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(54) Title: ROLLING BEARING ASSEMBLY, TOOL AND PROCESS FOR MOUNTING SUCH A ROLLING BEARING ASSEMBLY

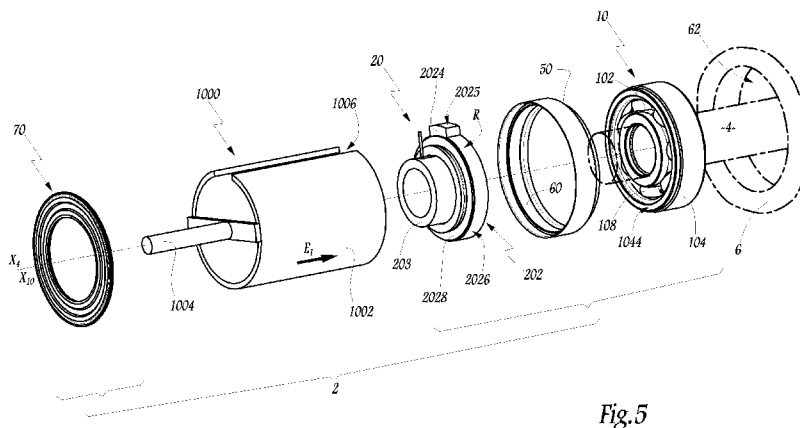


Fig.5

(57) Abstract: This rolling bearing (2) assembly comprises a rolling bearing (10), having an inner ring (102) and an outer ring (104), a target (60) adapted to rotate with the inner ring or with the outer ring, around a rotation axis (X_{10}) of the bearing, and a sensor unit (20) comprising a sensor unit body (202) supporting at least one sensing element adapted to read the target. The sensor unit body (202) is provided with at least one recess (R) giving access to a lateral face (1044) of at least one of the inner ring (102) and the outer ring (104) when the sensor unit (20) is in a working position with respect to the rolling bearing (10).

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ROLLING BEARING ASSEMBLY, TOOL AND PROCESS FOR MOUNTING SUCH A ROLLING BEARING ASSEMBLY

TECHNICAL FIELD OF THE INVENTION

5 This invention relates to a rolling bearing assembly comprising, amongst others, a target and a sensor unit with at least one sensing element adapted to read the target. The invention also relates to a tool and a process for mounting such a rolling bearing assembly onto a support member.

10 TECHNICAL FIELD OF THE INVENTION

A rolling bearing comprises an inner ring, an outer ring and several rolling bodies installed between these two rings. These rolling bodies can be balls, rollers or needles. In the sense of the present invention, a rolling bearing can be, for instance, a ball bearing, a roller bearing or a needle bearing.

15 It is known to use a tachometer in order to determine the rotation speed of a member supported by a rolling bearing. As considered in EP-A-1 251 354, one can use a sensor assembly including an active part, such as a magnetic multipolar ring, forming a target whose rotation is detected by a sensing element mounted in a sensor unit body fast in rotation with the inner ring of a ball bearing. The target is mounted on a synthetic
20 support member. When they are aligned along the rotation axis of the rolling bearing, the sensor unit body and the synthetic support member hide the rolling bearing, so that this bearing is not accessible. Therefore, in case one needs to mount the rolling bearing assembly onto a support member, one must push the rolling bearing by an action on an exposed lateral face of the sensor unit body or the synthetic support member, which might
25 damage or destroy this element.

SUMMARY OF THE INVENTION

This invention aims at solving the above-mentioned problem with a new rolling bearing which can be easily and safely mounted onto a support member.

30 To this end, the invention concerns a rolling bearing assembly comprising a rolling bearing, having an inner ring and an outer ring, a target adapted to rotate with the inner ring or with the outer ring, around a rotation axis of the bearing, and a sensor unit comprising a sensor unit body supporting at least one sensing element adapted to read the target. According to the invention, the sensor unit body is provided with at least one
35 recess giving access to a lateral face of at least one of the inner ring and outer ring when the sensor unit is in a working position with respect to the rolling bearing.

Thanks to the invention, the recess of the sensor unit body can be used to introduce a part of a tool in order to exert a thrust effort onto the lateral face of the inner ring or outer ring of the rolling bearing. This allows to push this rolling bearing into a housing of a support member.

5 In the present description, the words "axial", "radial", "axially", "radially", "centrifugal", "centripetal" and similar words relate to the axis of rotation of one ring of the rolling bearing with respect to the other ring. A direction is "axial" when it is parallel to this axis and "radial" when it is perpendicular and secant to this axis. A surface is "axial" when it is perpendicular to this axis and "radial" when a direction perpendicular to this surface is radial. For instance, an axial effort is parallel to the axis of rotation and an axial surface is annular and perpendicular to this axis.

According to further aspects of the invention, which are advantageous but not compulsory, the rolling bearing assembly might incorporate one or several of the following features:

15 - The target rotates with the outer ring of the rolling bearing and the sensing element is mounted in a supporting part of the sensor unit body which defines, with an inner radial face of the target, a radial gap through which the sensing element reads the target and the recess is formed by a part of the sensor body having a reduced outer diameter, as compared to the outer diameter of the supporting part.

20 - The target rotates with the inner ring of the rolling bearing and the sensing element is mounted on a supporting part of the sensor body which defines, with an outer radial face of the target, a radial gap through which the sensing element reads the target and the recess is formed by a part of the sensor body having an enlarged inner diameter, as compared to the inner diameter of the supporting part.

25 - The recess is provided in an intermediate part of the sensor unit body, between its inner radial surface and its outer radial surface.

- The sensing unit has several sensing elements, each mounted in a respective supporting part and a recess is provided between each pair of two adjacent supporting parts.

30 - The recess is a hole going through the sensor unit body, from one lateral face of this body to the opposite lateral face of this body. In such a case, the opening can be equipped with a deformable sealing arrangement, movable between a sealing configuration and an open configuration where it grants access to the opening.

35 - The recess has an end wall adapted to transmit a thrust effort exerted through the recess onto the inner ring and/or the outer ring of the ball bearing.

The invention also concerns a tool to be used with a rolling bearing assembly as mentioned here-above in order to mount it onto a support member. This tool has at least one projection of a cross-section adapted for it to go through one recess of the sensor unit body in order to exert a thrust effort on the lateral face of a corresponding ring of the rolling bearing.

Finally, the invention concerns a process for mounting a rolling bearing assembly as mentioned here-above onto a support member, this method comprising the steps of:

- a) fastening the sensor unit body to the rolling bearing,
- b) pushing the rolling bearing into a corresponding housing of the support member with a thrust axial effort exerted on a lateral face of the ring of the rolling bearing, through the recess of the sensor unit body.

Advantageously, the process comprises a further step of c) fastening a flange equipped with the target to one of the rings of the rolling bearing.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood on the basis of the following description which is given in correspondence with the annexed figures and as an illustrative example, without restricting the object of the invention. In the annexed figures:

- figure 1 is a perspective view of a hub and a fork of a two-wheeled vehicle, the hub including a rolling bearing assembly according to the invention,
- figure 2 is a partial cross-section, at a larger scale and along plane II on figure 1, showing a rolling bearing assembly used in the device of figure 1,
- figure 3 is an enlarged view of detail III on figure 2,
- figure 4 is a sectional view along line IV-IV on figure 2,
- figure 5 is a perspective exploded view of the rolling bearing assembly represented on figures 2 to 4, showing how this assembly is mounted with respect to the shaft and the hub shown on figures 1 to 3 which are partially represented in chain-dotted lines,
- figure 6 is a sectional view, in a plane similar to the one of figure 4, of a sensor unit body belonging to a rolling bearing assembly according to a second embodiment of the invention,
- figures 7, 8 and 9 are respective sectional views similar to figure 6 for a third, a fourth and a fifth embodiment of the invention,
- figure 10 is a cut view along line X-X on figure 9 during a process according to the invention,

- figure 11 is a cut view similar to figure 10 for a sixth embodiment of the invention, and
- figure 12 is a cut view similar to figure 10 for a rolling bearing assembly according to a seventh embodiment of the invention.

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DETAILED DESCRIPTION OF SOME EMBODIMENTS

Figure 1 depicts the use of a rolling bearing assembly 2 in conjunction with a shaft 4 and a hub 6. The hub 6 belongs to a non-represented wheel which is held by two fork members 8 supporting shaft 4. The rolling bearing assembly 2 of the invention is used in conjunction with another rolling bearing assembly 3 in order to support, with a possibility of rotation, hub 6 around shaft 4 which is stationary when fork members 8 are stationary.

Rolling bearing assembly 2 includes a ball bearing 10 comprising an inner ring 102 and an outer ring 104 defining between them a rolling chamber where balls 106 are held in position by a cage 108. Ring 102 is fast with shaft 4 and ring 104 is rotatable around a central axis X_{10} of rolling bearing 10 which is superimposed with the central longitudinal axis X_4 of shaft 4 when rolling bearing 10 is mounted on shaft 4.

Rolling bearing assembly 2 also includes means to determine a rotation parameter of the outer ring 104, with respect to the inner ring 102. A rotation parameter is representative of the pivoting movement of one part with respect to another. Such a parameter can be an angle measuring the angular position of one part with respect to the other, around the central axis X_{10} of ball bearing 10. Such a parameter can also be a speed, a displacement, an acceleration or a vibration.

These detection means include a sensor unit 20 having a body 202 supporting a Hall effect cell 204 forming a sensing element. An electric cable 205 connects cell 204 to an appropriate electronic control unit which is remote from rolling bearing assembly 2. Alternatively, some electronic components can be embedded in body 202 in order to treat the output signal of cell 204.

Body 202 is mounted on an annular shoe 203 which also belongs to sensor unit 20. Shoe 203 is fitted around shaft 4 and wedged onto inner ring 102 thanks to a skirt 2032 blocked in an inner peripheral groove 1022 of inner ring 102. Thus, body 202 is fast in rotation with inner ring 102. A terminal nut 40 is mounted on shaft 4 and adapted to exert on shoe 203 an axial effort E_{40} , that is an effort parallel to axis X_{10} . This axial effort is transmitted, as an effort E_{30} , by shoe 203 to inner ring 102 which is in abutment against a spacer 42 extending between rolling bearing assemblies 2 and 3.

A metallic flange 50 is wedged on outer ring 104. Flange 50 acts as a cover for an encoder washer 60 which constitutes a target for Hall effect cell 204. Encoder washer 60

is magnetically active and includes several magnetic North and South poles regularly distributed around axis X_{10} in working configuration of rolling assembly 2. Encoder washer 60 is mounted on the radial inner face 502 of flange 50. Encoder washer 60 can be glued onto face 502 or blocked against this surface by an elastic deformation of flange 50.

5 Sensing element 204 is arranged to detect encoder washer 60 in a radial direction.

Flange 50 includes a first cylindrical portion 504 having a circular cross-section and defining face 502. Flange 50 also includes a second cylindrical portion 506 with a circular cross-section, these two portions being joined together by an annular portion 508 which is perpendicular to axis X_{10} . Thanks to annular portion 508, portions 504 and 506 can have
10 different inner diameters.

Portion 506 is wedged onto outer ring 104. More precisely, portion 506 is introduced within an outer groove or recess 1042 of outer ring 104, so that items 50 and 104 are fast in rotation with each other. Other possibilities to fasten flange 50 onto outer ring 104 include gluing, force fitting and screwing.

15 D_{104} denotes the outer diameter of outer ring 104, that is the maximum diameter of ball bearing 10. The smaller this diameter, the more compact ball bearing 10 is and the more compact rolling bearing assembly 2 can be. d_{60} denotes the internal diameter of encoder washer 60, that is the dimension of the target which determines the geometry of a radial air gap G formed between the part of body 202 which surrounds cell 204 and the
20 radial inner face 602 of encoder washer 60. Diameter d_{60} is actually the diameter of face 602. Diameter d_{60} is larger than diameter D_{104} . This allows encoder washer 60 to be large enough to define several well differentiated magnetic poles, even if diameter D_{104} is small.

A sealing gasket 70 is mounted on body 202 and extends radially outwardly from this body, so that its terminal deformable lip 72 comes in sliding contact against radial
25 inner face 502 of flange 50. Thus, air gap G and encoder washer 60 are efficiently protected against pollution, in particular water or humidity.

As shown on figure 4, sensor unit body 202 has a cylindrical inner radial surface 2022 with a circular cross-section, adapted to surround shoe 203. Hall effect cell 204 is embedded into a radial projection 2024 of sensor unit body 202 which surrounds and
30 protects cell 204. Projection 2024 extends radially outwardly, with respect to axis X_{10} within a first angular sector having an included angle α of about 30° . R_{MAX} denotes the radius of the outer radial surface 2025 of projection 2024. The radial thickness of air gap G equals the difference between twice R_{MAX} and d_{60} .

35 Outside the angular sector of projection 2024, sensor unit body 202 has a cylindrical outer radial surface 2026 which has a radius R_{min} smaller than radius R_{MAX} .

Thus, an empty space or recess R is formed around the part 2028 of sensor unit body 202 surrounded by surface 2026. This recess R extends radially between surfaces 2026 and 602, on a second angular sector having an included angle β equal to 360° minus the value of α , that is about 330° in the example of figure 4

5 When sensor body 202 is mounted on inner ring 102, recess R gives access to the lateral face 1044 of outer ring 104 on the second angular sector having β as to included angle, that is on most of its circumference.

Thanks to this recess R, a tool 1000 can be used to exert a thrust onto surface 1044 after sensor unit body 202 and flange 50 have been mounted, respectively on inner ring
10 102 and outer ring 104.

Tool 1000 includes a partly cylindrical body 1002 and driving rod 1004 rigidly connected to body 1002. Body 1002 forms, with respect to driving rod 1004, an axial projection having a shape adapted to go through recess R, without interference with radial projection 2024. To this end, body 1002 has a longitudinal slot 1006 adapted to
15 accommodate projection 2024.

Mounting of rolling bearing assembly 2 on hub 6 occurs as follows: sensor unit 20 is mounted onto ring 102 by the introduction of skirt 2032 within groove 1022. Then, flange 50 is mounted onto ring 104 by the introduction of cylindrical portion or skirt 506 within groove 1042. Alternatively, mounting of flange 50 onto ring 104 can occur before
20 mounting of sensor unit 20 onto inner ring 102. Irrespective of the order of these steps, they result in the sensor unit 20 and encoder washer 60 being in a working position with respect to ball bearing 10.

Thanks to the configuration of part 2028 of body 202, the recess R formed around surface 2026 gives access to surface 1044 of ring 104, from the side of unit 20 which is
25 opposite to ball bearing 10, that is from the side of sensor unit body visible on figure 5 and oriented to the left on figures 2 and 3.

It is thus possible to use tool 1000 in order to push ball bearing 10 within a housing 62 of hub 6 by exerting a direct thrust effort E_1 onto surface 1044. This effort does not risk to damage sensor unit 20 or encoder washer 60, since it is exerted through recess R.

30 When rolling bearing 10 is correctly positioned within housing 62, it is then possible to install sealing gasket 70 around sensor unit body 202 in order to obtain the configuration of figures 1 to 3.

In the second to seventh embodiments of the invention represented on figures 6 to 12, elements similar to the ones of the first embodiment have the same reference
35 numbers. Hereafter, mainly differences between these embodiments and the first one are mentioned.

In the second embodiment of the invention represented on figure 6, sensor unit body 202 includes two projections radial 2024₁, 2024₂ where two sensing elements 204₁ and 204₂ are located. Two recesses R₁ and R₂ are formed between projections 2024₁ and 2024₂ at the level of two portions 2028₁ and 2028₂ of body 202 whose outer radial surfaces 2026₁, 2026₂ have a diameter R_{min} smaller than the diameter R_{MAX} of the outer radial surfaces 2025₁ and 2025₂ of the projections 2024₁ and 2024₂.

A tool adapted to be used with this sensor body includes two projections having a C shape of about 150°, corresponding to the shape of recesses R₁ and R₂.

In the embodiment of figure 7, sensor unit body 202 holds four sensing elements 204₁ to 204₄ embedded each in a radial projection 2024₁ to 2024₄. Four recesses R₁, R₂, R₃ and R₄ are defined around body 202 by portions of this body having an outer radial surface of a reduced diameter R_{min}, as compared to the radius R_{MAX} of the projections 2024₁ to 2024₂.

The embodiment of figure 8 corresponds to the case where two sensing elements 204₁ and 204₂ are supposed to read a target 60 partially represented in chain-dotted lines and located radially inside the sensor unit body 202. This corresponds to the case where sensor unit 20 is fastened to the outer ring of a rolling bearing, which is stationary, whereas the target 60 is fastened to the inner rotating ring of this rolling bearing. In this context, a radial inner projection 2024₁ or 2024₂ is created around each unit 204₁ and 204₂. Two parts 2028₁ and 2028₂ of body 202 have an inner diameter r_{MAX} which is larger than the inner diameter r_{min} of the inner radial surface 2025₁ and 2025₂ of projections 2024₁ and 2024₂. This difference in diameter creates two recesses R₁ and R₂ within body 202, radially inside parts 2028₁ and 2028₂. These recesses R₁ and R₂ give access to a lateral face of the inner ring of a bearing when sensor unit body 202 is mounted on such a bearing.

According to non-represented alternative embodiments of the invention, one or more than three sensing elements 204 can be used with a sensor unit body 202 surrounding the target. Then, the number of recesses is adapted.

In the embodiment of figures 9 and 10, four openings O₁, O₂, O₃ and O₄ are created in four intermediate zones of a sensor unit body 202 which supports a sensing element 204. Each opening constitutes a recess through sensor unit body 202. These openings O₁ to O₄ are created about midway between the inner radial surface 2022 and the outer radial surface 2025 of sensor unit body 202. Each opening O₁ to O₄ goes through sensor unit 202, from a first lateral face 2027 to the opposite lateral face 2029. Figure 10 shows how sensor body 202 is positioned with respect to the inner and outer rings 102 and 104 of a ball bearing 10 when it is fastened to the inner ring 102 and when a metallic flange 50

holds an encoder washer 60, as in the first embodiment. Opening O_1 gives partially access to a lateral face 1044 of outer ring 104 and to a lateral face 1024 of inner ring 102.

A tool with four fingers, one of which is represented on figure 10 with reference 1002 is used to act directly onto surfaces 1044 and 1024 when one uses an axial effort thrust E_1 to push ball bearing 10 within a recess 62 of a support member, such as hub 6 in the first embodiment.

In the sixth embodiment of the invention represented on figure 11, the opening O_1 is equipped with two sealing lips 81 and 82 which isolate opening O_1 and ball bearing 10 from the outside. When a finger 1002 of a tool is used to push ball bearing 10 as a consequence of an axial thrust effort E_1 , sealing lips 81 and 82 are elastically deformed, in the direction of arrows A, thus giving access to opening O_1 for finger 1002.

In the seventh embodiment of figure 12, a recess R_1 is made within a sensor unit body 202, this recess being opened to the outside, that is to the left of figure 12, in order to accommodate a finger 1002 of a tool when necessary. This recess R_1 is closed by an end wall 203 formed by sensor unit 202 which permanently isolates ball bearing 10 from the outside. As the axial thickness t of wall 203 is much smaller than the axial thickness T of body 202, wall 203 does not hinder the force transmission between finger 1002 and the lateral faces 1024 and 1044 of the rings 102 and 104 of ball bearing 10, when it is necessary to push this ball bearing within a housing such as housing 62 of the first embodiment, with an axial thrust effort E_1 .

The features of the embodiments mentioned here-above can be combined.

As mentioned here-above, the invention is particularly adapted for realizing a tachometer of a two-wheeled vehicle. However, other applications can be considered.

CLAIMS

1. A rolling bearing (2) assembly comprising:

- a rolling bearing (10), having an inner ring (102) and an outer ring (104),

5 - a target (60) adapted to rotate with said inner ring or with said outer ring, around a rotation axis (X_{10}) of said bearing, and

- a sensor unit (20) comprising a sensor unit body (202) supporting at least one sensing element (204 204₁-204₄) adapted to read the target,

10 wherein the sensor unit body (202) is provided with at least one recess (R , R_1 - R_4 , O_1 - O_4) giving access to a lateral face (1024, 1044) of at least one of said inner ring (102) and said outer ring (104) when said sensor unit (20) is in a working position with respect to said rolling bearing (10).

15 2. Rolling bearing assembly according to claim 1, wherein the target (60) rotates with said outer ring (104) and said sensing element (204, 204-204₂) is mounted in a supporting part (2024, 2024₁-2024₄) of said sensor unit body (202) which defines, with an inner radial face (602) of said target (60), a radial gap (G) through which said sensing element reads said target and wherein said recess (R , R_1 - R_4) is formed by a part (2028, 2028₁-2028₂) of said sensor body having a reduced outer diameter (R_{min}) as compared to the outer diameter (r_{MAX}) of said supporting part.

25 3. Rolling bearing assembly according to claim 1, wherein the target (60) rotates with said inner ring (102) and said sensing element (204₁-204₂) is mounted on a supporting part (2024₁-2024₂) of said sensor body (202) which defines, with an outer radial face of said target, a radial gap through which said sensing element reads said target and wherein said recess (R_1 , R_2) is formed by a part (2028₁, 2028₂) of said sensor body having an enlarged inner diameter (r_{MAX}) as compared to the inner diameter (r_{min}) of said supporting part.

30 4. Rolling bearing assembly according to claim 1, wherein said recess (O_1 - O_4) is provided in an intermediate part of said sensor unit body, between its inner radial surface (2022) and its outer radial surface (2025).

35 5. Rolling bearing assembly according to one of the previous claims, wherein said sensing unit (20) has several sensing element (204₁-204₂), each mounted in a respective

supporting part (2024₁-2024₄) and wherein a recess (R₁-R₄) is provided between each pair of two adjacent supporting parts.

5 6. Rolling bearing assembly according to one of the previous claims, wherein said recess is a hole (O₁-O₄) going through said sensor unit body (202), from one lateral face (2027) of said body to the opposite lateral face (2029) of said body.

10 7. Rolling bearing assembly according to claim 6, wherein said opening (O₁-O₂) is equipped with a deformable sealing arrangement (81, 82), movable (A) between a sealing configuration and an open configuration where it grants access to said opening.

15 8. Rolling bearing assembly according to one of claims 1 to 5, wherein said recess (R₁) has an end wall (2023) adapted to transmit a thrust effort (E₁) exerted through said recess onto said inner ring (102) and/or said outer ring (104) of said ball bearing (10).

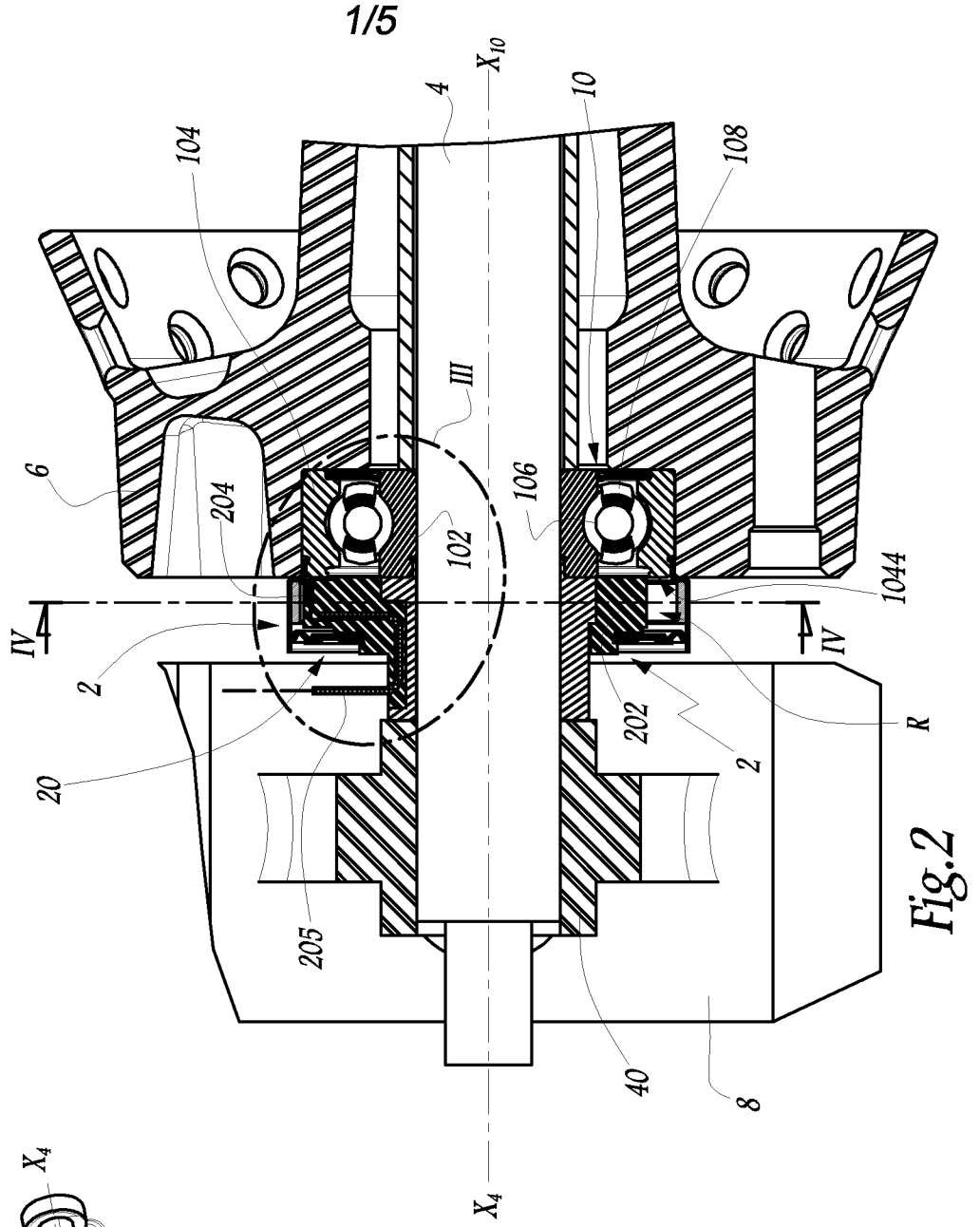
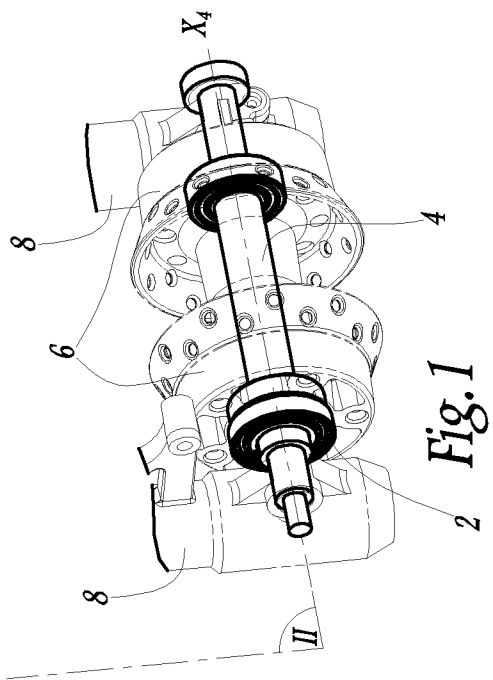
20 9. A tool (1000) for mounting a rolling bearing assembly (2) according to any of the previous claims onto a support member (6), wherein said tool has at least one projection (1002) of a cross-section adapted for it to go through one recess (R₁-R₄, O₁-O₄) of said sensor unit body (2) in order to exert a thrust effort (E₁) on said lateral face (1024, 1044) of said ring (102, 104).

10. A process for mounting a rolling bearing assembly (2) according to claims 1 to 9 onto a support member (6), this method comprising the steps of:

25 a) fastening said sensor unit body (202) to said rolling bearing (10),
b) pushing said rolling bearing into a corresponding housing (62) of said support member with a thrust axial effort (E₁) exerted on said lateral face of said ring (1024, 1044) of said rolling bearing, through said recess (R₁-R₄, O₁-O₄) of said sensor unit body.

30 11. Process according to claim 10, wherein it comprises a further step of:

c) fastening a flange (50) equipped with said target (60) to one of the rings (102, 104) of said rolling bearing (10).



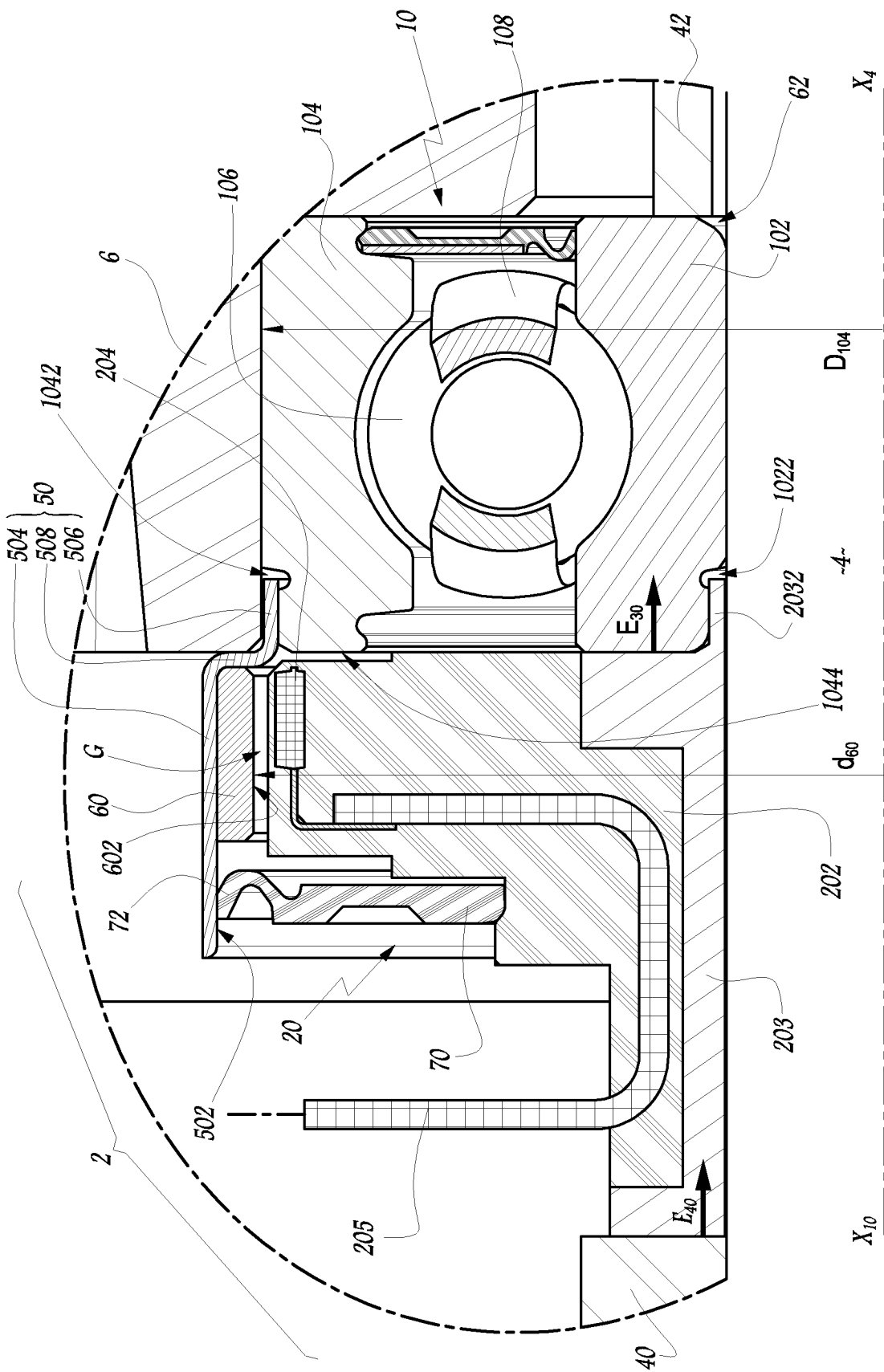


Fig. 3

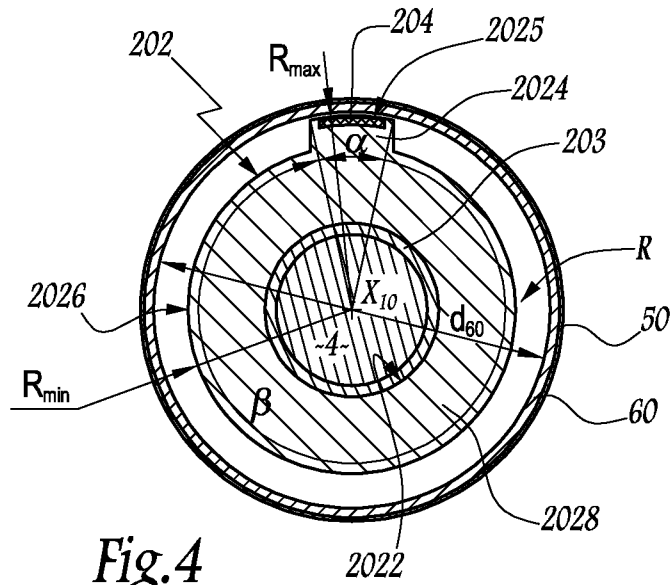


Fig. 4

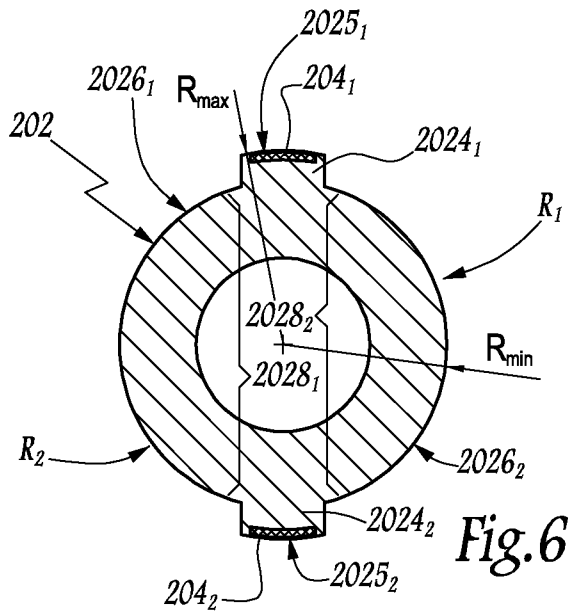


Fig. 6

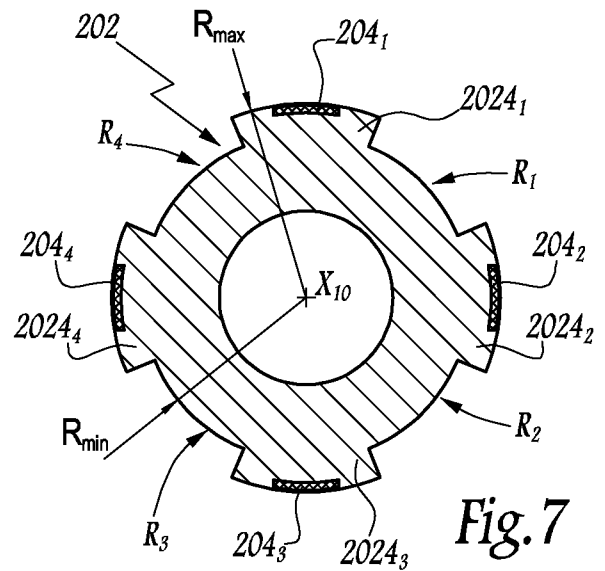


Fig. 7

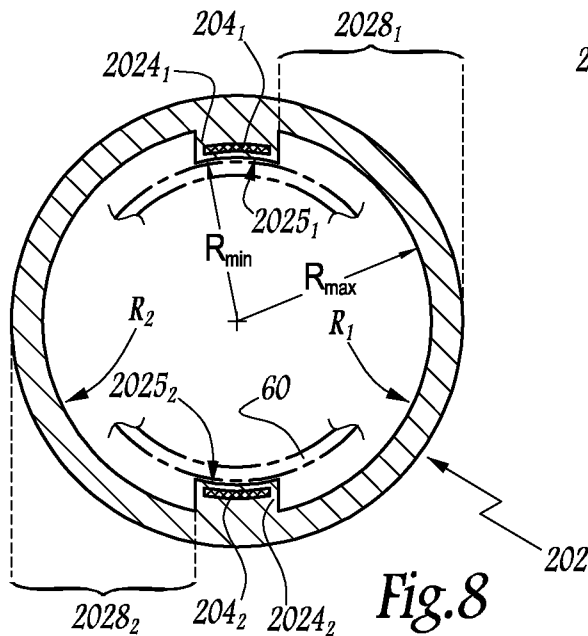


Fig. 8

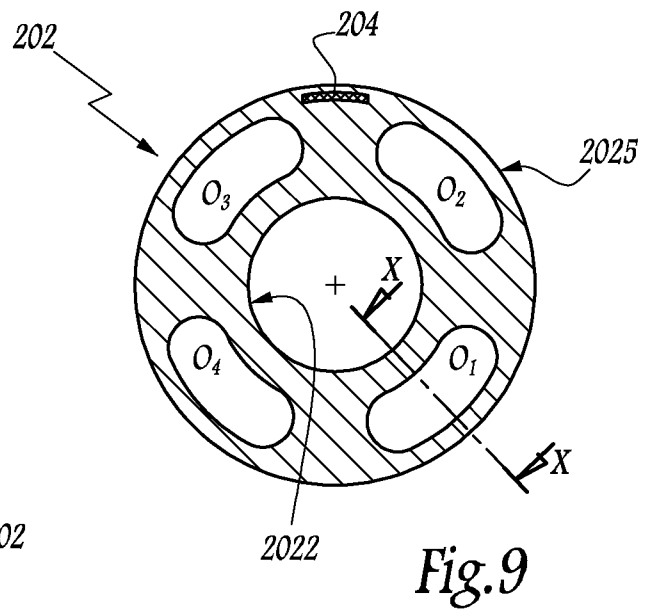


Fig. 9

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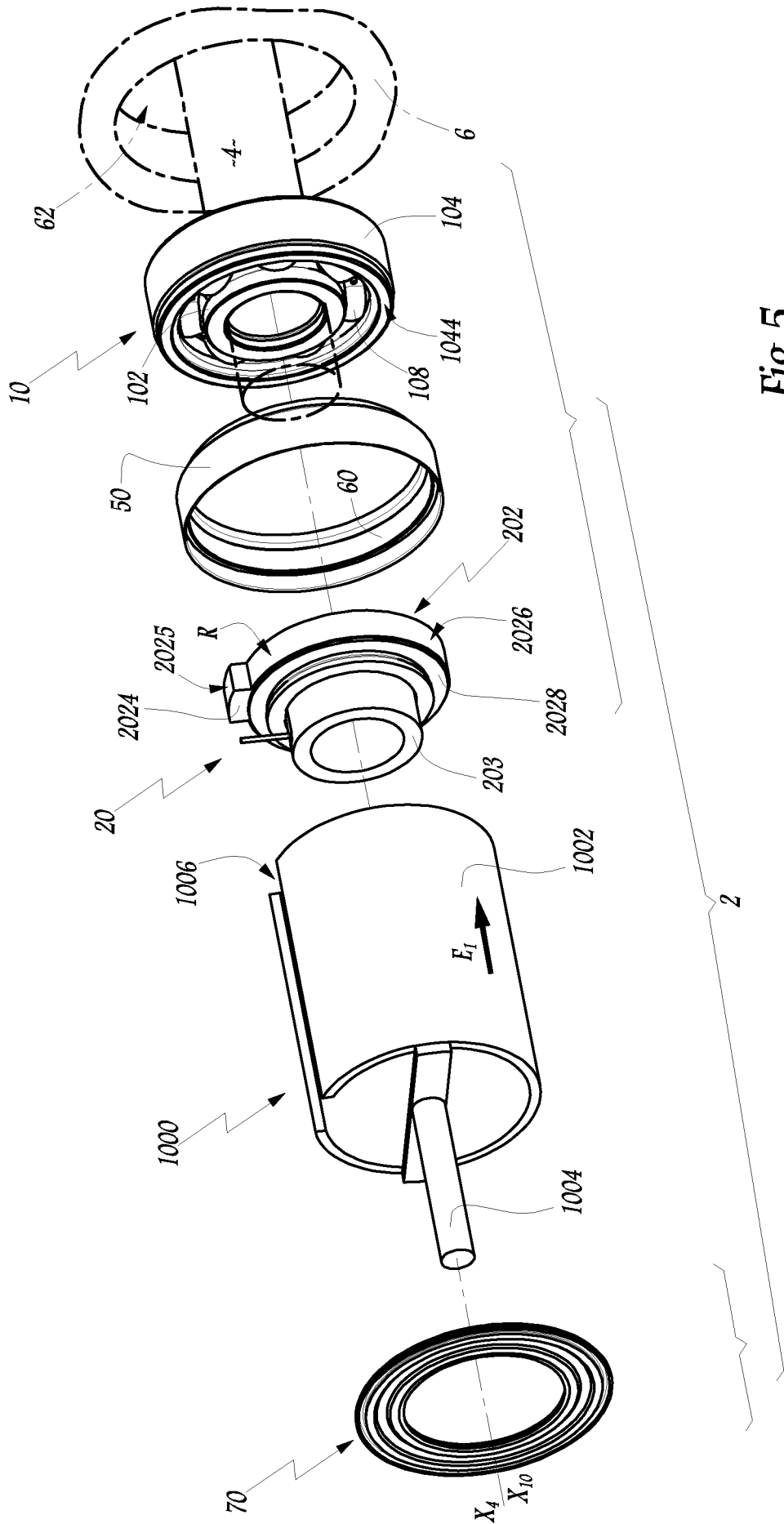


Fig.5

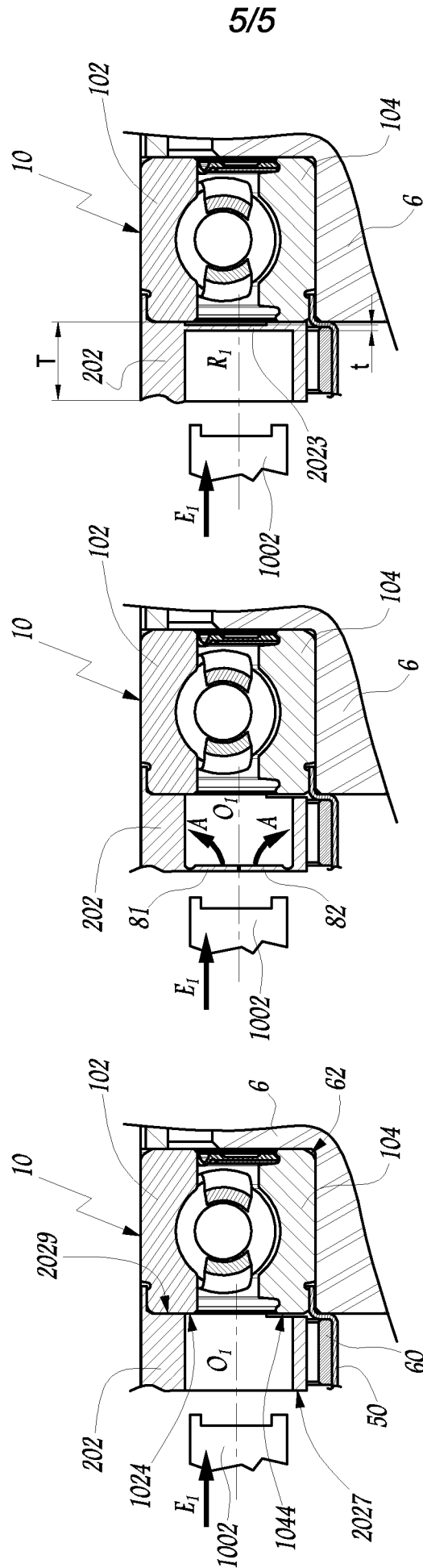


Fig. 12

Fig. 11

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2010/001274

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16C35/06 F16C41/00 F16J15/32 G01P3/44
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 G01P B60B F16J

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.
X	EP 1 739 317 A1 (SKF AB [SE]) 3 January 2007 (2007-01-03) paragraph [0023] - paragraph [0034] figures 1-4	1,3,5-11
X	JP 2004 360720 A (NTN TOYO BEARING CO LTD) 24 December 2004 (2004-12-24) * abstract figures 1-3,9,10	1,3-6, 8-11
X	EP 1 557 676 A1 (NSK LTD [JP]) 27 July 2005 (2005-07-27) paragraph [0057] - paragraph [0076] figures 1-4	1,2,5, 7-11
X	EP 1 933 155 A1 (SKF AB [SE]) 18 June 2008 (2008-06-18) figures 5,6	1,5,6, 9-11
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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

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2010/001274

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