



(51) International Patent Classification:

F16C 25/08 (2006.01) F16C 19/06 (2006.01)
F16C 33/78 (2006.01)

(21) International Application Number:

PCT/EP2013/069971

(22) International Filing Date:

25 September 2013 (25.09.2013)

(25) Filing Language:

English

(26) Publication Language:

English

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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, BN, BR, BW, BY,

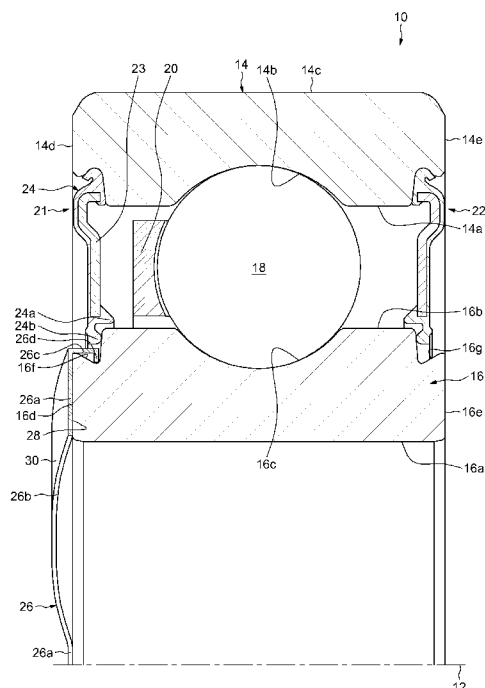
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DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR,
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TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM,
ZW.

(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, 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,
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))

(54) Title: ROLLING BEARING WITH SEAL AND AXIAL PRE-STRESSING MEMBER



(57) Abstract: The rolling bearing comprises an inner ring (16), an outer ring (14), at least one row of rolling elements (18) disposed radially between said rings, at least one seal (21) fixed to one of the rings (14) and arranged radially between said rings, and at least an axially elastic member (26) fixed to the other ring (16) and mounted in axial contact with a lateral surface (16d) of said other ring delimiting axially said other ring.

Rolling bearing with seal and axial pre-stressing member

5 The present invention relates to rolling bearings, in particular rolling bearings having an inner ring and an outer ring with one or more rows of rolling elements, for example balls.

In particular, the present invention relates to rolling bearings used in industrial electric motors. An electric motor generally comprises a casing inside which is mounted a stator and a rotor, and
10 two rolling bearings located at each end of the rotor's shaft.

In such application, known ISO deep groove ball bearings are usually used. These bearings comprise inner and outer rings of the massive or solid type. A "solid ring" is to be understood as a ring obtained by machining with removal of material (by turning, grinding)
15 from steel tube stock, bar stock, rough forgings and/or rolled blanks.

Document EP-B1-1 037 051 discloses an instrumented rolling bearing mounted into the casing of the electric motor and stacked conical washers axially interposed between said rolling bearing and the casing. Such a device uses a plurality of pre-stressing washers that
20 are independent of the rolling bearing. Accordingly, the motor manufacturer has to manage, handle and assemble a large number of components.

One aim of the present invention is to overcome these drawbacks.

25 It is a particular object of the present invention to provide a rolling bearing that is economical, having good sealing properties and easy to install in a machine for which it is intended, for example in an electric motor.

In one embodiment, the rolling bearing comprises an inner
30 ring, an outer ring, at least one row of rolling elements disposed radially between the rings and at least one seal fixed to one of the rings and arranged radially between said rings. The rolling bearing further comprises at least an axially elastic member fixed to the other

ring and mounted in axial contact with a lateral surface of said other ring delimiting axially said other ring.

5 The axial retention of the elastic member on the inner ring or on the outer ring of the rolling bearing makes it possible to reduce the number of components to be procured and to be fitted. Manufacturing errors resulting from forgetting the elastic member are thus avoided, for example for a motor manufacturer when the rolling bearing is intended to an electric motor.

10 Advantageously, the elastic member is fixed to the outer ring radially on the side opposite to a fixing portion of the seal with respect to the rolling elements.

15 In a preferred embodiment, the elastic member is fixed to said other ring into a radial space existing between the inner and outer rings. Advantageously, the elastic member may be fixed into a groove formed on said other ring.

In a preferred embodiment, the seal comprises at least one sealing lip cooperating with said groove to apply a dynamic sealing with said other ring.

20 This leads to manufacture the ring with a limited number of machining operations since only one groove is provided on said ring to fix the elastic washer and to cooperate with the sealing lip of the seal.

The seal may be fixed into a groove formed on the associated ring and which radially faces the groove formed on said other ring.

25 Preferably, the elastic member is provided with a bearing surface axially spaced apart from the lateral surface of said other ring and adapted to be in contact with an element outside said rolling bearing, and with an opposite abutment surface in axial contact with said lateral surface and axially located outside from a radial space existing between the inner and outer rings.

30 Advantageously, the elastic member may comprise at least one axial retaining means for fixing said member to said other ring. The elastic member may comprise a plurality of axial retaining means regularly spaced apart in the circumferential direction.

Preferably, the elastic member is made in one part. The elastic member may be a washer.

5 In one embodiment, the elastic member comprises radial portions mounted in axial contact with the lateral surface of said other ring and elastic portions connected to said radial portions and axially spaced apart from said lateral surface. Preferably, the elastic portions are located axially on the side opposite to the retaining means(s) with respect to the radial portions. The elastic portions may be regularly spaced apart in the circumferential direction.

10 The elastic portions may comprise corrugations. In another embodiment, the elastic portions may comprise tongues. Alternatively, the elastic member may be a conical washer.

The present invention and its advantages will be better understood by studying the detailed description of a specific embodiment given by way of non-limiting example and illustrated by
15 the appended drawing showing a half axial section of a rolling bearing according to an example of the invention.

As illustrated on the Figure, a rolling bearing 10, with an axis 12, comprises an outer ring 14, an inner ring 16, a plurality of rolling elements 18, which in this case are balls, interposed between the rings,
20 and a cage 20 for maintaining said rolling elements circumferentially spaced apart. The rolling bearing 10 further comprises on each side an annular seal 21, 22 mounted on the outer ring 14 and provided to close the radial space that exists between the rings 14 and 16, and an axially elastic washer 26 mounted on the inner ring. As will be described
25 later, the elastic washer 26 is adapted to exert an axial preload.

The outer and inner rings 14, 16 are concentric and of the solid type. One of the rings rotates while the other is fixed or also rotates. The outer ring 14 comprises a bore 14a of cylindrical shape from
30 which a toroidal circular raceway 14b for the rolling elements 18 is formed, said raceway being directed radially inwards. Two annular recesses or grooves are also formed radially towards the outside from the bore and arranged laterally to the raceway 14b. The grooves are symmetrical relative to a radial plane passing through the centre of the

rolling bearing 10. The outer ring 14 also comprises an outer cylindrical surface 14c and two opposite radial lateral surfaces 14d, 14e which axially delimit the bore 14a and said outer surface

5 The inner ring 16 comprises a cylindrical bore 16a and an outer cylindrical surface 16b from which a toroidal circular raceway 16c for the rolling elements 18 is formed, said raceway being directed radially outwards. The inner ring 16 further comprises two opposite radial lateral surfaces 16d, 16e which axially delimit the bore 16a and the outer surface 16b of said ring. The lateral surfaces 16d, 16e are
10 respectively coplanar with the lateral frontal surfaces 14d, 14e of the outer ring.

The inner ring 16 further comprises two annular recesses or grooves 16f, 16g formed radially towards the inside from the outer surface 16a and arranged laterally to the raceway 16c. The groove 16f, 16g is respectively situated in a radial plane containing the
15 corresponding groove of the outer ring 14. The groove 16f, 16g radially faces the corresponding groove of the outer ring 14. In the disclosed example, each groove 16f, 16g has a frustoconical form, extends obliquely inwards from the associated lateral surface 16d, 16e and is delimited axially by a radial wall connected to the outer surface
20 16b of the inner ring. Alternatively, each groove may have a different profile in cross-section for example a circular or a rectangular one.

Each seal 21, 22 is arranged radially between the outer and inner rings 14 and 16, fixed to said outer ring and arranged laterally to
25 the rolling elements 18. Each seal 21, 22 is mounted into one of the grooves of the outer ring 14. Each seal 21, 22 is entirely housed into the radial space delimiting between the outer and inner rings 14, 16. Each seal 21, 22 is axially offset towards the inside with regard to associated lateral surface 14d, 14e of the outer ring.

30 In this example, the seals 21, 22 are identical to one another and symmetrical relative to the transverse radial plane passing through the centre of the rolling bearing 10. Since the seals 21, 22 are identical, only one of them will be described here.

The seal 21 is provided with a rigid insert or core member 23 made of metal or thermoplastic and with an elastic sealing member 24 made of rubber, synthetic resin, polymer or the like, which partially covers the core member 23.

5 The sealing member 24 covers an outer surface of the core member 23 and forms two radially opposed peripheral sealing portions applying respectively a static sealing with the outer ring 14 and a dynamic sealing with the inner ring 16. "Static sealing" means the
10 sealing made between two parts that do not move relative to one another. "Dynamic sealing" means the sealing made between two parts that move relative to one another. The outer sealing portion of the elastic member 24 is press-fitted in the groove of the outer ring 14 in order to attach the seal 21 to said ring. At the groove, the outer sealing
15 portion matches the shape of said groove to form a means for fixing or attaching the seal 21 to the outer ring 14. The outer sealing portion surrounds the outer portion of the core member 23 so that only the elastic sealing member 24 is in contact with the outer ring 14.

 The inner sealing portion of the elastic member 24 is provided with first and second inner sealing lips 24a and 24b, which are
20 concentric with each other and which extend axially inwards. The second lip 24b bears axially against the radial wall of the groove 16f of the inner ring. The first lip 24a has a larger diameter than the second lip 24b and extends axially inward over the outer surface of the inner ring 16. The first lip 24a has an axial cylindrical surface which
25 forms a labyrinth with said outer surface 16b. The first lip 24a is in direct contact with the inner portion of the core member 23 and is linked to the second lip 24b by means of a radial annular bridge.

 The elastic washer 26 is made in one part and may be advantageously manufactured in an economic way by cutting, stamping
30 and folding a metal sheet. Alternatively, the washer 26 may be made from synthetic material like polyamide.

 In this example, the elastic washer 26 is a corrugated washer. The washer 26 bears axially against the lateral surface 16d of the inner ring. The washer 26 has an inner diameter equal or greater than the

diameter of the bore 16a of the inner ring. The washer 26 comprises a plurality of radial portions 26a coming into axial contact with the lateral surface 16d of the inner ring and a plurality of corrugated portions 26b connected to said radial portions. Each corrugated portion 26b is connected to two successive radial portions 26a. The corrugated portions 26b are regularly spaced apart in the circumferential direction. The washer 26 comprises here four corrugated portions 26b. The corrugated portions 26b extend axially outwards, i.e. axially on the side opposite to the outer and inner rings 14, 16. The corrugated portions 26b are axially spaced apart from lateral surface 16d of the inner ring and more generally from said ring. The radial portions 26a and the corrugated portions 26b of the washer are located outside from the radial space that exists between the outer and inner rings 14, 16. Each radial portion 26a delimits a radial abutment surface 28 of the washer against the lateral surface 16d of the inner ring and each corrugated portion 26b delimits a bearing surface 30 located axially on the opposite side to said abutment surface 28 and axially spaced apart from said lateral surface 16d.

The washer 26 further comprises a plurality of lugs 26c projecting axially from the edge of large-diameter of the radial portions 26a. Each lug 26c extends axially the associated radial portion 26a in the direction of the inner ring 16 and radially surrounds the groove 16b of said ring. Each lug 26c comprises at its free end a retaining hook 26d extending radially inwards into the groove 16f to secure the washer 26 to the inner ring. The hooks 26d are regularly spaced apart in the circumferential direction. The lugs 26c and the hooks 26d are located axially on the side opposite to the corrugated portions 26b with regard to the radial portions 26a.

The lugs 26c and the hooks 26d are located radially and axially into the radial space existing between the outer and inner rings 14, 16 inside which are also housed the rolling elements 18 and the seals 21, 22. The lugs 26c and the hooks 26d are axially located between the lateral surfaces of the outer and inner rings 14, 16. The hooks 26d are identical to one another and are adapted to engage within the groove

16f of the inner ring to secure the elastic washer 26 on said ring. The elastic washer 26 is directly secured on the inner ring 16. The hooks 26d form retaining or anchorage means cooperating with the inner ring 16 to fix or attach the washer 26 to said ring. The retaining means of the washer 26 are located inside the radial space delimiting by the outer and inner rings 14, 16 and radially on the side opposite to the fixing portion of the seal with respect to the rolling elements 18. The mounting of the washer 26 on the inner ring 16 can be easily achieved for example with a simple axial pushing movement without angular indexation.

Otherwise, the cooperation of the retaining hooks 26d with the groove 16f which is also provided to cooperate with the seal 21 enables to secure the washer 26 on the inner ring 16 without additional machining operations on said ring in view of the anchorage of said washer. Accordingly, the inner ring 16 may be manufactured in an economic way.

When such a rolling bearing 10 is mounted in a motor, the bore of the inner ring 16 is fitted on the shaft supporting the rotor and the outer surface of the outer ring 14 is fitted in the motor casing. During the mounting of the rolling bearing 10 into the casing, the bearing surface 30 of washer axially comes into contact with a radial shoulder provided on the rotor's shaft. An axial compression of the elastic washer 26 between the inner ring 16 and the shoulder of the shaft is achieved. In return, by reaction from the shoulder, the axial washer 26 exerts a permanent axial force on the inner ring 16. The axial pre-stress exerted by the axial washer 26 is transmitted from the inner ring 16 to the outer ring 14 by way of the rolling elements 18.

The use of the elastic washer 26 allows the rolling bearing 10 to be axially preloaded while accommodating different expansions of the rotor's shaft, generally made of steel, and of casing, generally based on aluminium, said rolling bearing being able to slide axially with respect to the casing.

The rolling bearing is compact and may be transported and handled with complete safety without any risk of loss of the elastic

washer. Besides, the motor manufacturer has one less component to procure, manage and fit. The roller bearing may be fitted in the electric motor, particularly easily without requiring any special precaution.

5 In the previous example, the elastic washer is fixed into the annular groove formed on the inner ring which is also used to achieve a sealing between said ring and the seal. As previously mentioned, the inner ring may thus be manufactured in an economic way. However, alternatively, it may also be possible to provide, on the bore of the
10 inner ring or on its lateral surface, a plurality of recesses spaced apart in the circumferential direction or an annular groove in order to cooperate with the hooks of washer. In another variant, it could also be possible to press-fit the elastic washer into such additional groove or spaced recesses, or into the annular groove formed on the outer
15 surface of the inner ring to form the retaining means of the washer.

 In the illustrated example, a corrugated washer is used for axially pre-stressing or preloading the rolling bearing. Alternatively, it is also possible to provide another type of elastic member, such as
20 conical washer of the Belleville type or a washer provided with a plurality of elastic tongues, having retaining means cooperating with the associated ring.

 The invention has been illustrated on the basis of a rolling bearing comprising a seal which is made in two parts, provided with a rigid core member and with an elastic sealing member having a
25 friction sealing lip which bears against the groove of the inner ring. Alternatively, it might be possible to foresee a sealing lip which extends in the direction of the wall delimiting the groove to form a narrow annular passage with said wall and to delimit a labyrinth sealing portion.

30 In another variant, the seal may be made in one part, may have a form of a shield advantageously made of metal for example by cutting and stamping a metal sheet, and may apply a dynamic sealing without contact with the inner ring.

In the disclosed embodiment, the elastic washer is fixed on the inner ring and the seal is mounted on the outer ring. Alternatively, it might be possible to have an inverted arrangement with the elastic washer fixed to the outer ring and the seal secured to the inner ring. In this case, the elastic washer is advantageously secured on the groove formed on the bore of the outer ring and which is also used to cooperate with the seal. In another variant, the elastic washer may be secured on the outer ring into an annular groove or a plurality of recesses formed on the outer surface of said ring or on its lateral frontal surface.

CLAIMS

1. Rolling bearing comprising an inner ring (16), an outer ring (14), at least one row of rolling elements (18) disposed radially between the rings, and at least one seal (21) fixed to one of the rings (14) and arranged radially between said rings, characterized in that it further comprises at least an axially elastic member (26) fixed to the other ring (16) and mounted in axial contact with a lateral surface (16d) of said other ring delimiting axially said other ring.

2. Rolling bearing according to claim 1, wherein the elastic member (26) is fixed to said other ring into a radial space existing between the inner and outer rings (14, 16).

3. Rolling bearing according to claim 1 or 2, wherein the elastic member (26) is fixed to the other ring radially on the side opposite to a fixing portion of the seal (21) with respect to the rolling elements (18).

4. Rolling bearing according to any of the preceding claims, wherein the elastic member (26) is fixed into a groove (16f) formed on said other ring.

5. Rolling bearing according to claim 4, wherein the seal (21) comprises at least one sealing lip (24b) cooperating with said groove.

6. Rolling bearing according to claim 4 or 5, wherein the seal (21) is fixed into a groove radially facing the groove (16f) formed on said other ring.

7. Rolling bearing according to any of the preceding claims, wherein the elastic member (26) is provided with a bearing surface (30) axially spaced apart from the lateral surface (16d) of said other ring and adapted to be in contact with an element outside said rolling bearing, and with an opposite abutment surface (28) in axial contact with said lateral surface (16d) and axially located outside from a radial space existing between the inner and outer rings.

8. Rolling bearing according to any of the preceding claims, wherein the elastic member (26) comprises at least one axial retaining means (26d) for fixing said member to said other ring.

9. Rolling bearing according to any of the preceding claims, wherein the elastic member (26) is made in one part.

10. Rolling bearing according to any of the preceding claims, wherein the elastic member (26) is a washer.

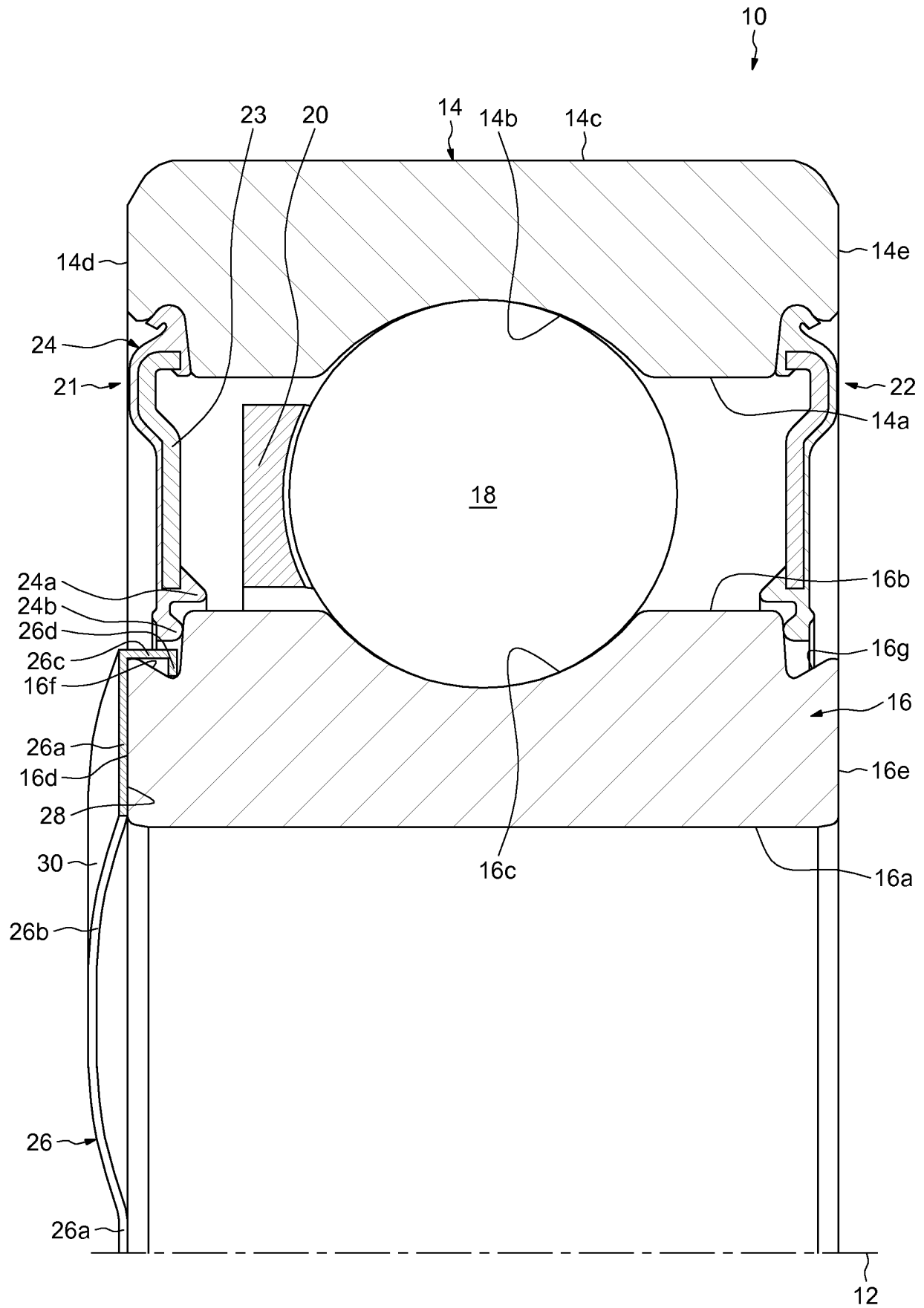
5 11. Rolling bearing according to any of the preceding claims, wherein the elastic member (26) comprises radial portions (26a) mounted in axial contact with the lateral surface (16d) of said other ring and elastic portions (26b) connected to said radial portions and axially spaced apart from said lateral surface.

10 12. Rolling bearing according to claim 11 dependent to claim 8, wherein the elastic portions (26b) are located axially on the side opposite to the retaining means(s) (26d) with respect to the radial portions (26a).

15 13. Rolling bearing according to claim 11 or 12, wherein the elastic portions (26b) are regularly spaced apart in the circumferential direction.

14. Rolling bearing according to any of the preceding claims 11 to 13, wherein the elastic portions comprise corrugations or tongues.

20 15. Rolling bearing according to any of the preceding claims claim 1 to 10, wherein the elastic member is a conical washer.



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/069971

A. CLASSIFICATION OF SUBJECT MATTER

INV. F16C25/08 F16C33/78
ADD. F16C19/06

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)
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 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 2012/024618 A1 (HOUDAYER CHRISTOPHE [FR] ET AL) 2 February 2012 (2012-02-02) paragraphs [0004], [0005], [0028]; figure 7	1-15
A	----- US 4 555 190 A (LEDERMAN FREDERICK E [US]) 26 November 1985 (1985-11-26) column 1, line 61 - column 3, line 26; figures	1-15
A	----- JP 2008 232284 A (JTEKT CORP) 2 October 2008 (2008-10-02) abstract; figures	1-15
A	----- US 2 044 380 A (COBB LELAND D) 16 June 1936 (1936-06-16) page 1, column 1, line 30 - column 2, line 39; figures	1-15
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Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

20 May 2014

Date of mailing of the international search report

27/05/2014

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/069971

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 2013/046526 A1 (PANASONIC CORP [JP]; YAMAGUCHI AKIRA) 4 April 2013 (2013-04-04) abstract; figures -----	1-15
A	EP 1 037 051 B1 (SKF FRANCE [FR]) 29 December 2004 (2004-12-29) cited in the application paragraph [0001] - paragraph [0026]; figures -----	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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