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(54) Title: A BEARING UNIT AND MANUFACTURING METHODS THEREOF

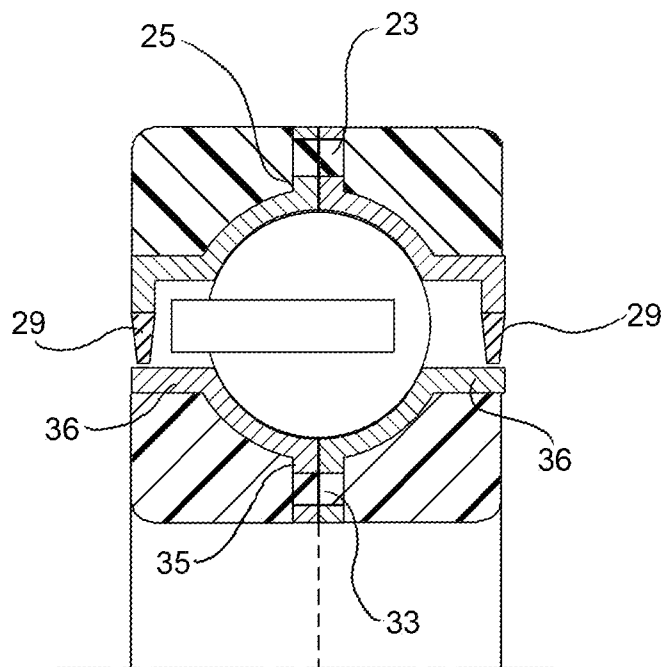


FIG. 4

(57) Abstract: The raceways of a bearing unit are formed by sheet metal annular inserts (21, 22, 31, 32) having axially adjacent radial flanges (25, 35) with peripheral edges (28, 38) which are flush with respective cylindrical or conical axial surfaces (51, 61) of a relevant annular body (50, 60) overmoulded on two or more of the sheet metal inserts in each race; axially aligned passages (23, 33) being formed through each pair of adjacent flanges so as the moulded material of the annular bodies (50, 60) fills the aligned passages (23, 33) and integrally binds each pair of sheet metal inserts together.



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A bearing unit and manufacturing methods thereof

The invention refers to rolling contact bearing units with races comprising annular bodies of material overmoulded on hardened sheet metal annular inserts defining the raceways.

5 The invention further relates to methods of manufacturing such bearing units.

There are known bearing assemblies having annular elements of plastic material overmoulded on the inner and outer races of a rolling bearing. These bearing assemblies are used in various technical fields, for example for rotatably supporting a shaft in an
10 electric motor, and particularly for applications where the bearing has to be prevented from potentially damaging electric currents passing through it. Bearing assemblies of the above kind are also used for applications where it is desired to reduce the amount of steel constituting the bearing, so as to gain a weight reduction and also reduce the number of costly treatments of the bearing steel.

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U.S. Pat. No. 3,606,502 discloses a bearing assembly with relatively rotatable outer and inner races. Each bearing race includes a pair of sheet metal annular inserts with concave sections defining together a raceway for a set of rolling elements interposed between the races. Overmoulded on the radially inner and outer pairs of sheet metal inserts are plastic
20 bodies. Another example of a wheel bearing assembly of the above kind is given in U.S. Pat. No. 4,113,328.

25

Although satisfactory results in terms of weight reduction are achieved by bearing units made in accordance with the principle underlying the aforementioned references, the main object of the present invention is to achieve, at the same time, an excellent final result in terms of high accuracy having regard to coaxiality or concentricity of the bearing raceways with respect to the central geometric axis of the axle or shaft mounted centrally in the bearing. Nevertheless, another object of the invention is also to gain economy in the manufacture of the bearing unit even further with respect to the prior art.

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These and other objects and advantages, which will be better understood in the following, are accomplished, in accordance with the present invention, by a bearing unit having the

features defined in claim 1. In summary, the raceways of a bearing unit are formed by hardened sheet metal annular inserts having radial flanges with peripheral edges. These edges are flush with respective cylindrical or conical axial surfaces of a relevant annular body overmoulded on two or more of the sheet metal inserts in each race. The radial
5 flanges of two inserts in a same race are axially adjacent. Axially aligned passages are formed at angularly spaced locations through each pair of adjacent flanges. The moulded material of the annular bodies fills the aligned passages and integrally binds each pair of sheet metal inserts together. Two preferred methods of manufacturing such a bearing, with two moulding steps or a single one, are defined in claims 14 and 19. Preferred
10 embodiments of the invention are set forth in the dependent claims.

In order that the present invention may be well understood there will now be described a few preferred embodiments thereof, given by way of example, reference being made to the accompanying drawings, in which:

15

figure 1 is an axial cross-sectional view schematically showing part of a first embodiment of a bearing unit according to the invention;

figure 2 is a side view showing part of a second embodiment of a bearing unit in accordance with the invention;

20

figure 3 is an axial cross-sectional view taken along line III-III in figure 2;

figure 4 is an axial cross-sectional view showing part of a third embodiment of a bearing unit according to the invention;

figures 5-11 are axial cross-sectional views of further embodiments of this invention;

25

figures 12-15 are axial cross-sectional views of still further embodiments of the invention, applied to the hub of a motor vehicle wheel;

figures 16-20 are schematic axial cross-sectional views showing the main steps of a first method of manufacturing a bearing unit in accordance with the present invention; and

30

figures 21-24 are axial cross-sectional views schematically showing the most important steps of a second method of manufacturing a bearing unit in accordance with the invention.

With reference initially to figure 1, numeral 10 designates as a whole an example of a first embodiment of a bearing unit according to the invention. The bearing unit 10 comprises a radially outer race 20, a radially inner race 30, and a set of rolling elements 40 (in this example balls) interposed between the races 20 and 30. Throughout the present description and the claims, terms and expressions indicating positions and orientations such as "inner", "outer", "radial", "axial" are to be construed as referring to the central axis of rotation x of the bearing unit.

Each bearing race 20, 30 is comprised of two sheet metal annular inserts 21, 22, 31, 32, and a single annular body 50, 60 which is overmoulded on the two metal inserts, fixing them together as a single piece. The sheet metal inserts each form a raceway section 24, 34, a radially extending flange 25, 35 near a radial mid-plane P of the bearing, and a cylindrical side rim 26, 36 extending axially away from the radial mid-plane of the bearing.

In this example, the raceway section of the two sheet metal inserts in a same race have concave, toroidal faces 27, 37 that jointly form the raceway of that race. In a same race, the radial flanges 25, 35 of the two sheet metal inserts of that race are located parallel, side to side, axially abutting one against the other, as will be explained in further detail herein after. In the outer race 20, both of the parallel radial flanges 25 have outer peripheral edges 28 ending flush with a radially outer peripheral surface 51 of the overmoulded body 50. In the inner race 30, both of the parallel radial flanges 35 have inner peripheral edges 38 ending flush with a radially inner peripheral surface 61 of the overmoulded body 60. The radially outer and inner peripheral surfaces 51, 61 are in most applications substantially cylindrical. In some cases (figs. 14 and 15), these surfaces will be slightly conical, but still defined by rotating a predetermined line around the axis of rotation of the bearing unit.

The flanges 25, 35 of each annular insert also perform a centering function: the radial distances between the peripheral edges 28, 38 of the flanges and the concave raceways are chosen so as to accurately centre all of the concave faces that define the raceways of the bearing unit with respect to the axis of rotation x.

In a same race, axially aligned passages 23, 33 are formed through each pair of adjacent

flanges at circumferentially spaced locations. The passages establish a communication between the axially abutting sides or faces of each pair of flanges. All these passages are filled with the material of the annular bodies 50, 60 overmoulded on the pairs of sheet metal inserts. As a result, the passages 23, 33 yield in the overmoulded annular bodies a number of corresponding complementary formations which bind each pair of sheet metal inserts together. To this end, the passages through adjacent flanges need not necessarily be perfectly aligned axially. Importantly, the passages should be at least partially axially aligned or overlapping, to such an extent that the material moulded there through will be strong enough to bind the components of the race firmly together.

In the embodiment of figure 1, the passages 23, 33 for the overmoulded material are shaped as axially aligned windows extending axially through the adjacent flanges from one side to the other. The radially outer and inner peripheral edges 28, 38 of the flanges 25, 35 are in this case circumferentially continuous. In the variant embodiment of figures 2 and 3, the passages 23, 33 are in form of peripheral recesses along the radial edges of the flanges, whereby these edges are circumferentially discrete, but still flush with the cylindrical surfaces 51, 61 of the overmoulded bodies 50, 60.

In use, the outer and inner cylindrical surfaces 51, 61 of the bearing unit will in most cases be fitted in a housing and around a central shaft (not shown). In order to ensure a better and more uniform distribution of strain and stress, the flanges preferably extend near a radial plane P of axial symmetry for the bearing unit (indicated in figure 1).

In figures 1 to 3, the annular gaps between the inner and outer races at either side of the bearing unit are sealed. In the outer race 20, the side rim 26 of each annular insert 21, 22 comprises a radial extension that projects towards the axial centerline of the bearing. Flexible sealing gaskets 70 can be moulded onto the radially inner edges of these extensions, which are adapted to slidably engage the rims 36 on the opposite race. In the variant embodiment of figure 4, the bearing comprises an integral shield. In this variant, the radial extensions 29 project from the rim 26 of the outer race towards the opposite inner race leaving a slight clearance (e.g. about 0.3 mm wide) so as to perform a labyrinth seal. As known to those skilled in the art, the bearing may also be sealed/shielded by

means of separate seals/shields fitted in the annular gap between the inner and outer races. In the case of separate seals/shields, the side rims of the annular inserts that will form the stationary race of the bearing do not comprise a radial extension 29.

- 5 The raceway surfaces 27, 37 of the sheet metal inserts 21, 22, 31, 32 may be polished in order to minimize friction, and coated with an anti-oxidizing agent.

Depending on the specific application, the overmoulded material may be a polymer (e.g. PEEK), injection-moulded alone or combined with a metal powder, for example a light
10 metal such as aluminium or alloys thereof. The filler may be chosen so as to compensate for thermal expansion to which some of the bearing parts may be subjected in use. Other filler materials, such as steel powder or glass fibre are also contemplated.

Figures 5 to 11 show other example embodiments of the present invention. In figure 5, an
15 outer flange with through bores is formed as a single piece with the outer race. Figure 6 shows an application for a castor wheel, figure 7 for a belt tensioner. In the embodiment of figure 8, one of the side rims is axially prolonged in order to provide a fixation means for an external item (not shown). Figure 9 shows an example wherein the rolling elements are flattened balls and an electric device such as a rotation sensing device or an electric power
20 pack schematically designated at T is fitted to the stationary side rim so as to be incorporated within the bearing unit. According to requirements, the inner or outer races may be rotatable or stationary, as the case may be. In figures 10 and 11 examples are shown wherein the radially inner race is flanged or shaped so as to fulfill specific applications.

25 In the further embodiment shown in figure 12, more than two sheet metal inserts 21, 22, 21' and 31, 32, 31' are incorporated in a same bearing race and held together by an overmoulded body 50, 60. This arrangement is preferred for bearing units having a dual set of rolling elements; the example of figure 12 refers to a bearing with a set of balls and a set
30 of rollers.

Figures 14 and 15 show embodiments of this invention applied to wheel bearing units.

Differently from the other embodiments shown herein, where two sheet metal inserts jointly form a raceway, in the embodiments of figures 14 and 15 each sheet metal insert provides a raceway by itself. Nevertheless, precise relative location of the raceways is guaranteed by the abutment of the adjacent radial flanges and the location of the centering peripheral rims on a given surface. Such a surface need not necessarily be cylindrical. It may be a conical surface or, more generally, a solid of revolution obtained by rotating a predetermined line around the intended axis of rotation. The flanged hub H of a vehicle wheel bearing is an example. A conical portion C of the hub provides the surface against which the inner peripheral edges of the radial flanges are to bear. For an aluminium flanged hub bearing locked by orbital rolling of a tubular end E of the hub (fig. 14), the polymer/aluminium powder filler will compensate for the thermal expansion of the aluminium hub, maintaining the required preload of the bearing. As known to those skilled in the field of aluminium hubs, these hubs have a drawback in that the bearing pre-load is lost with a split inner ring section due to the different thermal expansion rates of aluminium and steel or sheet metal steel inner races. Tests carried out by the Applicant show that, as a result of the addition of aluminium powder in the material overmoulded on the sheet metal inserts, the overmoulded bodies maintain the axial preload imparted to the bearing and to a high degree also compensate for the thermal expansion of the hub. Figure 15 refers to an application for a steel flanged hub bearing made out of a low carbon steel, forming a preloaded bearing unit by means of a lock ring laser-welded on the flanged hub.

A first method of manufacturing a bearing unit according to this invention with two moulding steps is schematically shown in figures 16 to 20. A first pair of sheet metal annular inserts 31, 32 for the inner bearing race are located with their radial flanges 35 axially abutting against one another (fig. 16). The inserts are centred by positioning their inner peripheral edges 38 against a radially inner reference surface R, in this example an axial cylindrical surface. The two inserts are circumferentially positioned in respect of one another so as to axially align the passages 33 of the two flanges, and preferably pre-assembled together in this position. Then, the inner annular body is injection-moulded within the so pre-assembled inserts, obtaining the inner race 30 (fig. 17). At this stage, the raceway concave surfaces and the counterfaces for the sealing gaskets on the side rims can be polished. A set of rolling elements 40 with a retaining cage 41 (fig. 18) is then fitted in

the raceway. The same rolling elements 40 provide an accurate reference for the subsequently positioned pair of metal inserts 21, 22 for the radially outer race (fig. 19). Also the radially outer inserts are positioned with axially abutting flanges 25, axially aligned passages 23 and outer flange edges 28 properly centred around the same intended central axis of the bearing. The radially outer inserts may be preassembled together before being fitted around the rolling elements 40. Finally, the outer annular body 50 is moulded over the pair of radially outer inserts, thereby forming the outer bearing race (fig. 20). The sealing devices 70 may optionally be fitted before or after over-moulding the outer body.

The steps of an alternative, second manufacturing method with a single moulding step are schematically depicted in figures 21 to 24. A first pair of sheet metal inserts 31, 32 for the inner race are located axially aligned, abutting and radially centred, as discussed in connection with fig. 16. A set of rolling elements (fig. 22) is set on the inner raceway defined by the inserts 31, 32, and then a pair of radially outer sheet metal inserts 21, 22 is positioned around the rolling elements (fig. 23). The sealing gaskets, where provided, are preferably attached to the side rims of the sheet metal inserts prior to the final and single injection-moulding step, in which the inner and outer annular bodies 50, 60 are formed simultaneously.

It will be appreciated that the invention provides an inexpensive though accurate bearing unit. Perfect concentricity of the bearing raceways with respect to the central geometrical axis is ensured by means of the radial flanges of the sheet metal annular inserts, which can be made precisely by blanking and possibly also trimming the sheet metal. At any rate, a very short manufacturing route is needed, requiring little raw material, and eliminating costly manufacturing steps normally indispensable with conventional rolling bearing units, such as turning, grinding, machining, hardening, etc.

The invention is not intended to be limited to the embodiments described and illustrated herein, which should be considered as examples of implementing the assembly and bearing unit of the invention. Rather, the invention may be modified with regard to the shape and arrangement of parts, number of components, construction and functional details, as will be apparent to those skilled in the art. For example, the passages in the radial flanges may

be arranged differently from the foregoing embodiments. In order to dispense from having to adjust the relative circumferential or angular position of the two sheet metal inserts for a same race, the circumferential extent of the passages may be chosen so that some of the passages through the two adjacent flanges will always be at least partly axially juxtaposed or aligned. This will guarantee that the overmoulded material will flow through the passages and form a single, integral body extending on either side of the flanges.

CLAIMS

1. A bearing unit (10) comprising:

an outer race (20) and an inner race (30) rotatable relative to the outer race, each
5 race including

– at least two sheet metal annular inserts (21, 22, 31, 32), each insert having a
raceway section (24, 34) defining at least part of a raceway for a set of rolling elements
(40) interposed between the inner and outer races, and

– a single annular body (50, 60) which is overmoulded on and integral with
10 the two or more inserts and forms a radially peripheral, cylindrical or conical surface
(51, 61),

characterised in that

each sheet metal insert forms a radially extending flange (25, 35) with a peripheral
edge (28, 38) ending flush with the radially peripheral surface (51, 61) of the relevant
15 overmoulded annular body (50, 60) and that

the radial flanges of two sheet metal inserts in a same race are located axially
abutting against one another and provide at least partially axially aligned passages (23, 33)
formed at angularly spaced locations through each pair of adjacent radial flanges, whereby
the overmoulded material of the relevant annular body (50, 60) fills the aligned passages
20 (23, 33) and integrally binds each pair of sheet metal inserts together in each race.

2. A bearing unit according to claim 1, characterised in that the passages comprise
windows extending axially through the adjacent flanges from one side to the other, and that
the radially inner and outer peripheral edges (28, 38) of the flanges (25, 35) are
25 circumferentially continuous.

3. A bearing unit according to claim 1, characterised in that the passages comprise
peripheral recesses extending axially through the adjacent flanges from one side to the
other, and that the radially outer and inner peripheral edges (28, 38) of the flanges (25, 35)
are circumferentially discrete.

4. A bearing unit according to claim 1, 2 or 3, characterised in that the radial flanges
(25, 35) extend near a radial mid-plane (P) of axial symmetry for the bearing unit.

5. A bearing unit according to any one of the preceding claims, characterised in that at least one of the sheet metal inserts forms a side rim (26, 36) extending axially away from the radial mid-plane (P) of the bearing.

5 6. A bearing unit according to claim 5, characterised in that at least one side rim (26, 36) comprises a radial extension (39) projecting towards the radially opposite race.

7. A bearing unit according to claim 6, characterised in that the radial extension (29) is provided with a flexible gasket (70) that is adapted to slidingly contact a surface of the
10 radially opposite race.

8. A bearing unit according to claim 6, characterised in that the radial extension (29) projects towards the radially opposite race leaving a slight clearance therewith, so as to perform labyrinth sealing action.
15

9. A bearing unit according to any one of the preceding claims, characterised in that the two sheet metal inserts in a same race have raceway sections (24, 34) jointly forming a raceway (27, 37).

20 10. A bearing unit according to any one of claims 1 to 9, characterised in that the two sheet metal inserts in a same race have raceway sections each forming a raceway for a respective set of rolling elements.

11. A bearing unit according to any one of the preceding claims, characterised in that
25 the overmoulded material comprises a plastics material.

12. A bearing unit according to claim 11, characterised in that the plastics material includes a polymer combined with a metal particle filler.

30 13. A bearing unit according to claim 12, particularly for the hub of a motor vehicle wheel, characterised in that the metal filler includes particles of aluminium or alloys thereof.

14. A method of manufacturing a rolling bearing unit including a radially outer race (20), a radially inner race (30) and at least one set of rolling elements (40) interposed between the inner and outer races, the method including the steps of:

5 a) providing at least two radially inner sheet metal annular inserts (31, 32), each insert forming:

– a raceway section (34) adapted for defining at least part of a radially inner raceway for a set of rolling elements,

– a radially inwardly extending flange (35) with a radially inner peripheral edge (38), and

10 – a plurality of axial passages (33) formed at angularly spaced locations through the radial flanges (35);

b1) locating the radial flanges (35) of the two inserts (31, 32) axially abutting against one another so as to axially align at least partly the passages (33) of the two radial flanges,

15 b2) radially centring the two inserts (31, 32) by positioning their inner peripheral edges (38) against a reference surface (R);

c) moulding an annular body (60) within the annular inserts (31, 32), filling the aligned passages (33) and forming a peripheral, radially inner cylindrical surface (61) flush with the inner peripheral edges (38), thereby obtaining a radially inner bearing race (30) with at least one radially inner raceway (37);

d) fitting a set of rolling elements (40) around each inner raceway (37);

20 e) providing at least two radially outer sheet metal annular inserts (21, 22), each outer insert forming:

– a raceway section (24) adapted for defining at least part of a radially outer raceway for a set of rolling elements (40),

25 – a radially outwardly extending flange (25) with a radially outer peripheral edge (28);

– a plurality of axial passages (23) formed at angularly spaced locations through the radially outwardly extending flanges (25);

30 f1) locating the radially outwardly extending flanges (25) of two of the outer inserts (21, 22) axially abutting against one another so as to axially align at least partly the passages of the two flanges (25),

f2) radially centring the two outer inserts (21, 22) by positioning their raceway sections (24) on the set of the rolling elements (40) already fitted on the inner raceway(s);

g) moulding an annular body (50) around the outer inserts (21, 22), filling the aligned passages (23) and forming a radially outer peripheral axial surface (51) flush with the outer peripheral edges (28), thereby obtaining a radially outer bearing race (20) with at least one radially outer raceway (27).

15. A method according claim 14, wherein the step c) is preceded by the step of:

b3) angularly relatively rotating the two radially inner sheet metal inserts (31, 32) so as to at least partly axially align the passages (33) of the two relevant, axially abutting flanges (35).

16. A method according claim 14 or 15, wherein the step g) is preceded by the step of:

f3) angularly relatively rotating the two radially outer sheet metal inserts (21, 22) so as to at least partly axially align the passages (23) of the two relevant, axially abutting flanges (25).

17. A method according claim 14, including the step of: polishing surfaces of the radially inner sheet metal inserts after the moulding step c).

18. A method according claim 14, wherein the moulding step g) is preceded by the step of:

fitting sealing means (70) to at least one of the sheet metal inserts at at least one side of the bearing unit.

19. A method of manufacturing a rolling bearing unit including a radially outer race (20), a radially inner race (30) and at least one set of rolling elements (40) interposed between the inner and outer races, the method including the steps of:

a) providing at least two radially inner sheet metal annular inserts (31, 32), each insert forming:

– a raceway section (34) adapted for defining at least part of a radially inner raceway (37) for a set of rolling elements,

- a radially inwardly extending flange (35) with a radially inner peripheral edge (38), and

- a plurality of axial passages (33) formed at angularly spaced locations through the radial flanges (35);

5 b1) locating the radial flanges (35) of two inserts (31, 32) axially abutting against one another so as to axially align at least partly the passages (35) of the two flanges (35),

 b2) radially centring the two inserts (31, 32) by positioning their inner peripheral edges (38) against a reference surface (R);

10 c) fitting a set of rolling elements (40) around each inner raceway (37);

 d) providing at least two radially outer sheet metal annular inserts (21, 22), each outer insert forming:

- a raceway section (24) adapted for defining at least part of a radially outer raceway (27) for said set of rolling elements (40),

15 – a radially outwardly extending flange (25) with a radially outer peripheral edge (28), and

- a plurality of axial passages (23) formed at angularly spaced locations through the outwardly extending radial flanges (25);

 e1) locating the outwardly extending radial flanges (25) of two of the outer inserts (21, 22) axially abutting against one another so as to axially align at least partly the passages (23) of these two flanges,

 e2) radially centring the two outer inserts (21, 22) by positioning their raceway sections (24) on the set of rolling elements (40) already fitted on the inner raceway(s); and

 f) simultaneously moulding:

25 – a radially inner annular body (60) within the radially inner annular inserts (31, 32), filing the aligned passages (33) of the radially inwardly extending flanges (35) and forming a radially inner axial peripheral surface (61) flush with the inner peripheral edges (38) of the radially inwardly extending flanges (35), thereby obtaining a radially inner bearing race (30) with at least one radially inner raceway (37); and

30 – a radially outer annular body (50) on and around the radially outer inserts (21, 22), filing the aligned passages (23) of the radially outwardly extending flanges (25) and forming a radially outer axial peripheral surface (51) flush with the outer peripheral edges

(28) of the radially outwardly extending flanges (25), thereby obtaining a radially outer bearing race (20) with at least one radially inner raceway (27).

20. A method according claim 19, wherein the moulding step f) is preceded by the step
5 of:

angularly relatively rotating the two radially outer sheet metal inserts (21, 22) and/or the two radially inner sheet metal inserts (31, 32) so as to at least partly axially align the passages (23) and/or (33) of the two relevant, axially abutting flanges (25, 35).

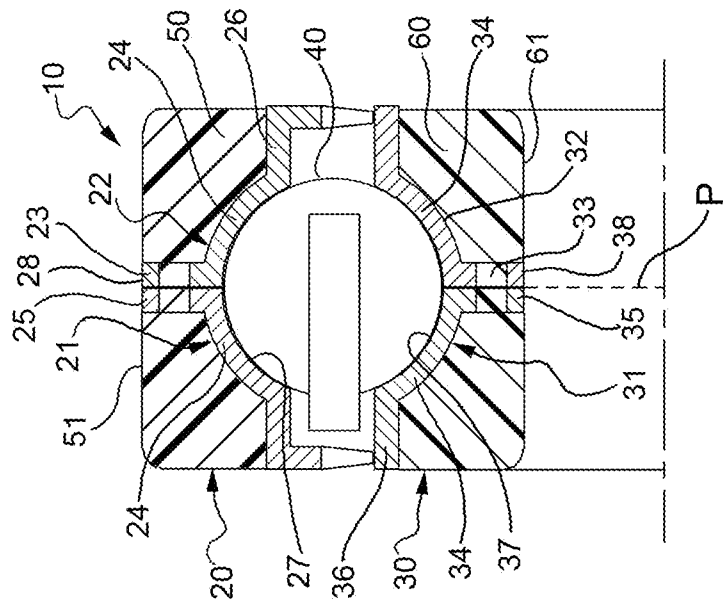


FIG.1

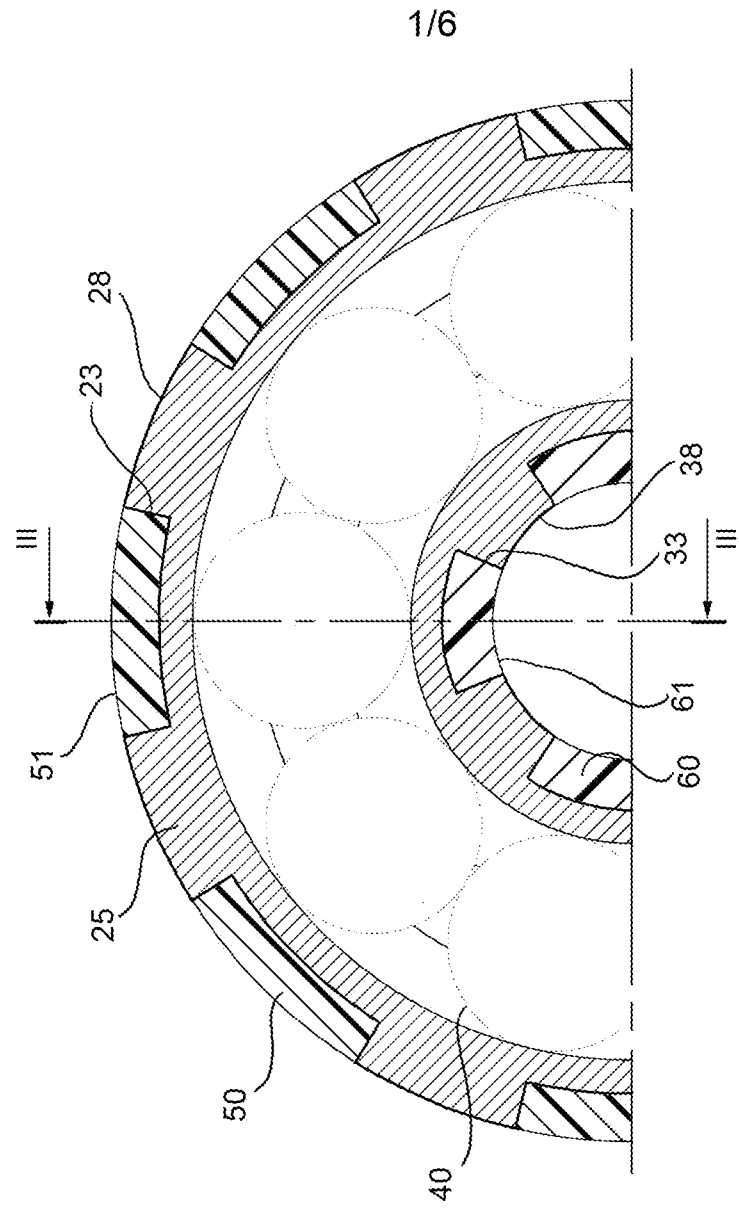


FIG.2

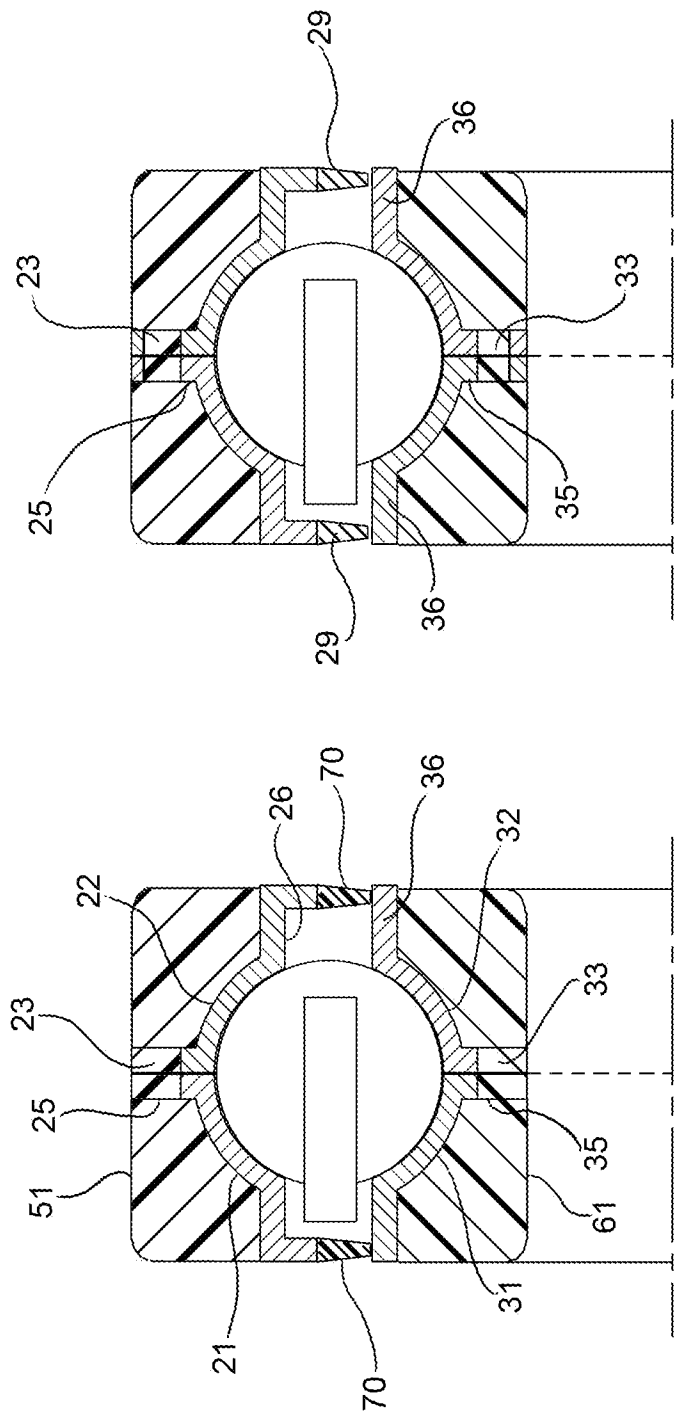


FIG.4

FIG.3

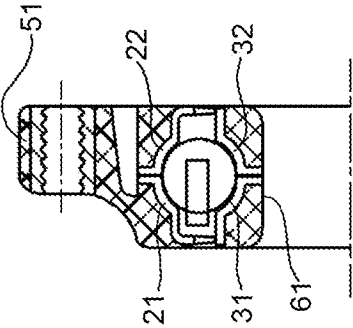


FIG. 5

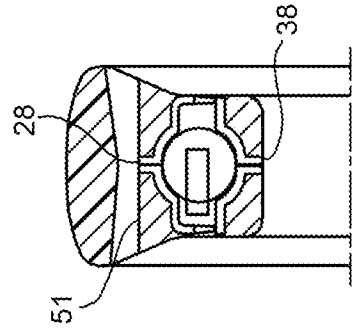


FIG. 6

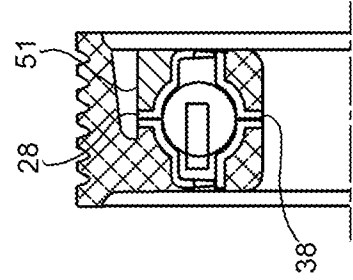


FIG. 7

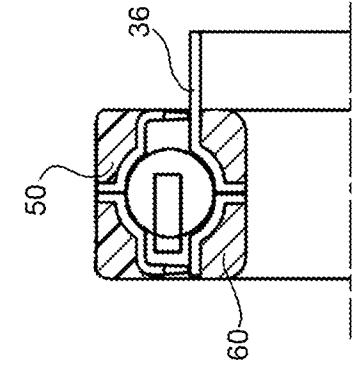


FIG. 8

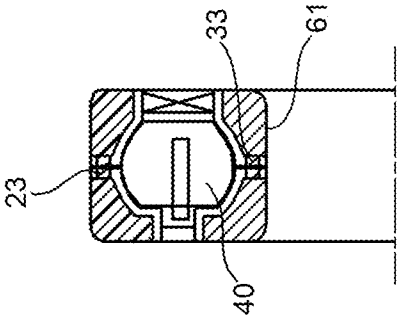


FIG. 9

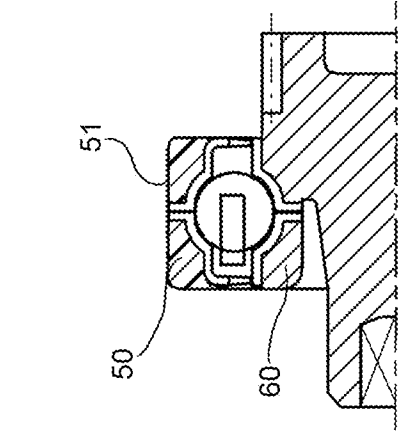


FIG. 10

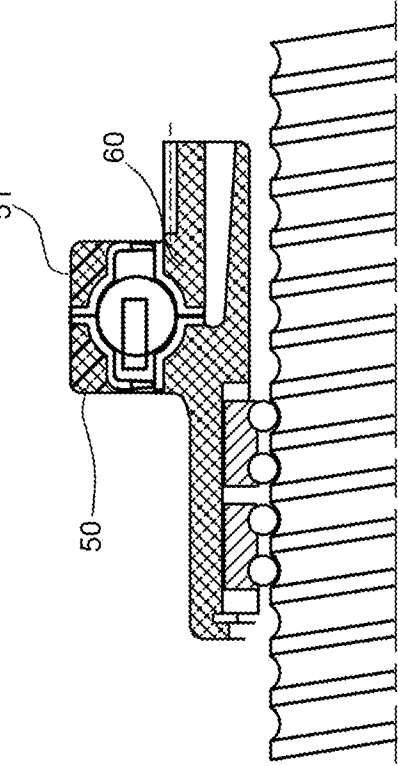


FIG. 11

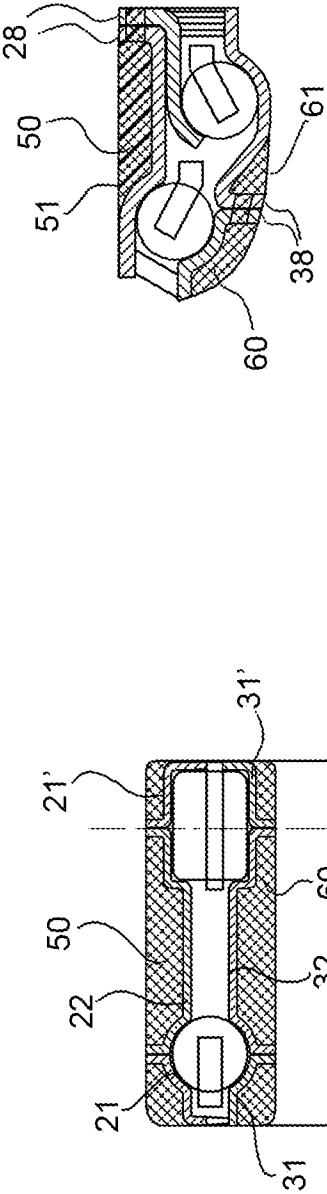


FIG. 12

FIG. 13

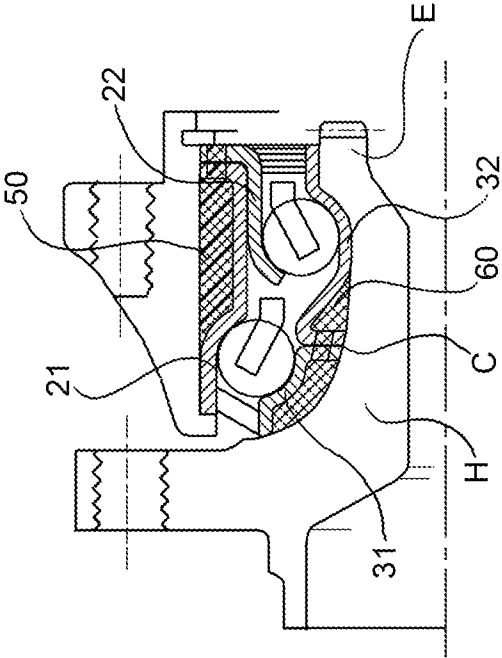
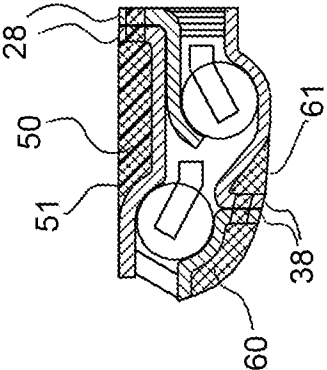


FIG. 14

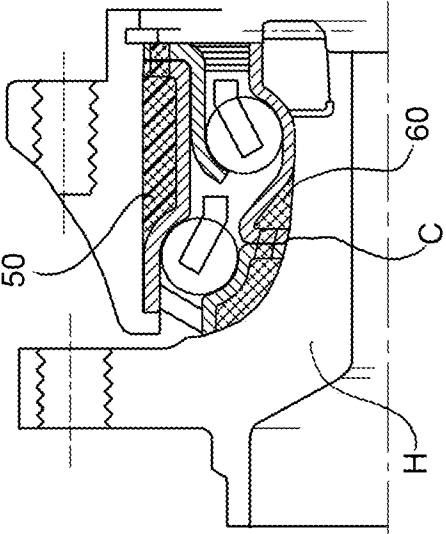


FIG. 15

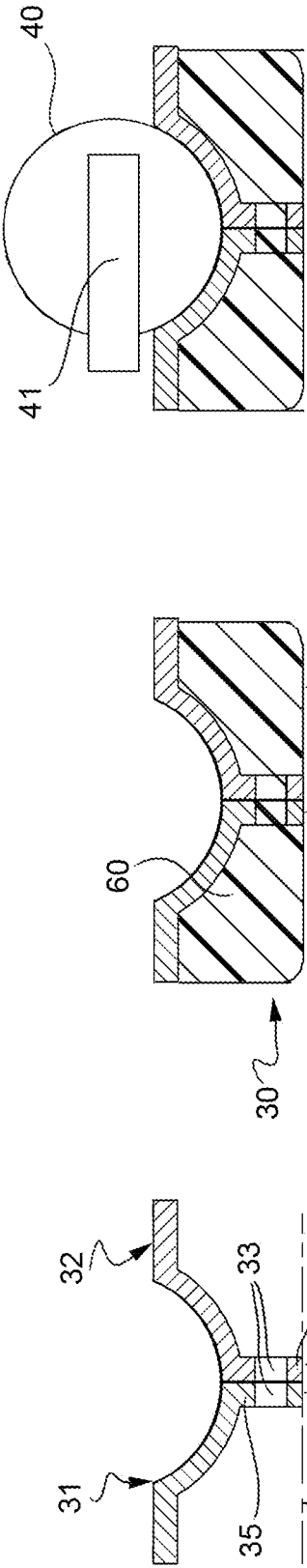


FIG. 16

FIG. 17

FIG. 18

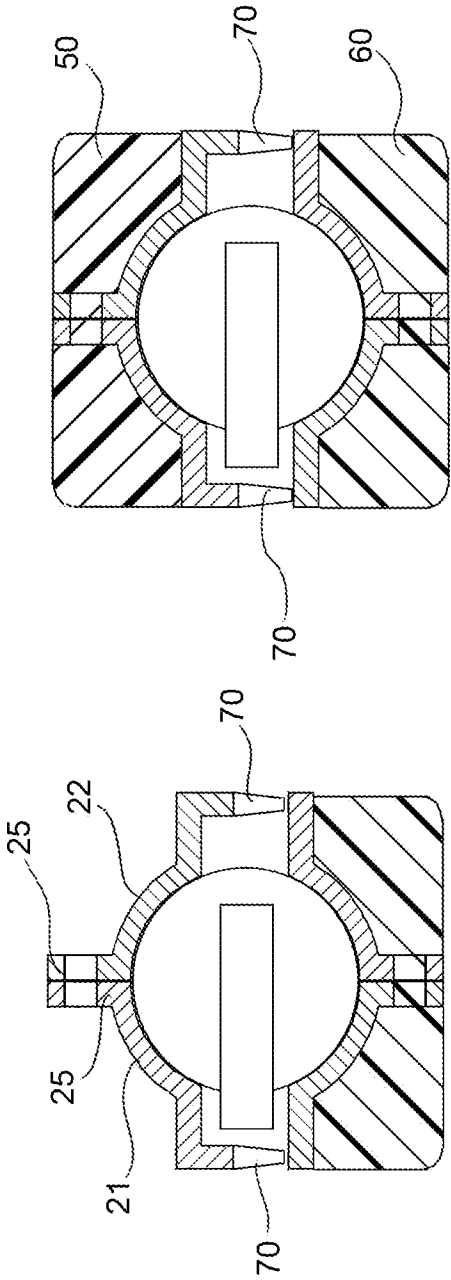


FIG. 19

FIG. 20

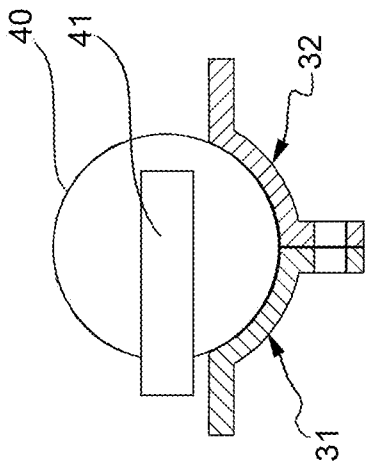


FIG. 22

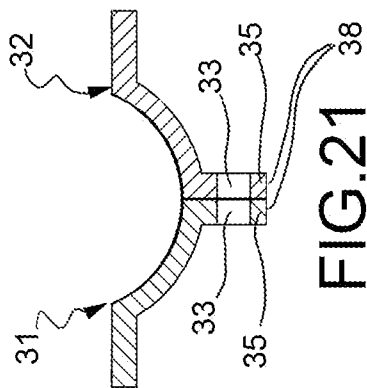


FIG. 21

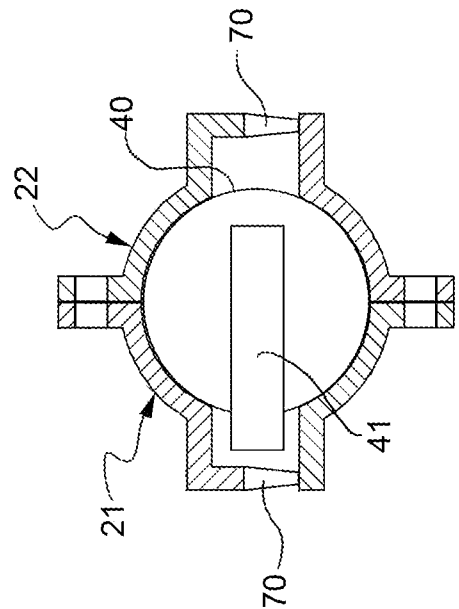


FIG. 23

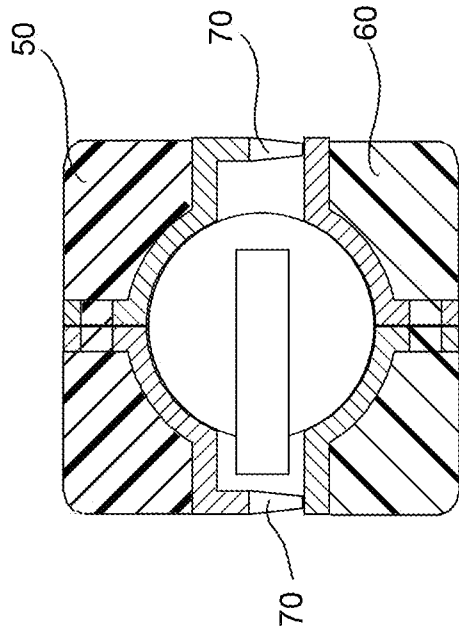


FIG. 24

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2008/068242

A. CLASSIFICATION OF SUBJECT MATTER

INV. F16C33/60 F16C33/64

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 3 606 502 A (GERMOND HUBERT DE) 20 September 1971 (1971-09-20) cited in the application figure 4 abstract -----	1, 14, 19



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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- *E* earlier document but published on or after the international filing date
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- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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- *G* document member of the same patent family

Date of the actual completion of the international search

27 October 2009

Date of mailing of the international search report

03/11/2009

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/EP2008/068242

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
US 3606502	A	20-09-1971	DE	1944010 A1		05-03-1970
			FR	1587716 A		27-03-1970
			GB	1241387 A		04-08-1971
