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(FR). MANCEAU, Alexandre [FR/FR]; 51, rue Fleurie,
F-37540 Saint Cyr sur Loire (FR).

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

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(71) Applicant (for all designated States except US): AK-
TIEBOLAGET SKF [SE/SE]; Hornsgatan 1, S-415 50
Göteborg (SE).

(72) Inventors; and

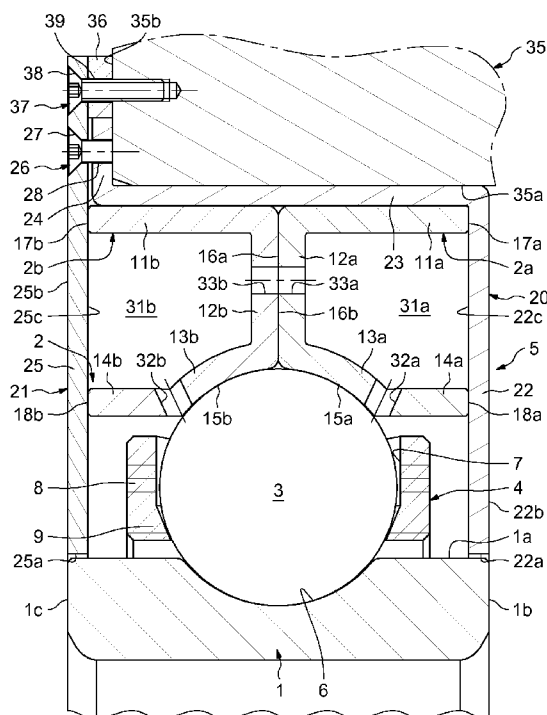
(75) Inventors/Applicants (for US only): CORDIER,
Stéphane [FR/FR]; 36, rue de la Fuye, F-37000 Tours
(FR). LAPINTE, Julien [FR/FR]; 74, rue Ronsard - Apt
14, F-37100 Tours (FR). LIVERATO, Yves-André [FR/
FR]; Les Petites Gaudières, F-37370 Saint Patern Racan

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(54) Title: ROLLING BEARING COMPRISING A HOUSING FOR RETAINING ONE OF THE RINGS OF THE BEARING

FIG.1



(57) Abstract: The rolling bearing comprises an inner ring 1, an outer ring 2, at least one row of rolling elements 3 positioned between raceways provided on the rings, and at least an annular housing 5 inside which at least one of the rings is arranged, the said ring is at least in two portions 2a, 2b. The housing 5 comprises at least two distinct parts 20, 21 for retaining the portions 2a, 2b of the said ring and fixing means 26; 44; 50 for fixing the said parts together. Each of the two portions of said ring delimits with the housing a closed space 31 a, 31b inside which a lubricant is located. Passage means for the lubricant comprising axial holes 33a, 33b at least partly facing one another are made in the thickness of a radial portion 12a, 12b of each of the two portions 2a, 2b of said ring and put the two closed spaces into communication.



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**Rolling bearing comprising a housing for retaining
one of the rings of the bearing.**

5 The present invention relates to rolling bearings, particularly to rolling bearings comprising an inner ring and an outer ring with one or more rows of rolling elements held by a cage between raceways provided in the two rings. The rolling elements may, for example, be balls. This may, for example, be the case of the rolling bearings used in industrial electric motors or in motor vehicle gearboxes.

10 In such applications, the bearings are chiefly under radial load, often under a load that is relatively light in relation to the load bearing capacity of the bearings used. The rotational speeds in applications of this type are of the order of 3000 revolutions/ minute.

15 Patent US 3,876,266 discloses a rolling bearing comprising an inner ring, an outer ring made in two parts, a housing for retaining the two parts of the said ring and a row of balls held by a cage. One of the parts of the ring, in conjunction with the housing, defines a space inside which a resilient axial preloading ring is housed.

20 The procedure for assembling such rolling bearings is as follows. Having inserted the balls into the associated cage and mounted this subassembly on the inner ring, the two parts of the outer ring are positioned around the row of balls. This subassembly and the resilient preloading ring are then mounted in the housing so that it rests against a first radial end plate. At this stage of assembly, the housing is of
25 L-shaped cross section, prior to the creation of a second radial end plate which at this point is still in the form of an axial extension. Next, the said extension of the housing is bent to form this second radial end plate which, together with the first radial end plate opposite, is able to retain the two parts of the outer ring.

30 Given the way in which these rolling bearings are assembled, and particularly the fact that the housing is bent over to form the second radial end plate, it is relatively difficult to guarantee the existence of the desired axial clearance or, on the other hand, of the

predefined axial preload. In the latter instance, it is then necessary to provide the resilient axial preloading ring, which adds to the cost of the rolling bearing.

5 It is therefore an object of the present invention to solve these problems by proposing a rolling bearing of simple design, that is easy to assemble, that is economical, and in which the desired clearance or axial preload can easily be obtained during the assembly operations and maintained once the bearing has been assembled.

10 It is also an object of the present invention to provide a rolling bearing which is able to operate for a long time in both an effective and economic manner.

In one embodiment, a rolling bearing comprising an inner ring, an outer ring, at least one row of rolling elements positioned between raceways provided on the rings, and at least an annular housing inside which at least one of the rings is arranged, the said ring is achieved at least in two portions. The housing comprises at least two distinct parts for retaining the portions of the said ring and fixing means for fixing the said parts together. Each of the two portions of said ring delimits with the housing a closed space inside which a lubricant is located. Passage means for the lubricant comprising axial holes at least partly facing one another are made in the thickness of a radial portion of each of the two portions of said ring. Said holes put the two closed spaces in communication.

15
20

Assembling two separate parts or components in order to obtain the enclosing ring or housing that retains the portions of the ring makes the assembly operations easier and makes it possible to guarantee that the desired operational clearance or axial preload for the rolling bearing will be obtained.

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Otherwise, this thus provides a rolling bearing able to operate for a long time thanks to effective internal lubrication.

30

The parts of the housing preferably each comprise a radial end plate for axially retaining the portions of the said ring.

In one embodiment, at least one radial portion of one of the portions of the said ring is in contact with one of the end plates, at least

one radial portion of the other portion of the said ring being in contact with the other end plate. One of the parts of the housing may also comprise an axial portion in radial contact with the portions of the said ring and which connects with the end plate of the said part. The said
5 ring is in contact via its periphery with the axial portion of the housing, and this centres it. The said part of the housing may also comprise a radial flange extending the axial portion outwards.

In one embodiment, one of the parts of the housing comprises at least one portion extending beyond the inner ring and/or beyond the
10 outer ring for attaching the bearing to an external element. This portion may be axial, radial or oblique.

The fixing means may comprise fixing screws. The fixing means may also comprise welds or brazing. Alternatively, it is even possible to plan to fix the two parts together using crimping, bonding, riveting,
15 snap-fastening, etc.

The lubricant may be grease or oil. When the lubricant is oil, this oil may advantageously be contained in a porous element mounted inside the closed space.

Special-purpose passage means are preferably provided to allow
20 lubricant to pass between the closed space and the raceways. The passage means may comprise holes or passages made in the thickness of the said ring. These passages preferably open onto the raceway of the said ring.

In one embodiment, the ring mounted in the housing has been
25 created by cutting and pressing a metal sheet, the said ring comprising an external axial portion in contact with an axial portion and a radial end plate of one of the parts of the housing, a radial portion, a toroidal portion defining part of a raceway, and an internal axial portion. The aforementioned closed space is defined by the said portions of the ring
30 and by the radial end plate of the said part of the housing.

It may be advantageous to plan for the internal walls of the aforementioned closed space to have an oil-repellent coating, to encourage the dispersal of the lubricant.

The bearing ring that defines the closed space containing the lubricant may be the outer ring or the inner ring of the bearing.

When the said ring is the inner ring of the bearing, it is advantageous for this also to be the rotating ring so that the centrifugal force applied to the lubricant while the bearing is running encourages extraction of the lubricant and thus lubrication of the raceways.

Alternatively, the two portions of the ring may be of the solid type. What is meant by part of solid type is a part, the shape of which has been obtained by machining with the removal of chips (turning, grinding) from tubes, bar stock, rough forgings and/or rolled performs.

In one embodiment, the two rings of the bearings are of the same structure. Each ring is arranged inside a housing.

The present invention will be better understood from studying the detailed description of a number of embodiments considered by way of entirely non-limiting examples and illustrated by the attached drawings in which:

- Figure 1 is an axial half-section of the rolling bearing according to the invention, in a first embodiment;
- Figure 2 is an axial half-section of a second embodiment;
- Figure 3 is an axial half-section of a third embodiment;
- Figure 4 is an axial half-section of a fourth embodiment; and
- Figure 5 is an axial half-section of a fifth embodiment.

Reference is made to Figure 1 which illustrates a first embodiment of a rolling bearing according to the invention, this bearing comprising an inner ring 1, an outer ring 2 made up of two outer portions or half-rings 2a, 2b, a row of rolling elements 3 consisting, in the example illustrated, of balls, and held by a cage 4 between the inner ring 1 and the outer ring 2. The two half-rings 2a, 2b of the outer ring are arranged in an enclosing ring or housing 5.

The inner ring 1 is solid and on its exterior cylindrical surface 1a has a toroidal groove 6 forming a raceway for the rolling elements 3, the radius of curvature of which groove is slightly greater than the

radius of the rolling elements. The inner ring 1 may be manufactured by turning or by forming by a steel preform, the said preform then being ground and possibly lapped at the site of the raceway 6 to give the ring 1 its geometrical characteristics and final surface finish.

5 The cage 4 comprises a plurality of pockets 7 designed to house the rolling elements 3 and keep them uniformly circumferentially spaced. The pockets 7 are advantageously of spherical shape with a diameter slightly greater than that of the rolling elements 3. The pockets 7 are made in the radial thickness of the cage 4 which has a
10 radial portion 8 radially facing the outer ring 2 and which is extended radially inwards by a conical portion 9. The conical portion is situated radially facing the inner ring 1 and extends axially towards the rolling elements 3. The radial portion 8 and the conical portion 9 define the pockets 7. The conical portion 9 forms a guide portion that allows the
15 rolling elements 3 to guide the cage 4.

 In this embodiment, the two portions 2a, 2b of the outer ring 2 are identical and symmetric with respect to the axial plane of symmetry of the bearing in order to reduce manufacturing costs. As an alternative, it is of course possible to plan for the portions 2a, 2b to be non-
20 symmetric. These two outer half-rings 2a, 2b may advantageously be manufactured by cutting and pressing a metal sheet, the components obtained then being hardened by heat treatment. The raceways intended for the rolling elements 3 may be ground and/or lapped in order to give them their definitive geometric characteristics and surface finish.
25 Because in this example the two half-rings 2a, 2b are identical, just one of them, the one bearing the reference "a" will be described here, it being understood that the identical elements of the other half-ring 2b bear the reference "b".

 The half-ring 2a of the outer ring 2 comprises an outer axial
30 portion 11a, a radial portion 12a, a toroidal portion 13a and an internal axial portion 14a. The radial portion 12a connects to the outer axial portion 11a and to the toroidal portion 13a. The toroidal portion 13a defines part of a raceway 15a for the rolling elements 3. The radius of curvature of the raceway 15a slightly exceeds the radius of the rolling

elements 3. The toroidal portion 13a also connects to the inner axial portion 14a. The two outer half-rings 2a, 2b are arranged with the radial faces 16a, 16b of the radial portions 12a, 12b in axial contact with one another, substantially in the axial plane of symmetry of the rolling bearing and of the rolling elements 3.

The housing 5 comprises two annular parts 20, 21 enclosing the two outer half-rings 2a, 2b so as to hold them firmly together in the axial direction. The parts 20, 21 of the housing 5 may advantageously be produced in an economical way from a single metal sheet by cutting and pressing.

The part 20 comprises an annular radial end plate 22 extending into the immediate vicinity of the outer cylindrical surface 1a of the inner ring 1. An inner edge 22a of the end plate 22 leaves a radial clearance to the said cylindrical surface 1a. The outer radial face 22b of the end plate 22 lies in a radial plane containing the radial face 1b of the inner ring 1. The part 20 also comprises an annular axial portion 23 axially extending an outer edge of the end plate 22 and extending axially towards the part 21 of the housing 5 into the immediate vicinity thereof. The part 20 also comprises an annular radial flange or upstand 24 extending the axial portion 23 radially outwards axially on the opposite side to the end plate 22. The flange 24 extends radially beyond the annular portion 23 and leaves a small axial clearance to the part 21 of the housing 5.

The part 21 of the housing consists of an annular radial end plate 25 extending into the immediate vicinity of the outer cylindrical surface 1a of the inner ring 1 so that an inner edge 25a leaves a radial clearance to the said surface. The end plate 25 extends radially beyond the axial portion 23 of the part 20 and of the flange 24. The outer radial face 25b of the end plate 25 lies in a radial plane containing the radial face 1c of the inner ring.

In order to allow the parts 20, 21 of the housing to be joined together, fixing screws 26 are provided for securing the end plate 25 of the part 21 to the radial flange 24 of the part 20. For this purpose, countersunk holes 27 are formed in the thickness of the end plate 25 to

accept the fixing screws 26. The holes 27 are preferably uniformly distributed over the end plate 25 in the circumferential direction. The flange 24 also comprises threaded portions 28 formed in its thickness and lying in register with the holes 27 in the end plate 25 for accepting the screws 26 and for fixing the parts 20, 21 of the housing 5 together.

The half-rings 2a, 2b are centred in the axial portion 23 of the part 20 of the housing 5 by contact between the axial portions 11a, 11b and the bore of the said axial portion. The outer radial faces 17a, 17b which form the annular edges of the outer axial portions 11a, 11b are respectively in contact with the radial end plates 22, 25 of the parts 20, 21 of the housing 5, thus axially clamping the two half-rings 2a, 2b together. The outer radial faces 18a, 18b that form the annular edges of the inner axial portions 14a, 14b are also in contact with the radial end plates 22, 25.

Each of the half-rings 2a, 2b defines, with the housing 5, an annular closed space 31a, 31b that acts as a lubricant reservoir, the lubricant contained in these spaces 31a, 31b not being depicted in the figure. More specifically, the closed space 31a is defined by the outer axial portion 11a, the radial portion 12a, the toroidal portion 13a, and the inner axial portion 14a, and, facing these portions, the radial end plate 22 of the part 20 of the housing 5.

The lubricant used may be grease or oil. Passage means may be provided to allow the lubricant to pass from the closed spaces 31a, 31b, that act as lubricant reservoirs, as far as the raceways 6 and 15a, 15b.

These passage means comprise a plurality of communication through-holes 32a, 32b made in the thickness of the outer half-rings 2a, 2b at the region where the inner axial portion 14a, 14b and the toroidal portion 13a, 13b meet. This arrangement of the holes 32a, 32b allows the lubricant to be dispersed directly onto the rolling elements 3 at the ends of the raceways 15a, 15b. There is also a plurality of axial through-holes 33a, 33b made in the thickness of the radial portion 12a, 12b. The axial holes 33a, 33b made respectively in the two half-rings 2a, 2b at least partially face one another. This arrangement, which can be maintained through appropriate positioning at the time of assembly

or through angular indexing means which have not been depicted, provided on the two half-rings 2a, 2b, allows the two closed spaces 31a, 31b to intercommunicate. This arrangement also, when there is a small axial clearance between the half-rings 2a, 2b, allows lubricant to flow out of the holes 33a, 33b directly onto the rolling elements in the raceways 15a, 15b. For preference, the internal surfaces of the spaces 31a, 31b that form a lubricant reservoir have an oil-repellent coating which has the effect of preventing lubricant from adhering to the internal walls and thus of encouraging it to be transferred.

The various elements of the rolling bearing are assembled as follows. Having inserted the rolling elements 3 into the pockets 7 of the cage 4 and having mounted that subassembly on the inner ring 1, the two half-rings 2a, 2b are positioned around the row of rolling elements 3. Lubricant is packed into the space 31a which constitutes a first lubricant reservoir between the half-ring 2a and the inner ring 1. Lubricant is also packed into the second space 31b and into the volume remaining between the inner 1 and outer 2 rings.

The part 20 of the housing is then mounted over the top of the two half-rings 2a, 2b in such a way that the two half-rings are in contact via their periphery with the axial portion 23 so as to centre the outer ring 2. The outer radial faces 17a, 18a of the axial portions 11a, 14a are in contact with the inner radial face 22c of the end plate 22 of the part 20. After this fitting of the two half-rings 2a, 2b into the part 20 of the housing 5, the end plate 25 that constitutes the part 21 of the housing is fitted to retain the half-rings 2a, 2b axially. In this respect, the inner radial face 25c of the end plate 25 comes to press against the outer radial faces 17b, 18b of the axial portions 11b, 14b. The axial portions 11a, 14a of the half-ring 2a come to press against the end plate 22 of the part 20, the axial portions 11b, 14b of the half-ring 2b come to press against the end plate 25 of the part 21, the radial portions 12a, 12b of the said rings being axially in contact with one another. The parts 20, 21 allow the two half-rings 2a, 2b to be held firmly together. Next, the relative position of the two parts 20, 21 of the housing 5 is fixed by tightening the screws 26.

In this embodiment, the inner radial faces 16a, 16b of the radial portions 12a, 12b are in contact with one another. This contact between the radial portions 12a, 12b makes it possible to obtain the rolling bearing with internal clearance. Of course, in order to ensure that the raceways 15a, 15b and 6 preload the rolling elements 3 so that the rolling bearing operates with zero internal clearance, it is possible to plan for the inner radial faces 16a, 16b of the radial portions 12a, 12b not to be in contact.

When assembling the rolling bearing, the predetermined relative axial arrangement of the half-rings 2a, 2b is easily obtained by bringing the end plate 25 axially close to the flange 24 until the desired position is reached. From the relative axial position of the end plate 25 and of the flange 24 it is actually easy to check whether the desired internal clearance or, on the other hand, the desired axial preload within the rolling bearing has been achieved. The fact that the housing 5 is produced in two parts 20, 21 makes it easy to check whether the clearance or preload intended for the rolling bearing has indeed been achieved, before the parts 20, 21 are fixed together. Moreover, the two parts 20, 21 can be fixed together in a way that ensures that this characteristic of the rolling bearing will be maintained after it has been assembled and installed in the mechanical assembly for which it is intended once it has been assembled.

Once the rolling bearing has been completely assembled, the part or parts 20, 21 of the housing 5 can be used to mount it on an external element. In the example illustrated in the figure, the rolling bearing is pushed into a bore 35a of an external element 35, the flange 24 of the part 20 of the housing 5 resting against an outer radial face 35b of the said element. An annular spacer piece 36 is provided between the outer radial face 35b of the element 35 and the inner radial face 25c of the end plate 25 of the part 21 of the housing. The spacer piece 36 also rests against the outer edge of the flange 24 of the part 20.

In order to fix the rolling bearing to the external element 35, there are fixing screws 37 provided. For this, countersunk holes 38 are

formed in the thickness of the end plate 25 to accept the fixing screws 37. The holes 38 are preferably uniformly distributed on the end plate 25 in the circumferential direction. The holes 38 are arranged radially between the holes 27 and the outer edge of the end plate 25. The spacer
5 piece 36 also has threaded portions 39 formed in its thickness and facing the holes 38 in the end plate 25 to accept the screws 37 and attach the rolling bearing to the external element 35.

Thus, the portion of the end plate 25 that runs radially beyond the outer ring 2 not only allows the two parts 20, 21 to be joined
10 together but also allows the rolling bearing to be fixed in its entirety to the external element 35. In this embodiment, the portion used to attach the rolling bearing to the external element 35 extends radially beyond the outer ring 2 from the flange 24 of the part 20 of the housing. It will readily be appreciated that the end plate 25 of the part 21 of the
15 housing may alternatively or in addition comprise one or more axial or oblique portions running axially and/or radially beyond the outer ring 2 to allow the rolling bearing to be attached to other elements or alternatively to allow external means to be attached to the rolling bearing. To these ends, it is also possible to provide radial, axial,
20 oblique portions extending radially and/or axially beyond the inner ring 1. Such portions could also be provided on the part 20 of the housing 5.

In the embodiment illustrated in Figure 1, the outer ring 2 is made up of the two half-rings 2a, 2b and the inner ring 1 is of the solid type. In an alternative form of embodiment, it might be possible to have
25 the outer ring solid while the inner ring would be made up of two half-rings produced by pressing a thin metal sheet in a similar way to the half-rings 2a, 2b of the embodiment of Figure 1. These two half-rings would be mounted inside a housing made in two parts and joined together. In other words, this arrangement would be identical to that of
30 the embodiment illustrated in Figure 1, but with the elements reversed.

In such a case, it would be advantageous for the inner ring made up of the two half-rings functionally to constitute the rotating part of the rolling bearing. This is because in this case, when the rolling bearing rotates, the lubricant contained in the two spaces of the half-

rings that act as lubricant reservoirs would be subjected to centrifugal force and would tend to be dissipated through the passages made in the rings towards the raceways of the bearing.

5 The embodiment illustrated in Figure 2, in which identical elements bear the same references, differs from the embodiment of Figure 1 in that the two rings 1, 2 of the bearing have the same structure. In other words, the inner ring 1 is symmetric to the outer ring 2 considering a median axial plane of the rolling bearing passing through the centre of the rolling elements 3. The inner ring 1 therefore
10 comprises two half-rings 10a, 10b identical in design to the half-rings of the outer ring 2. The half-rings 10a, 10b are enclosed in a housing 40 made as a single piece, i.e. a 1-piece housing. The housing 40, advantageously made of pressed sheet metal, comprises two radial end plates 40a, 40b and an axial portion 40c that connects to the two radial
15 end plates in such a way as to enclose the two half-rings 10a, 10b and holds them firmly together. The respective radial end plates 22, 40a, and 25, 40b face one another with a radial gap. The inner and outer axial portions of the half-ring 10b press against the inner radial face of the end plate 40b, the inner and outer axial portions of the half-ring 10a
20 being pressed against the inner radial face of the end plate 40a, ensuring that the two half-rings are clamped axially together. The half-rings 10a, 10b are centred in the axial portion 40c of the housing 40 by contact between the outer axial portions and the outer surface of the said axial portion 40 of the housing.

25 In this embodiment, the rolling bearing therefore comprises four closed spaces acting as lubricant reservoirs, namely the spaces defined in each of the parts 2a, 2b of the outer ring and the spaces defined in each of the parts 10a, 10b of the inner ring. In this embodiment, we also have the lubricant passages in the half-rings 10a, 10b of the inner
30 ring provided on the half-rings 2a, 2b of the outer ring.

The embodiment of Figure 3, in which identical elements bear the same references, differs from the first embodiment only in that the rolling bearing is assembled with the external element 35 by one or more runs of welding 42 between the radial face 35b of the external

element 35 and the spacer piece 36. Alternatively, it might also be possible to plan for the rolling bearing to be assembled with the external member 35 by brazing, crimping, bonding, riveting, snap-fastening or by any other appropriate means.

5 The embodiment illustrated in Figure 4, in which the identical elements bear the same references, differs from the first embodiment in that the end plate 25 of the part 21 presses axially against the flange 24 of the part 20 and in that fixing screws 44 are used both to assemble the said parts 20, 21 of the housing of the rolling bearing and to attach the
10 bearing to the external element 35. Countersunk holes 46 are formed in the thickness of the end plate 25 to accept the screws 44. The flange 24 also comprises threaded portions 48 made in its thickness facing the holes 46.

15 The embodiment illustrated in Figure 5 in which the identical elements bear the same references differs from the embodiment previously described in that the parts 20, 21 of the housing of the bearing are assembled via one or more runs of welding 50 provided between the outer edge of the end plate 25 of the part 21 and the radial flange 24 of the part 20. The rolling bearing is attached to the external
20 element 35 again by one or more runs of welding 52. Alternatively, it might be possible to plan for the parts 20, 21 to be joined together by crimping, welding, riveting, snap-fastening or any other appropriate means.

25 The specific features and characteristics mentioned for each of the embodiments could be applied without major modification to the other embodiments. Moreover, although the present invention has been illustrated using single-row ball bearings, it will be understood that the invention can be applied without major modification to bearings using rolling elements that are not balls and/or that have several rows of
30 rolling elements.

CLAIMS

1. Rolling bearing comprising an inner ring (1), an outer ring (2), at least one row of rolling elements (3) positioned between raceways provided on the rings, and at least an annular housing (5) inside which at least one of the rings is arranged, the said ring is at least in two portions (2a, 2b), the housing (5) comprising at least two distinct parts (20, 21) for retaining the portions (2a, 2b) of the said ring and fixing means (26; 44; 50) for fixing the said parts together, characterized in that each of the two portions of said ring delimits with the housing a closed space (31a, 31b) inside which a lubricant is located, and in that passage means for the lubricant comprising axial holes (33a, 33b) at least partly facing one another are made in the thickness of a radial portion (12a, 12b) of each of the two portions (2a, 2b) of said ring and put the two closed spaces into communication.

2. Rolling bearing according to Claim 1, in which the parts (20, 21) of the housing each comprise a radial end plate (22, 25) for axially retaining the portions (2a, 2b) of the said ring.

3. Rolling bearing according to Claim 2, in which at least one radial portion (11a) of one of the portions (2a) of the said ring is in contact with one of the end plates (22), at least one radial portion (11b) of the other portion (2b) of the said ring being in contact with the other end plate (25).

4. Rolling bearing according to Claims 2 or 3, in which one of the parts (20, 21) of the housing comprises an axial portion (23) in radial contact with the portions (2a, 2b) of the said ring and which connects with the end plate (22) of the said part.

5. Rolling bearing according to Claim 4, in which the said part of the housing comprises a radial flange (24) extending the axial portion (23) outwards.

6. Rolling bearing according to any one of the preceding claims, in which at least one of the parts (20, 21) of the housing comprises at least one portion extending beyond the inner ring (1)

and/or beyond the outer ring (2) for attaching the bearing to an external element.

7. Rolling bearing according to any one of the preceding claims, in which the fixing means comprise fixing screws (26; 44).

5 8. Rolling bearing according to any one of the preceding claims, in which the fixing means comprises welds (50) or brazing.

10 9. Rolling bearing according to any one of the preceding claims, in which the inner ring (1) and the outer ring (2) are of the same structure, each of the rings being arranged inside a housing (5, 40).

FIG.3

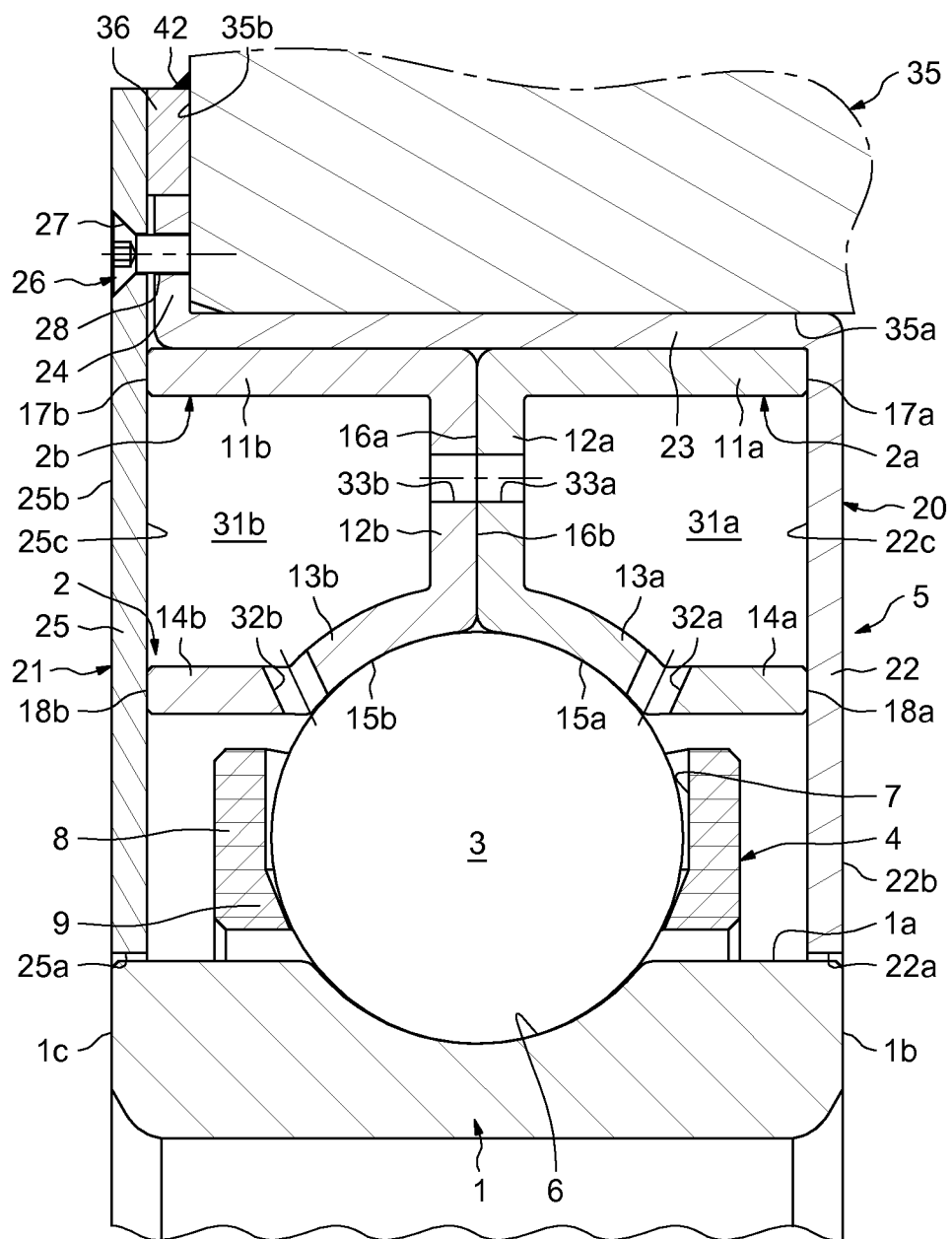


FIG.4

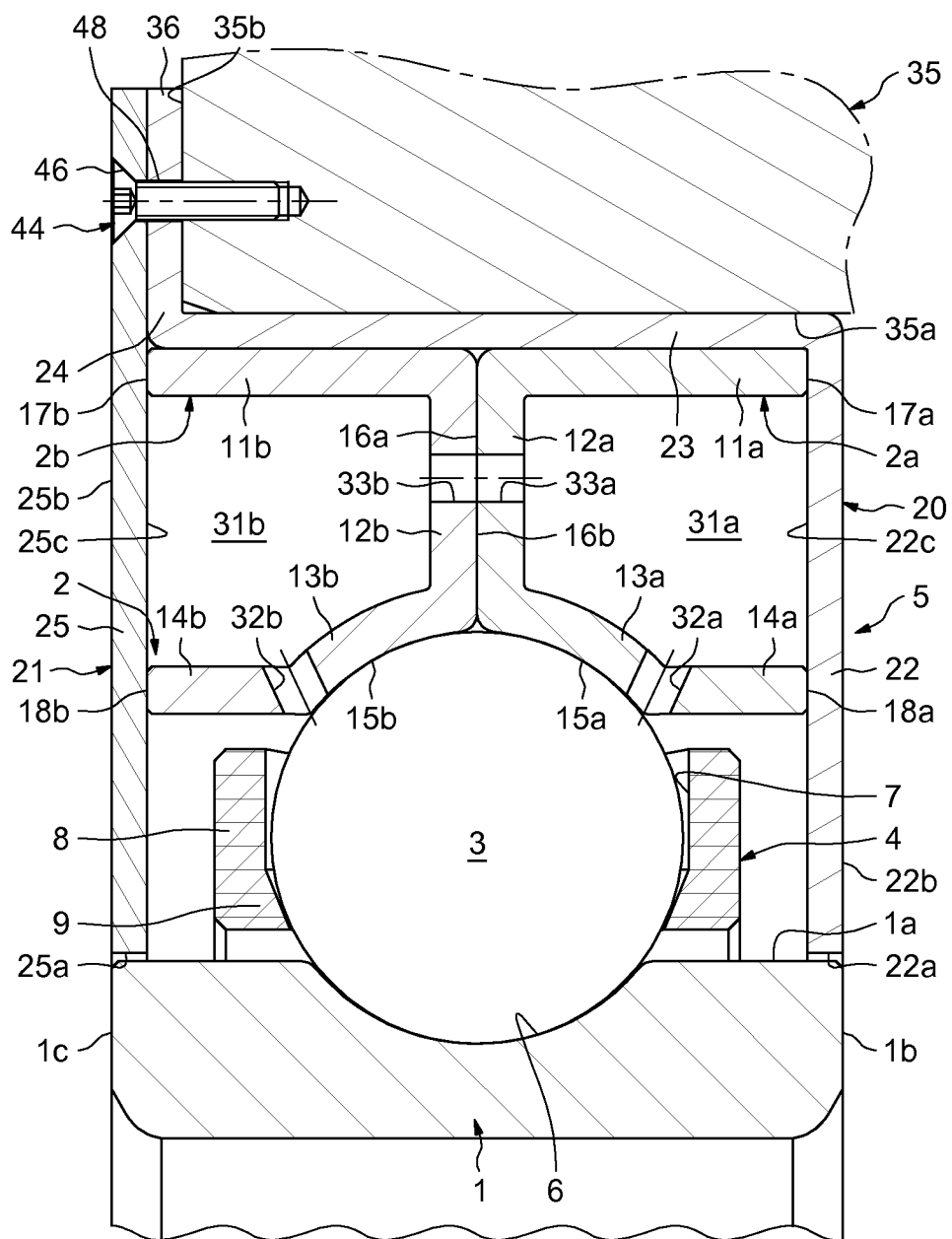
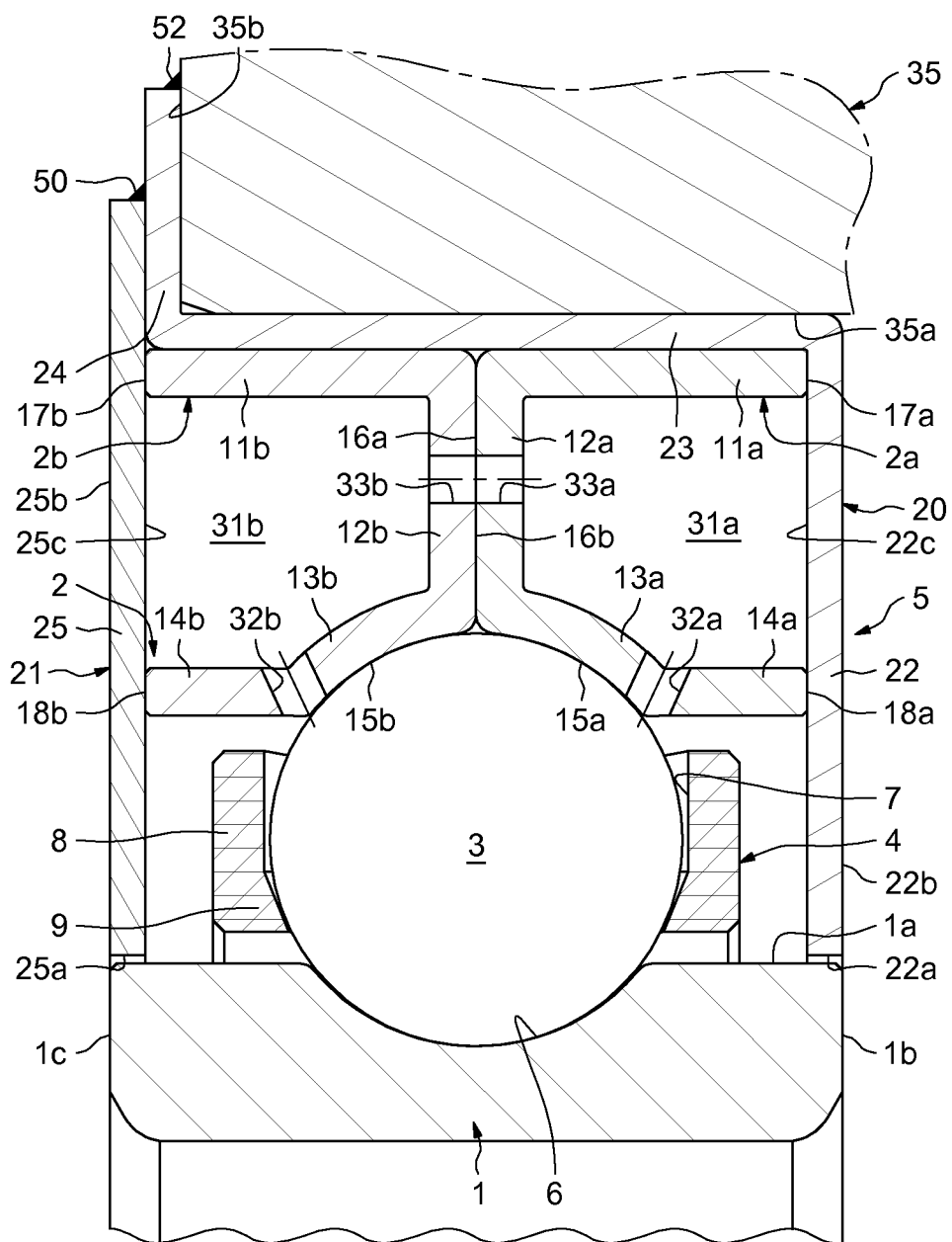


FIG.5



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2010/055805

A. CLASSIFICATION OF SUBJECT MATTER

INV. F16C33/60 F16C33/66
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)
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 3 480 342 A (VENABLE LAWRENCE B) 25 November 1969 (1969-11-25) column 2, line 53 - column 3, line 16 figures 1,2	1
A	FR 1 111 621 A (COMPTOIR GENERAL DU ROULEMENT) 2 March 1956 (1956-03-02) page 2, paragraph 4 figures 1-5 column 2, line 53 - column 3, line 16 figures 1,2	1
A	US 3 504 955 A (BAILEY JOSEPH K) 7 April 1970 (1970-04-07) figures 1-5	1
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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

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Date of mailing of the international search report

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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

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International application No
PCT/EP2010/055805

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	DE 25 18 789 A1 (RANSOME HOFFMANN POLLARD) 20 November 1975 (1975-11-20) figure 5	1
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2010/055805

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FR 1111621	A	02-03-1956	NONE
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DE 2518789	A1	20-11-1975	CA 1042966 A1 21-11-1978 FR 2268983 A1 21-11-1975 GB 1509526 A 04-05-1978 IT 1035562 B 20-10-1979 SE 7505021 A 30-10-1975
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