



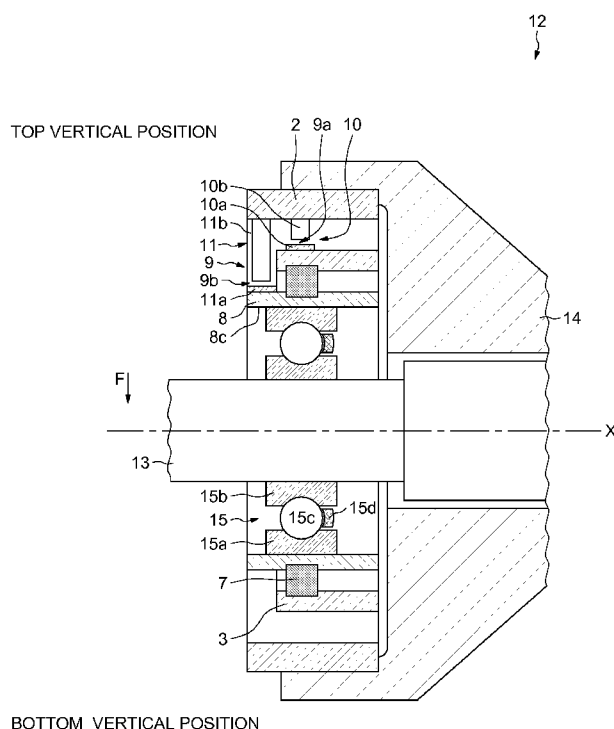
- (51) **International Patent Classification:**
G01L 5/00 (2006.01) *G01L 1/22* (2006.01)
- (21) **International Application Number:**
PCT/EP2011/053686
- (22) **International Filing Date:**
11 March 2011 (11.03.2011)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (71) **Applicant (for all designated States except US):** AK-TIEBOLAGET SKF [SE/SE]; S-415 50 Göteborg (SE).
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- (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, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

- (54) **Title:** DEVICE FOR HOUSING A BEARING PROVIDED WITH A SYSTEM FOR DETECTING THE LOAD APPLIED TO THE BEARING.

FIG.4



- (57) **Abstract:** A housing device (1), provided with a system (9) for detecting the load applied to an element (15) arranged in said housing (1), comprises an inner part (3) adapted to support said element (15) and an outer part (2), said inner and outer parts (2, 3) being linked by at least two deformable connecting elements (5, 6), such that the inner part (3) may be displaced relative to the outer part (2) under the action of a load applied to said element (15), the system (9) for detecting the applied load comprising first detection means (10) for directly detecting the displacement of one of the parts (3), relative to the other part (2), under the action of a load applied to said element (15). Said housing (1) comprises a deformable ring (7) mounted in the bore (3a) of the inner part (3).



Published:

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

**Device for housing a bearing provided with a system for detecting
the load applied to the bearing**

5 The present invention relates to the field of housing device for bearings, in particular for rolling bearings. More particularly, the invention relates to the detection of the load applied to said bearings during operation or standstill, for example in a washing machine.

10 Conventionally, a bearing device is mounted inside the hub of a washing machine in order to support the drum shaft. Such bearing device comprises a housing made of steel and elastomer so as to be deformed elastically upon introduction of clothes in the drum, and upon rotation of the drum due to centrifugal forces. The bearing device usually contains displacement sensors for calculating forces linked to the weight of the clothes in the drum.

15 Patent application WO 2007/077307 (SKF) discloses a housing device having an outer part and an inner part provided with a bore adapted to cooperate with a rolling bearing mounted on the drum shaft of a washing machine. Said parts are linked by two deformable connecting elements such that the inner part may be displaced relative to the outer part under the action of a load applied to the rolling bearing. Said housing is provided with a system for detecting the load applied to the bearing.

20 However, such device is very sensitive to temperature variations because of the material used for the inner and outer parts.

25 Moreover, it is particularly difficult to determine the load during standstill.

 One aim of the present invention is therefore to overcome the aforementioned drawbacks.

30 It is a particular object of the present invention to provide a reliable and accurate load measurement device.

It is another object of the present invention to provide a device for measuring load which is not very sensitive to variations in environmental conditions, such as temperature variations, and able to determine the load during standstill.

5 In one embodiment, the invention provides a housing device, provided with a system for detecting the load applied to an element arranged in said housing, comprises an inner part adapted to support said element and an outer part, said inner and outer parts being linked by at least two deformable connecting elements, such that the inner
10 part may be displaced relative to the outer part under the action of a load applied to said element, the system for detecting the applied load comprising first detection means for directly detecting the displacement of one of the parts, relative to the other part, under the action of a load applied to said element.

15 The housing comprises a deformable ring mounted in the bore of the inner part.

Under static or quasi-static conditions, it is the deformable ring which deforms under the action of load applied to the element inside the housing; while under dynamic conditions, the deformable ring
20 reaches its maximum deformation and thus becomes hard which lead to the deformation of the deformable connecting elements linking the inner and outer parts. Thanks to the deformable ring, low loads can be detected at static or quasi-static conditions.

Advantageously, the housing comprises second detection means
25 for detecting the deformation of the deformable ring under the action of a load applied to the element.

In one embodiment, the deformable ring is in direct contact with the element arranged in said housing.

In another embodiment, the housing comprises an intermediate
30 ring between the deformable ring and the element.

For example, the intermediate ring comprises on its outer surface an annular groove adapted to cooperate with the deformable ring.

5 Advantageously, the first detection means comprise a first mobile detection portion rigidly connected to the inner part and a first fixed detection portion mounted in the bore of outer part, said first mobile and fixed portions being aligned.

More preferably, the outer part may extend axially beyond the inner part.

10 The second detection means may comprise a second mobile detection portion rigidly connected to the intermediate ring and a second fixed detection portion mounted in the bore of outer part, on the axial part extending beyond the inner part, said second mobile and fixed portions being aligned.

15 Preferably, the first and second detection means comprise at least one capacitive sensor.

The deformable ring may be made of elastomeric material.

More preferably, said element arranged in the housing comprises a bearing.

20 According to another aspect, it is proposed a washing machine comprising a drum rotatably mounted on a fixed hub by means of at least one rolling bearing arranged in a housing as previously described.

25 Advantageously, the housing is angularly positioned in such a way that the detection means are located either on the top or bottom vertical position.

The present invention will be better understood with the aid of the detailed description of a number of embodiments given by way of non-limiting example and illustrated by the attached drawings, in
30 which:

- Figure 1 is a perspective view of a housing device according to the invention;

- Figure 2 is a front view of the housing device of figure 1;
- Figure 3 is an axial section, along line III-III of Figure 2 ;
- Figure 4 is a view in axial section of a part of a washing machine having a housing device according to Figure 3.

5 As illustrated on Figures 1 and 2, a housing device, designed by general reference number 1, is designed to be installed in a mechanical assembly, for example a casing, a frame or a support (not illustrated) and comprises an outer part 2 and an inner part 3 separated by a space.

10 The inner part 3 comprises a body of annular shape having a substantially uniform thickness. The outer part 2 comprises a body of general annular shape having a substantially uniform thickness and adapted to be mounted in the bore of a casing, for example the hub 14 of a washing machine as illustrated in Figure 4.

15 The inner and outer parts 2, 3 are linked together by two deformable connecting elements 5, 6, for example having four arms 5a, 5b, 6a, 6b of rounded shape and deformable, such that the inner part 3 may be displaced relative to the outer part 2 under action of a load applied to an element inside the inner part 3. The arms 5a, 5b, 6a, 6b
20 are arranged symmetrically relative to a perpendicular plane passing through the axis X of the housing device 1. The connecting elements 5, 6 are capable of being elastically deformed in an applied load range which is sufficiently wide. The outer part 2, the inner part 3 and the connecting elements 5, 6 are in one piece, and may be made by
25 moulding synthetic material or even by moulding a metal for example steel or an aluminium alloy.

 The housing device 1 further comprises a deformable ring 7, made for example in elastomeric material, such as natural rubber or silicone material. The deformable ring 7 is mounted in the bore 3a of
30 the inner part 3 and can be directly or indirectly in contact with the element arranged inside the housing device 1.

 As illustrated on the embodiment of figures 1 and 2, the

housing device 1 comprises an intermediate ring 8 arranged in the bore 3a of the inner part 3, in such a way that the deformable ring 7 is disposed between the inner part 3 and said intermediate ring 8.

5 The structure of the housing device 1 is explained in more detail in figure 3, which illustrate an axial view along III-III of figure 2.

The outer part 2 extends axially beyond the inner part 3 and has substantially the same axial length as the intermediate ring 8.

10 The intermediate ring 8 is provided on its outer surface 8a with an annular groove 8b adapted to cooperate with the deformable ring 7 and extends axially beyond the inner part 3. The annular groove 8b presents an axial length slightly larger than the axial length of the deformable ring 7 in order to allow an axial deformation of the deformable ring 7. The inner part 3 of the housing device 1 is provided
15 on its bore 3a with an annular groove 3b adapted to cooperate with the deformable ring 7.

The housing device 1 further comprises a system for detection 9 of the load applied to an element arranged in said housing device 1. The system for detection 9 is locally implemented between the outer
20 part 2 and the intermediate ring 8, and preferably in the top vertical position shown on figures 2 to 4, once installed in a mechanical assembly, such as a washing machine 12. The system for detection 9 comprises two detection means 10, 11, first detection means 10 are mounted between the inner and outer parts 2, 3 for detecting the
25 displacement of one of the parts 3 relative to the other 2, and second detection means 11 are mounted between the intermediate ring 8 and the outer part 2 for detecting the deformation of the deformable ring 7 under the action of a load applied to the element arranged inside the housing device 1. The detection means 10, 11 may be of the capacitive
30 type.

The first detection means 10 comprises a first mobile detection portion 10a rigidly connected to the inner part 3 and extending

towards the outer part 2 and a first fixed detection portion 10b mounted in the bore 2a of the outer part 2 and extending towards the inner part 3, said first mobile and fixed portions 10a, 10b being aligned. A gap 9a is provided between the first mobile and fixed portions 10a, 10b.

The second detection means 11 comprise a second mobile detection portion 11a rigidly connected to the intermediate ring 8 and a second fixed detection portion 11b mounted in the bore 2a of the outer part 2, on the axial part extending beyond the inner part 3. The second mobile and fixed portions 11a, 11b are aligned. A gap 9b is provided between the second mobile and fixed portions 11a, 11b.

As may be seen on Figure 4, the housing device is mounted in a washing machine 12 comprising a drum shaft 13 rotatably mounted on a fixed hub 14 by at least one rolling bearing 15. The housing device 1 surrounds the rolling bearing 15. The hub 14 can be made of metal, such as steel or aluminium. The inner part 3 of the housing device 1 is provided with a bore 8c adapted to cooperate with the rolling bearing 15 mounted on the drum shaft 13.

The rolling bearing 15 comprises an outer ring 15a, an inner ring 15b and a row of rolling elements 15c, in this case balls, maintained at regular circumferential space by a cage 15d. The rolling elements 15c are arranged between an inner bearing race of the outer ring 15a and an outer bearing race of the inner ring 15b.

The drum shaft 13 is capable of being subjected to a radial load oriented in the direction of the arrow F. Said load causes a slight radial displacement of the shaft 13, the rolling bearing 15, the intermediate ring 8 and the inner part 3 relative to the outer part 2 of the housing device 1.

When a load is applied to the rolling bearing 15, the outer part 2 remains substantially immobile, whilst the intermediate ring 8 and possibly also the inner part 3 are displaced in the direction of the load applied, thanks to the deformation of the deformable connecting

elements 5, 6. The first 10 and second 11 detection means are preferably located in the top vertical position, so that when F is applied, the gaps 9a, 9b between the first mobile and fixed portions 10a, 10b and between the second mobile and fixed portions 11a, 11b are increased. If F increases, these gaps will increase as well. Alternatively, the first 10 and second 11 detection means could be best located in the bottom vertical position, so that when F is applied, the gaps 9a, 9b are decreased.

Under static or quasi-static conditions, at a rotational speed of the drum shaft 13 comprised between 0 and 100 rpm (rotation/minute), for example upon introduction of clothes in the washing machine 12, it is the deformable ring 7 that deforms elastically. The deformation at quasi-static conditions is measured thanks to the second detection means 11.

Under dynamic conditions, for example at a rotational speed of the drum shaft larger than 100 rpm (rotation/minute), due to centrifugal forces, the deformable ring 7 reaches its maximum deformation and becomes hard. It is thus the connecting arms 5a, 5b, 6a, 6b which deform, downwardly, but without substantially deforming the inner portion 3 due to its annular structure and without substantially deforming the outer part 2. The deformation at dynamic conditions is thus further measured with the first detection means 10.

The invention is not limited to the embodiments described and may be the subject of many variants. It could also be possible to mount the deformable ring directly on the outer ring of the rolling bearing, without an intermediate ring.

The housing device according to the invention for supporting load sensors is particularly economical, able to be used with conventional bearings and can be provided with speed sensors and/or temperatures sensors.

Furthermore, such a housing device is able to be mounted in a simple manner, while ensuring an accurate and reliable measurement

of the load.

Finally, thanks to a deformable ring arranged between the inner part and the rolling bearing, which is less sensitive to temperature variations than the inner part, it is possible to measure small loads, such as 0.150 kg (kilograms), and loads under static or quasi-static conditions.

CLAIMS

1. A housing device (1), provided with a system (9) for detecting the load applied to an element (15) arranged in said housing (1), comprises an inner part (3) adapted to support said element (15) and an outer part (2), said inner and outer parts (2, 3) being linked by at least two deformable connecting elements (5, 6), such that the inner part (3) may be displaced relative to the outer part (2) under the action of a load applied to said element (15), the system (9) for detecting the applied load comprising first detection means (10) for directly detecting the displacement of one of the parts (3), relative to the other part (2), under the action of a load applied to said element (15), characterized in that the housing (1) comprises a deformable ring (7) mounted in the bore (3a) of the inner part (3).

2. Housing according to claim 1, comprising second detection means (11) for detecting the deformation of the deformable ring (7) under the action of a load applied to the element (15).

3. Housing according to claim 1 or 2, in which the deformable ring (7) is in direct contact with the element (15) arranged in said housing (1).

4. Housing according to claim 1 or 2, comprising an intermediate ring (8) between the deformable ring (7) and the element (15).

5. Housing according to claim 4, in which the intermediate ring (8) comprises on its outer surface (8a) an annular groove (8b) adapted to cooperate with the deformable ring (7).

6. Housing according to any one of the preceding claims, in which the first detection means (10) comprise a first mobile detection portion (10a) rigidly connected to the inner part (3) and a first fixed detection portion (10b) mounted in the bore (2a) of outer part (2), said first mobile and fixed portions (10a, 10b) being aligned.

7. Housing according to any one of the preceding claims, in which the outer part (2) extends axially beyond the inner part (3).

8. Housing according to claim 7, in which the second detection means (11) comprise a second mobile detection portion (11a) rigidly connected to the intermediate ring (8) and a second fixed detection portion (11b) mounted in the bore (2a) of outer part (2), on the axial part extending beyond the inner part (3), said second mobile and fixed portions (11a, 11b) being aligned.

9. Housing according to claims 2 to 8, in which first and second detection means (10, 11) comprise at least one capacitive sensor.

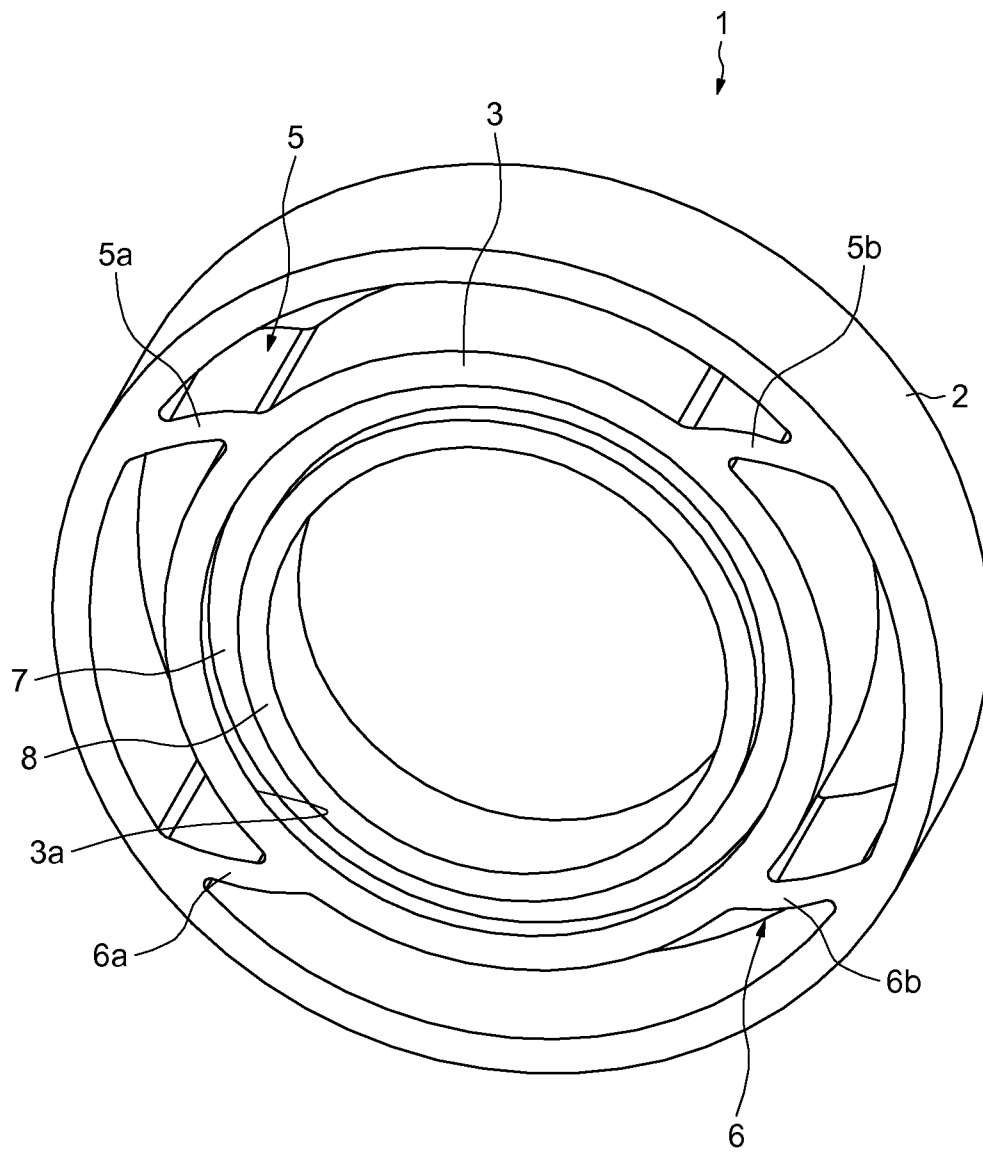
10. Housing according to any one of the preceding claims, in which the deformable ring (7) is made of elastomeric material.

11. Housing according to any one of the preceding claims, in which said element (15) arranged in the housing (1) comprises a bearing.

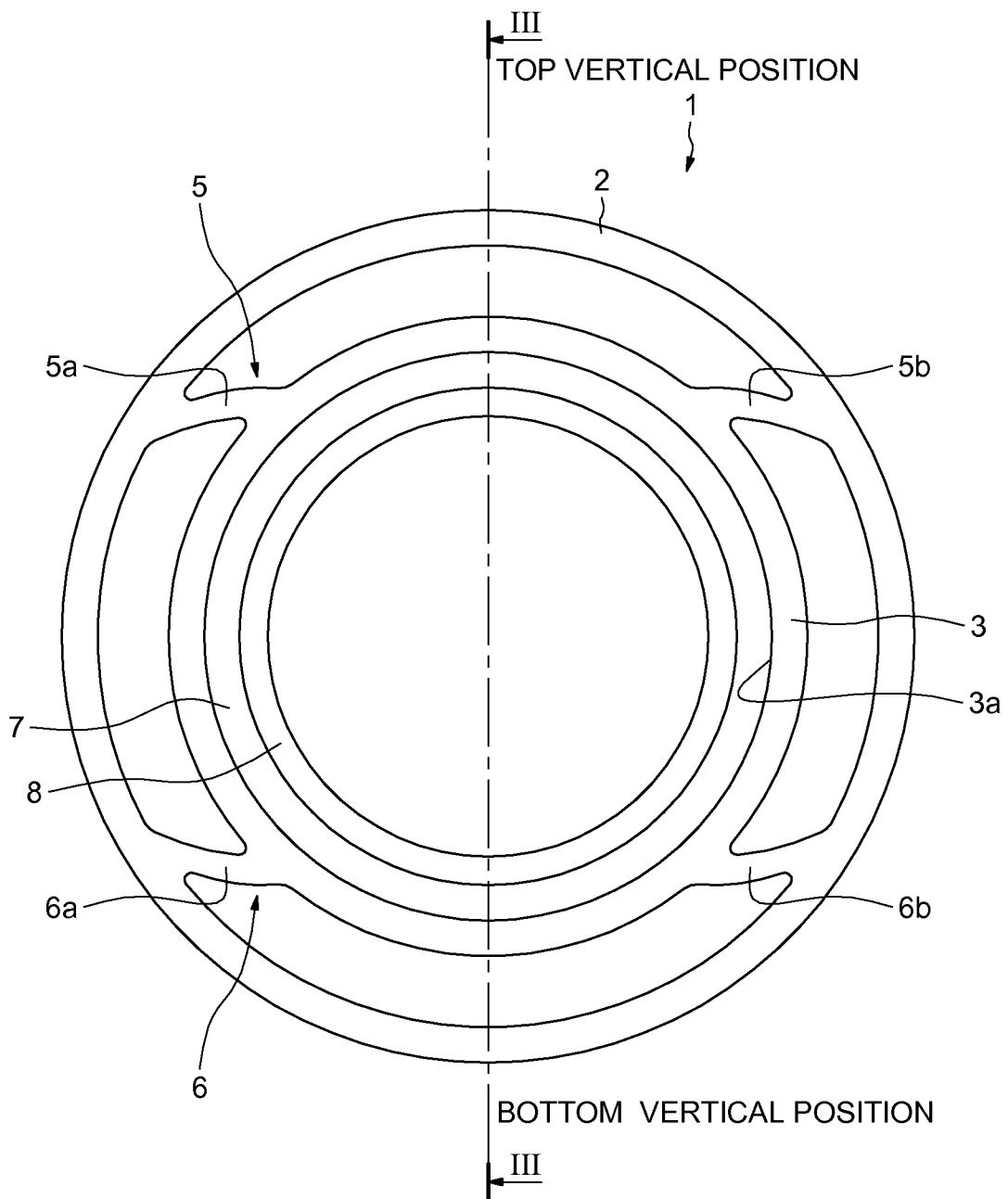
12. Washing machine comprising a drum shaft (13) rotatably mounted on a fixed hub (14) by means of at least one rolling bearing (15) arranged in a housing (1) as claimed in any one of the preceding claims.

13. Washing machine according to claim 12, in which the housing is angularly positioned in such a way that the detection means (10, 11) are located either on the top or bottom vertical position.

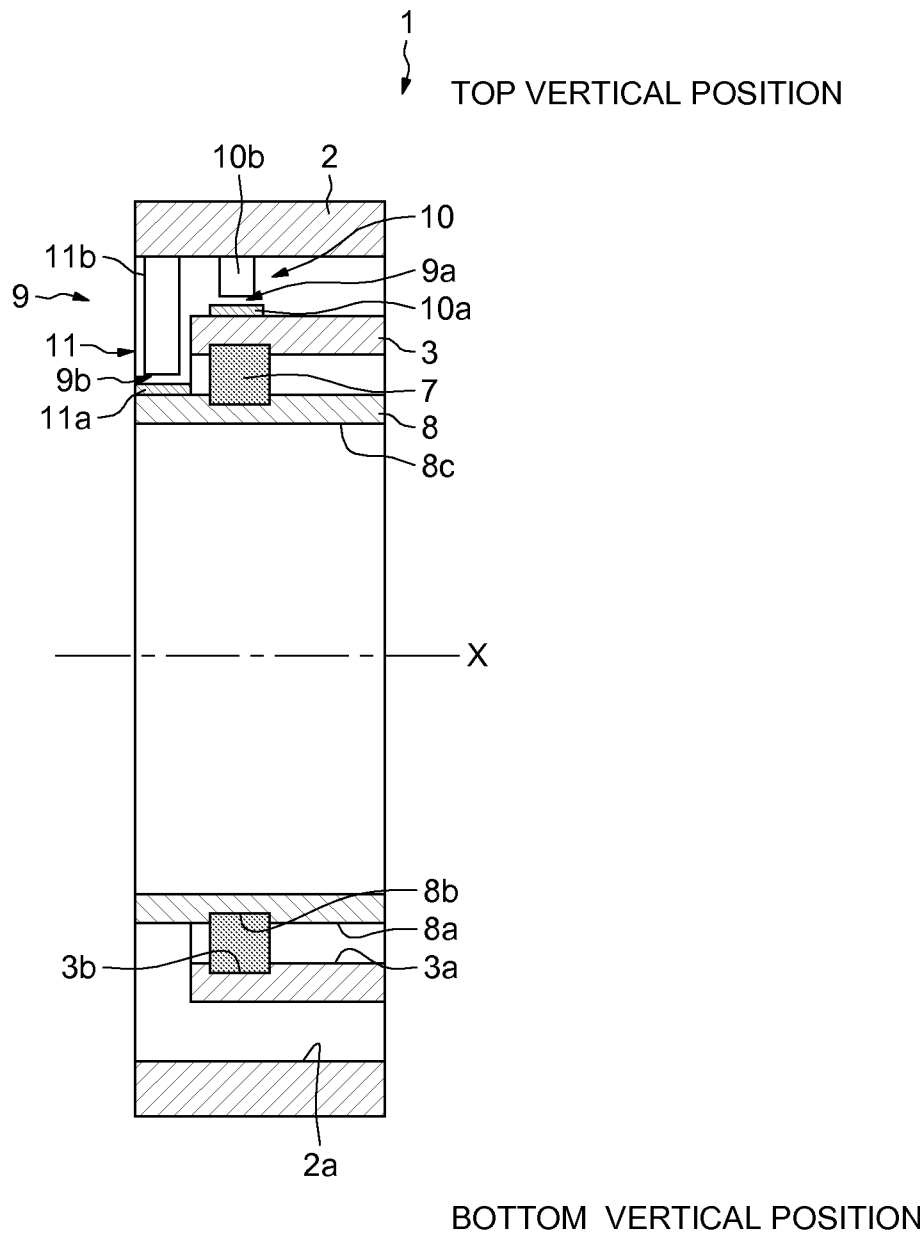
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FIG.1



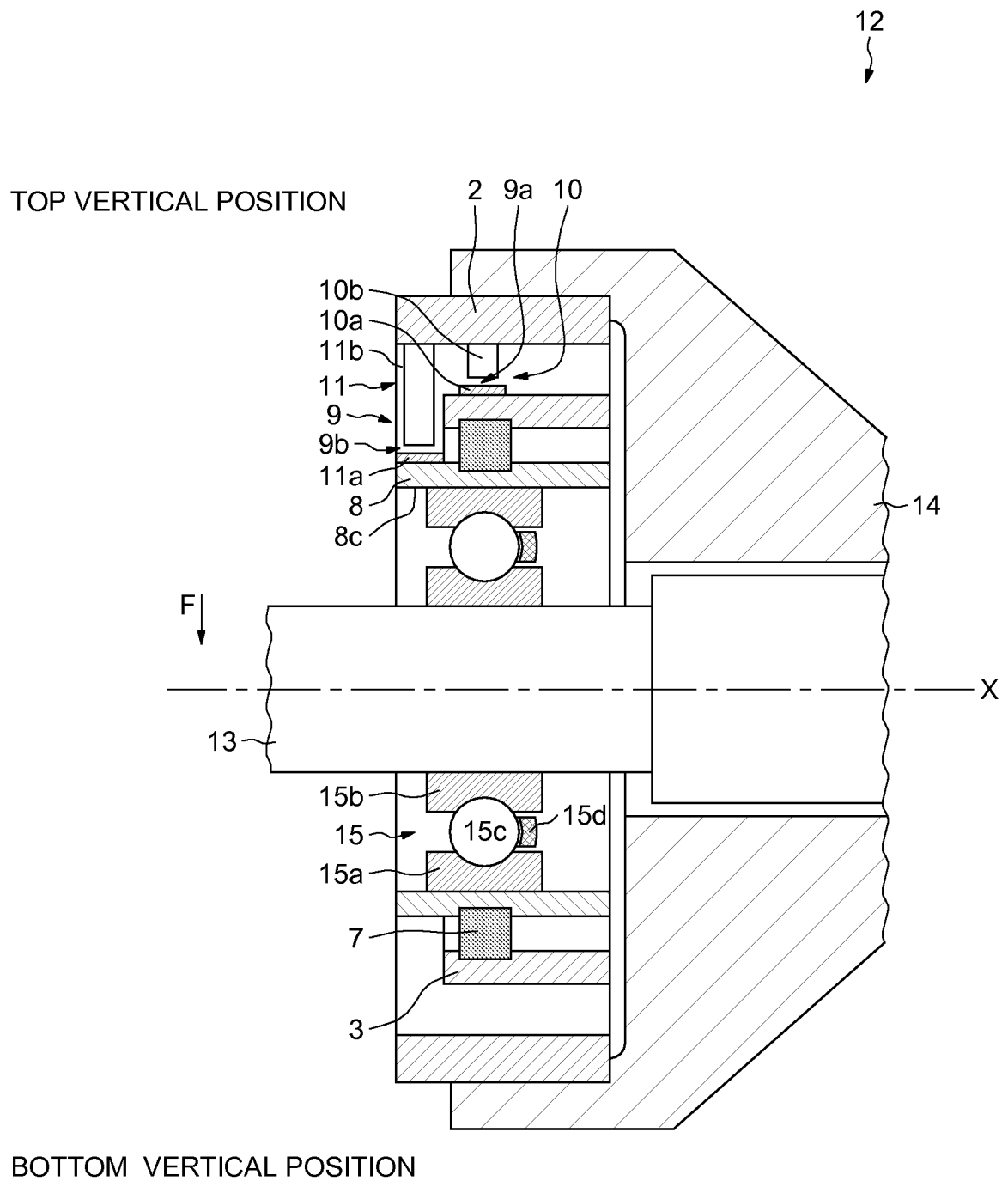
2/4
FIG.2



3/4
FIG.3



4/4
FIG.4



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/053686

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01L5/00 G01L1/22
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)
G01L

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

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Y	----- WO 2007/077307 A1 (SKF AB [SE]; NIARFEIX FRANCOIS [FR]; WABLE THIERRY [FR]; CALVETTO SEBA) 12 July 2007 (2007-07-12) cited in the application page 5, line 12 - page 12, line 2; figures 1-6	1-7,9-13
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Further documents are listed in the continuation of Box C.



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Date of the actual completion of the international search

9 November 2011

Date of mailing of the international search report

21/11/2011

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/053686

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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International application No

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