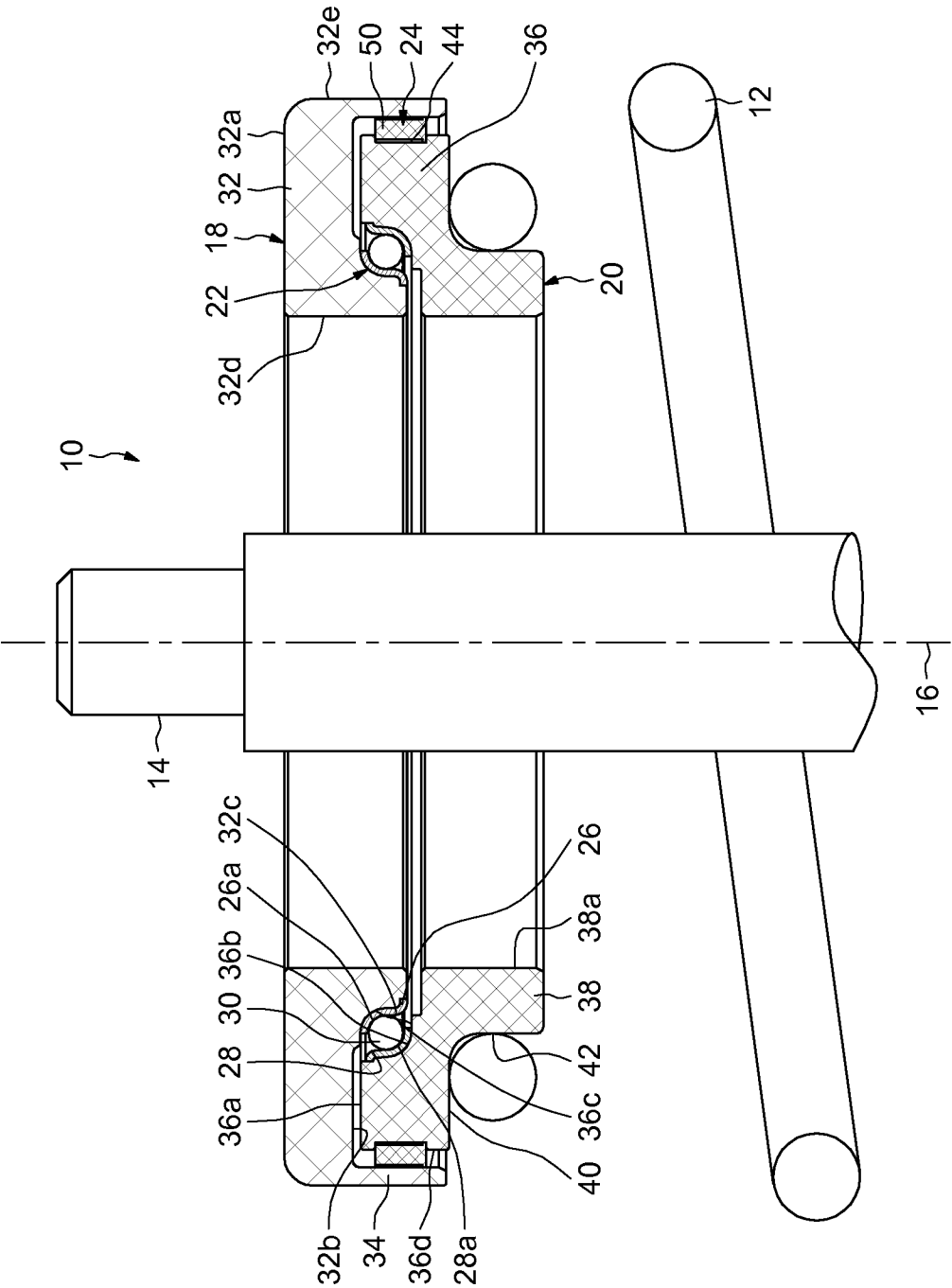


FIG.2

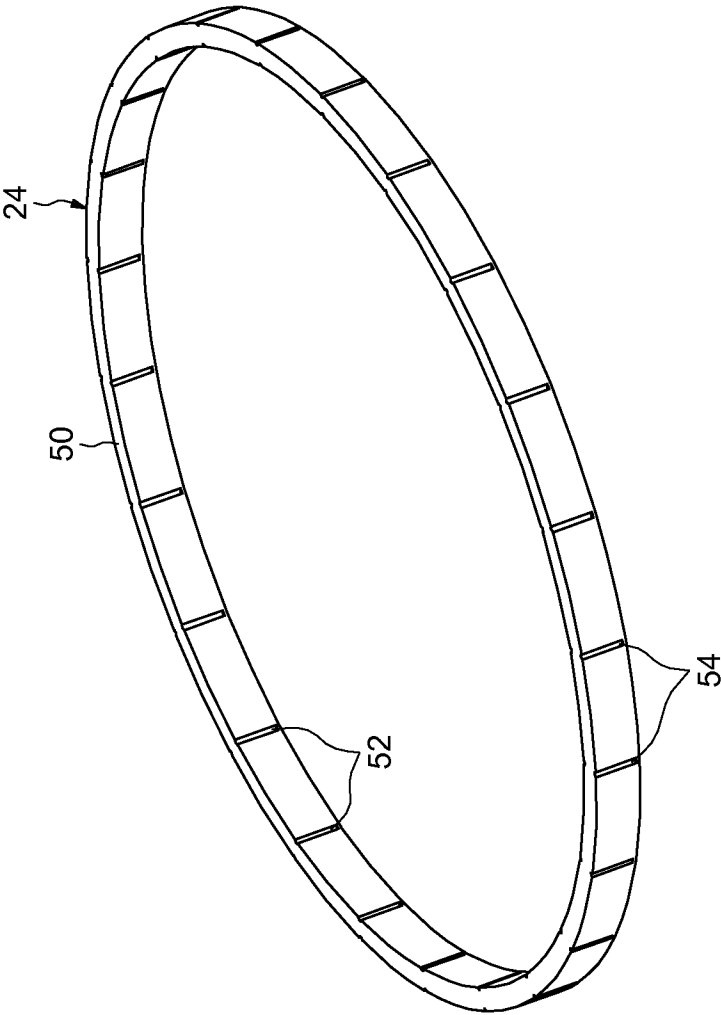


FIG.3

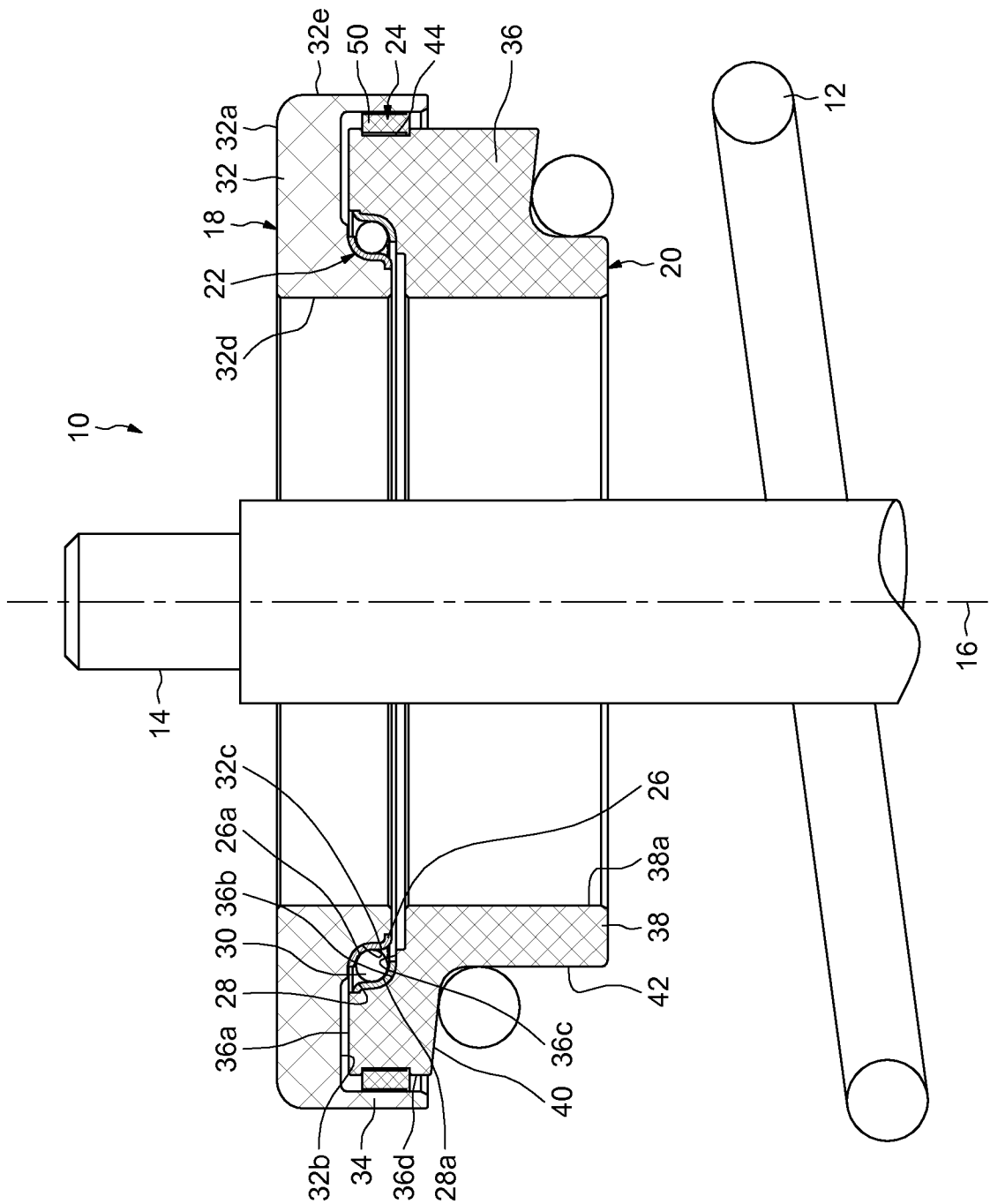
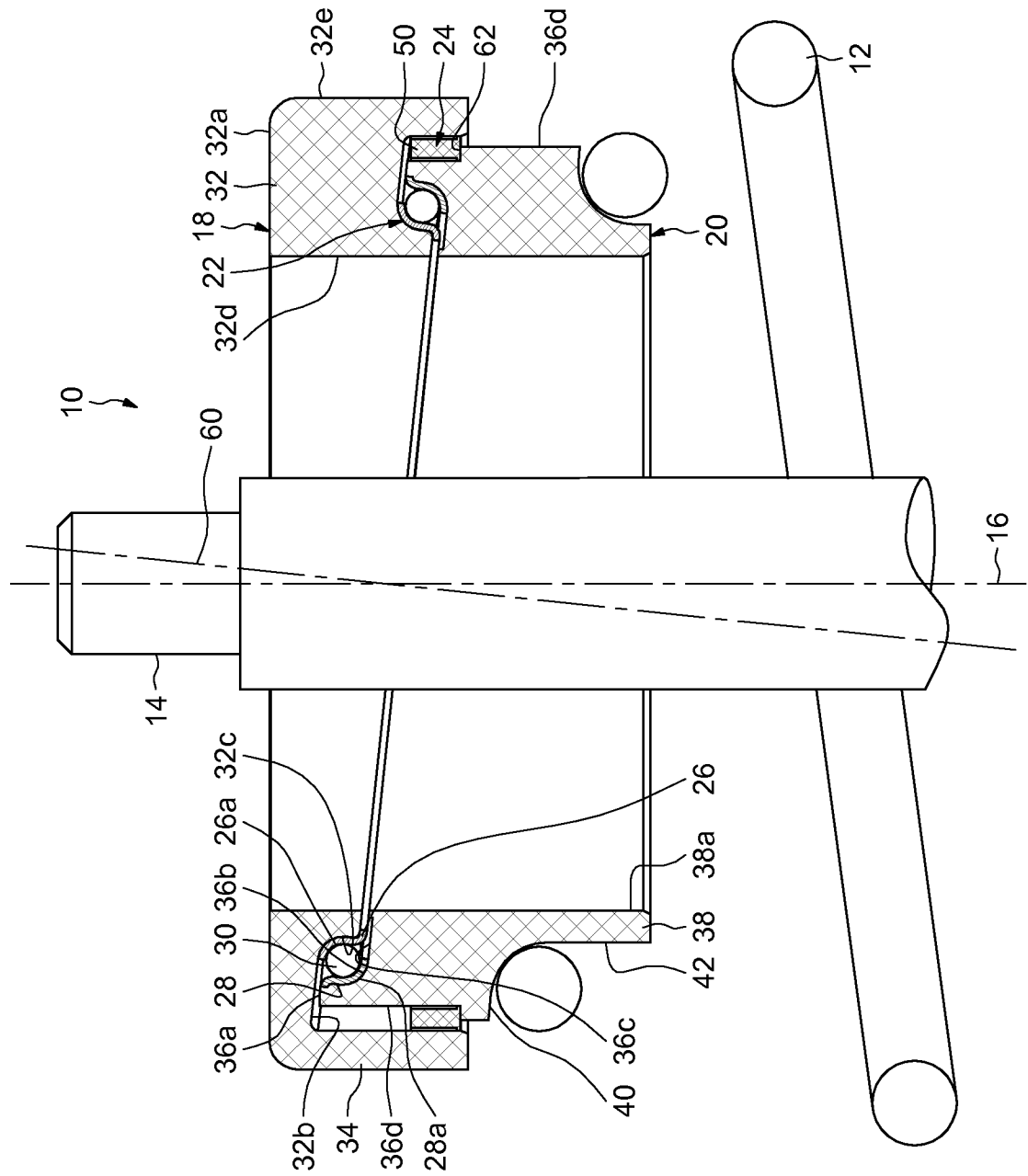


FIG.4



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2010/058080

A. CLASSIFICATION OF SUBJECT MATTER
 INV. B60G15/06 F16C21/00
 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)

B60G F16C

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 practical, 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.
A	US 4 484 824 A (HIGUCHI SEIJI [JP] ET AL) 27 November 1984 (1984-11-27) column 3, lines 22-38; figures 1,4 -----	1-11
A	US 4 325 566 A (STEPHAN GERARD) 20 April 1982 (1982-04-20) the whole document -----	1-11
A	EP 0 656 483 A1 (OILES INDUSTRY CO LTD [JP]) 7 June 1995 (1995-06-07) the whole document -----	1
A	FR 2 346 595 A1 (NADELLA [FR]) 28 October 1977 (1977-10-28) the whole document -----	1
-/--		

☒ 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 document 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

6 July 2010

Date of mailing of the international search report

15/07/2010

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

Savelon, Olivier

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2010/058080

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 901 737 A1 (SKF AB [SE]) 7 December 2007 (2007-12-07) cited in the application the whole document -----	1-11
A	FR 2 369 942 A1 (NADELLA [FR]) 2 June 1978 (1978-06-02) the whole document -----	1
A	FR 2 519 102 A1 (NIPPON SEIKO KK [JP]) 1 July 1983 (1983-07-01) the whole document -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2010/058080

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4484824	A	27-11-1984	JP 1038331 Y2 JP 59024530 U	16-11-1989 15-02-1984
US 4325566	A	20-04-1982	BR 8003327 A DE 3019857 A1 ES 8200451 A1 FR 2457410 A1 GB 2055155 A IT 1127595 B JP 55159319 A	30-12-1980 27-11-1980 16-01-1982 19-12-1980 25-02-1981 21-05-1986 11-12-1980
EP 0656483	A1	07-06-1995	DE 69427446 D1 DE 69427446 T2 JP 2600937 Y2 JP 7034220 U US 5476326 A	19-07-2001 18-10-2001 02-11-1999 23-06-1995 19-12-1995
FR 2346595	A1	28-10-1977	NONE	
FR 2901737	A1	07-12-2007	DE 102007024628 A1	06-12-2007
FR 2369942	A1	02-06-1978	ES 463777 A1 IT 1090612 B	16-06-1978 26-06-1985
FR 2519102	A1	01-07-1983	JP 58097318 U JP 62024819 Y2 US 4466751 A	02-07-1983 25-06-1987 21-08-1984