(57) Abstract: A bearing assembly (10) provided with a rolling bearing unit (20) having an outer ring (21) provided with a centring flange (2If) with a peripheral edge (27) and an inner ring (22) provided with a relevant centring flange (22f) with a relevant peripheral edge (28), the bearing rings (21, 22) having a contact configuration for rolling elements (23), wherein the bearing assembly (10) is further provided with a plastic modular body (50) which is snap-fixed on the bearing unit (20) and is radially limited by a radially outer, axial cylindrical surface (11) integral with the outer ring (21) and a radially inner, axial cylindrical surface (12) integral with the inner ring (22); a coupling device (80) being provided to join mechanically the plastic body (50) to the bearing unit (20) such that peripheral edges (27, 28) partly define the relevant cylindrical surfaces (11, 12), and the plastic modular body (50) being provided, for each ring (21) (22), with two annular bodies (51a, 51b) (52a, 52b) which are mounted on either side of said central flange (2If, 22f).
as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(H))

— of inventorship (Rule 4.17(iv))

— Published:
  — with international search report (Art. 21(3))
A bearing assembly

The present invention relates generally to a bearing assembly.

More particularly, the present invention relates to a bearing assembly having inner and outer rings and ring parts provided with annular bodies of plastics material.

Bearing assemblies having annular elements of plastic material overmolded on the inner and outer rings are known and used in several industrial and automotive applications, e.g. for rotatably supporting a shaft in an electric motor while preventing the bearing 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.

An object of the present invention is to provide a lightweight, cost effective bearing assembly capable of ensuring 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 bore.

Another object of the invention is to provide a permanent fixation of the ring parts using the annular plastic bodies, which can be flexibly used in a wide range of applications, according to the dimensions required or allowed for a specific application.
A further object of the invention is to provide a rolling element bearing that can be quickly and easily assembled.

Toward the attainment of these and additional objects and advantages, the present invention provides a bearing assembly as defined in claim 1. Preferred embodiments of the invention are set out in the dependent claims.

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

- figure 1 illustrates, in an axial cross-sectional view, a first preferred embodiment of the bearing assembly in accordance with the invention;
- figure 2 is a partial external view of the bearing assembly of figure 1; and
- figure 3 illustrates, in an axial cross-sectional view, a second embodiment of the bearing assembly in accordance with the invention.

Referring initially to figures 1 and 2, a first preferred embodiment of a bearing assembly according to the invention is generally designated 10.

The assembly 10 is radially delimited by a radially outer, axial cylindrical surface 11 and by a radially inner, axial cylindrical surface 12, and comprises:
- a bearing unit 20,
- a plastic modular body 50 which is radially delimited by the surfaces 11 and 12 and which is coupled with the bearing unit 20; and
- a coupling device 80 which mechanically joins the
plastic body 50 to the bearing unit 20.

As used herein, terms and expressions indicating positions and orientations such as "inner", "outer", "radial", "axial" will be construed with respect to the central axis X of rotation of the bearing unit 20. Further, the word "centring" is referred to bringing or keeping the components of the bearing assembly 10 concentric or coaxial to the central axis X.

The bearing unit 20 comprises a radially outer ring 21, a radially inner ring 22, a set of rolling elements 23 (in this example balls) interposed between rings 21 and 22.

Each ring 21, 22 is provided with a respective raceway 21R, 22R for the rolling elements 23 and is also provided with a respective radial flange 21f, 22f which extends in a direction radially opposite to the relevant raceway 21R, 22R. More specifically, the outer ring 21 forms a radially outwardly extending central flange 21f with an outer peripheral edge 27 ending flush with the outer cylindrical surface 11 of the bearing assembly 10. Similarly, the inner ring 22 has a radially inwardly extending central flange 22f with an inner peripheral edge 28 ending flush with the inner cylindrical surface 12 of the bearing assembly.

The function of the flanges 21f and 22f is to provide a continuous path made entirely in a robust metallic material, such as steel, extending radially from a central shaft (not shown) fitted in the inner ring 22, to an outer housing (not shown) in which the outer ring 21 is fitted. The components of such a path are the outer ring 21 and the inner ring 22 with the rolling elements 23. All these are parts strong,
stiff and accurately sized ferrous or non-ferrous members, which will guarantee perfect concentricity of the raceways 21R and 22R with respect to the axis of the axle or shaft mounted in the inner ring 22. In order to ensure uniform stress distribution and adequate stiffness, the flanges 21f, and 22f both extend in a same radial plane P of axial symmetry for the bearing assembly 10.

As also shown in figure 2, the flanges 21f and 22f have circumferentially spaced peripheral recesses 27R and 28R, whereby the edges 27 and 28 constitute circumferentially discrete portions of the cylindrical surfaces 11 and 12.

Each ring 21 and 22 is comprised of two sheet metal annular inserts 121a, 121b, 122a, 122b which form a contact configuration for the rolling elements 23, which might be balls, flattened balls or rollers.

Each insert 121a, 121b, 122a, 122b is provided with:

- a radially extending flange portion 131a, 131b, 132a, 132b;
- a cylindrical side rim 141a, 141b, 142a, 142b extending axially away from the plane P of the bearing unit 20; and
- a curved section 151a, 151b, 152a, 152b which joins the relevant flange portion 131a, 131b, 132a, 132b to relevant side rim 141a, 141b, 142a, 142b.

In the same ring 21, 22, the radial flanges 131a and 131b, 132a and 132b of the two sheet metal inserts 21a and 21b, 22a and 22b of that ring 21, 22 are arranged axially abutting against each other and are further arranged to be symmetrical about the plane P, so as to define the relevant flange 21f,
The cylindrical side rim 141a and 141b, 142a and 142b of each ring 21, 22 are faced to the cylindrical side rim 142a and 142b, 141a and 141b of the other ring 22, 21 and define a gap G between the inner ring 22 and the outer ring 21.

The curved section 151a and 151b, 152a and 152b of two sheet metal inserts 121a and 121b, 122a and 122b in a same ring 21, 22 have contact configuration faces, that jointly form the raceway 21R, 22R of that ring 21, 22 and that are symmetrically arranged with respect to the plane P.

The plastic modular body 50 is provided with:

- two annular bodies 51a and 51b which are coupled to the outer ring 21 and are both delimited by the surface 11, and

- two annular bodies 52a and 52b which are coupled to the inner ring 22 and are both delimited by the surface 12.

The two annular bodies 51a, 51b and the two annular bodies 52a, 52b each have a flat, radial side surface 53a, 53b and 54a, 54b facing away from the plane P and a cylindrical surface 55a, 55b and 56a, 56b lying flush with the edge 27 and 28 of the relevant flange 21f and 22f.

All the annular bodies 51a, 51b and 52a, 52b are mounted mechanically and are (semi) permanently joined, in pairs and side-to-side in an axial direction, to the inner and outer rings 22 and 21 by the coupling device 80 which consists of snap lock connection means to allow the modular body 50 to be quickly mounted on the bearing unit 20 and also to assemble together the two sheet metal annular inserts 21a, 21b and
22a, 22b of each ring 21, 22. The annular inserts can be made from hardened sheet metal, or local hardening of the raceway sections of the outer ring 22 and the inner ring 21 can be considered.

The coupling device 80 comprises, for each ring 21 and 22, a plurality of circumferentially spaced, axially extending hook portions 81a, 81b and 82a, 82b which perform a snap-lock action engaging the flanges 21f and 22f and which are circumferentially staggered.

The hook portions 81a, 81b, 82a and 82b are provided with a relevant radial grooves 84 opened towards the axis X in order to receive the relevant flange 21f, 22f and are integral with the relevant plastic bodies 51a, 51b and 52a, 52b.

The hook portions 81a, 81b and 82a, 82b axially extend from the bodies 51a, 51b and 52a, 52b towards the plane P and are placed two-by-two inside the same recesses 27R, 28R. More particularly, the hook portions 81a and 81b are snapped onto the flange 21f inside the recesses 27R and the hook portions 82a and 82b are snapped onto the flange 22f inside the recesses 28R. In this way, the edge 27 is still flush with the radially outer, cylindrical surfaces 55a and 55b of the two bodies 51a, 51b mounted to the outer ring 21 and the inner edge 28 is still flush with the radially inner, cylindrical surfaces 56a and 56b of the two annular plastic bodies 52a, 52b mounted to the inner ring 22.

As will be appreciated, the bearing assembly 10 is made lighter as a whole by the modular body 50 that is made of a of plastic material. At the same time, the centring flanges 21f and 22f of the bearing rings 21 and 22 will allow precise
metal-to-metal coupling with a central shaft and an outer housing, thereby ensuring perfect concentricity of the bearing raceways with respect to the central geometrical axis X. Another advantage is that the drive fit of the bearing assembly on a metal shaft and in a metal housing takes place between metal and metal, and is therefore reliable with time and not affected by temperature variations which could, on the other hand, reduce stability of the coupling of two materials having different coefficients of expansion, such as steel and plastic materials.

The process of putting together the bearing assembly will be quick. Optionally, in some applications an adhesive or centering means can be applied to the annular bodies or the bearing rings prior to snap-mounting these components together: a so-called pre-assembly step. After the parts of the bearing assembly as snap-locked together, the hardened sheet metal raceways of the inner and outer rings can be ground and/or polished to obtain smoother running surfaces.

Furthermore, it would be useful to point out that, optionally, also only one bearing ring 21, 22 may be provided with the centring flange 21f, 22f and, in this case, the other ring 22, 21 will be a one-piece bearing ring radially delimited by an axial cylindrical surface that entirely defines the relevant cylindrical surface 11, 12 of the bearing unit 10. In this case, which is not illustrated but it may easily be understood from the description, the plastic modular body 50 comprises only two annular bodies which are mounted on either side of the only one central flange 21f, 22f. The single centring flange 21f, 22f with axial cylindrical surface of the one-piece bearing ring will allow precise metal-to-metal coupling with a central shaft and/or
an outer housing as well. The bearing ring 21, 22 without centering flange 21f, 22f will be chosen depending on the specific application.

Depending on the specific application, the plastics material from which the modular body 50 is made can be e.g. a thermo hardened plastic or a polymer (e.g. PEEK), injection-moulded without or with a metal powder filler, for example a light 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.

The sheet metal annular inserts 21a, 21b, 22a, 22b may be assembled together by means of the same snap-mounting hooks 81a, 81b, 82a, 82b of the plastic annular bodies, as shown in the embodiment of figure 2, but, alternatively, as shown in figure 3, a bearing assembly 10' can be preassembled by bending a flange portion 133a, 133 a of one insert 21a, 22a over the adjacent flange portion 131b, 132b of the other insert 21b, 22b.

The annular plastic bodies 51a, 51b, 52a, 52b may thereafter be snap lock mounted over the two adjacent bent flange portions using the hook portions 81a, 81b and 82a, 82b.

Optionally, in all the possible embodiments of this invention, the annular bodies 51a and 51b may form skirt portions 65 (shown only in the upper part of figure 1) projecting radially from the sides of on one ring 21 towards the opposite ring 22, leaving a slight clearance (e.g. about 0.3 mm wide) so as to perform a labyrinth seal.
Alternatively, the annular gap $G$ between the inner and outer rings $21$ and $22$ at either side of the bearing unit $20$ are sealed by means of flexible sealing gaskets $66$ fitted on the rim $141a$, $141b$ of one ring $21$ and slidingly contacting the rim $142a$, $142b$ on the opposite ring $22$, as schematically depicted in the lower part of figure 1. As known to those skilled in the art, the sliding counterfaces for the gaskets $66$ may otherwise be provided by shields or flingers mounted on the opposite ring $22$, $21$.

Optionally, the skirt portion $65$ can be injection-moulded with a metal powder filler and can be magnetized in order to define an encoder for monitoring the speed of the bearing unit $20$ which can be provided with an external sensor (not shown) both for being coupled to the encoder and for monitoring either the temperature or other functional parameters of the bearing unit $20$.

While specific embodiments of the invention have been disclosed, it is to be understood that such disclosure has been merely for the purpose of illustration and that the invention is not to be limited in any manner thereby. Various modifications as to the rolling element contact configuration, the shape e.g. additional functions like extension with a flange for fixation purposes, fixation grooves in the outer ring, location of parts, and other constructional and functional details will be apparent to those skilled in the art in view of the foregoing. For example, the outer or the inner rings may indifferently be rotatable or stationary, according to the application requirements. Also, the axial thickness of the annular bodies to be mounted to a given bearing unit may be chosen as a function of the available space.
CLAIMS

1. A bearing assembly (10) (10') comprising:
   - a rolling bearing unit (20) having two rings (21, 22)
   - with a contact configuration for rolling elements (23) and
     rotatable relative to each other around a rotation axis (X),
   - modular body (50) which is made of plastics material
     and is fixed to the bearing unit (20), and is radially
     limited by at least a radially axial cylindrical surface
     (11) (12) integral with the bearing unit (20);
   - characterised in that the bearing assembly (10) (10') further
     comprises coupling means (80) which mechanically join the
     plastic body (50) to the bearing unit (20); at least one ring
     (21) (22) of the two rings (21) (22) being provided with a
     central, radially extending centring flange (21f) (22f)
     delimited by a relevant discrete peripheral edge (27) (28)
     which partly defines said cylindrical surface (11) (12), and
     the plastic modular body (50) comprising at least two annular
     bodies (51a, 51b) (52a, 52b) which are mounted on either side
     of said central flange (21f) (22f).

2. A bearing assembly as claimed in claim 1, characterised
   in that the rolling bearing unit (20) has an outer ring (21)
   and an inner ring (22) which are both provided with a
   central, radially extending centring flange (21f, 22f)
   delimited by a relevant discrete peripheral edge (27, 28);
   the modular body (50) comprising, for each ring (21) (22), two
   annular bodies (51a, 51b) (52a, 52b) which are mounted on
   either side of said central flange (21f, 22f) and being
   radially limited by a radially outer, axial cylindrical
   surface (11) and by a radially inner, axial cylindrical
   surface (12) which are integral with the outer ring (21) and,
   respectively, with the inner ring (22) and are partly defined
3. A bearing assembly according to claim 2, characterised in that the said coupling means (80) are defined by snap and quick coupling means to join either permanently or semi-permanently the plastic body (50) to the bearing unit (20).

4. A bearing assembly according to claim 2 or 3, characterised in that the flanges (21f, 22f) both extend in a same radial plane (P) of axial symmetry for the bearing unit (20).

5. A bearing assembly according to claim 2, 3, or 4, characterised in that the annular bodies (51a) (51b) (52a) (52b) each have a cylindrical surface (55a) (55b) (55a) (55b) lying flush with the peripheral edge (27, 28) of the relevant flange (21f, 22f).

6. A bearing assembly according to any one of claims 2 to 5, characterised in that the annular bodies (51a) (51b) (52a) (52b) are coupled, in pairs and side-to-side in an axial direction, to the inner and outer rings (21, 22) by said coupling means (80).

7. A bearing assembly according to any one of claims 2 to 6, characterised in that at least one of said body (51a) (51b) (52a) (52b) comprises a flange (65) which projects towards the opposite body (52a) (52b) (51a) (51b) in order to seal an annular gap (G) between the inner ring (22) and the outer ring (21) at a least one side of the bearing unit (20).

8. A bearing assembly according to any one of claims 2 to
6, characterised in that the bearing flanges (21f, 22f) have circumferentially spaced peripheral recesses (27R, 28R) and that the annular bodies (51a) (51b) (52a) (52b) have each a plurality of circumferentially spaced, axially extending hook portions (81a) (81b) (82a) (82b) which define said coupling means (80) and perform a snap-lock action engaging the flanges (21f, 22f) at said recesses (27R, 28R).

9. A bearing assembly according to claim 8, characterised in that the hook portions (81a) (81b) (82a) (82b) of two annular bodies (51a, 51b) (52a, 52b) snap lock mounted to a same flange (21f) (22f) are circumferentially staggered.

10. A bearing assembly according to claim 7 or 9, characterised in that each bearing ring (21, 22) is composed by two axially adjacent sheet metal annular inserts (21a, 21b, 22a, 22b), each insert (21a, 21b, 22a, 22b) forming a part of the contact configuration jointly defining a raceway (21R, 22R) for the rolling elements (23) of the axially adjacent insert, and a radially extending flange portion (131a) (131b) (132a) (132b) with circumferentially discrete peripheral edge portions (27, 28), axially abutting the flange portion of the axially adjacent insert and that the hook portions (81a) (81b) (82a) (82b) extend axially in said peripheral recesses (27R) (28R), engaging at least one of the flange portions in order to perform a snap lock connection action of the annular bodies to the relevant bearing ring.

11. A bearing assembly according to claim 10, characterised in that each hook portion (81a) (81b) (82a) (82b) engages both the flange portions two axially adjacent sheet metal annular
12. A bearing assembly according to claim 13, characterised in that two axially adjacent sheet metal inserts are pre-assembled and/or joined by bending parts of a flange portion of one insert over the flange portion of the other axially adjacent insert.

13. A bearing assembly according to any one of claims 8 to 12, characterised in that the sheet metal inserts form a side rim (141a, 141b, 142a, 142b) extending axially away from a radial mid-plane (P) of the bearing assembly (10) (10’).

14. A bearing assembly according to claim 13, characterised in that at least one side rim (141a, 141b, 142a, 142b) provides a sealing means (65) (66) projecting towards the radially opposite flange, in order to seal an annular gap (G) between the inner and outer rings (21) (22) at a side of the bearing unit (20).

15. A bearing assembly according to claim 14, characterised in that the sealing means (65) (66) includes a flexible gasket (66) slidingly contacting a surface secured to the radially opposite ring.

16. A bearing assembly according to claim 14, characterised in that the sealing means includes a side skirt (65) radially projecting from the side rim towards the radially opposite ring to perform labyrinth sealing action.

17. A bearing assembly according to claim 1, characterised in that the plastics material includes a polymer combined with a metal particle filler.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. F16C33/60

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

Other documentation searched other than minimum documentation to the extent that such documents are included in the fields searched:

Electronic database consulted during the international search (name of data base and where practical search terms used):

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Category</th>
<th>Citation of document with indication where appropriate of the relevant passages</th>
<th>Relevant to claim No</th>
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<tr>
<td>X</td>
<td>DE 10 2006 034729 B3 (SKF AB [SE]) 31 January 2008 (2008-01-31) paragraphs [0023] - [0025], [0029] - [0031]; figures 1,4,5</td>
<td>1-6,17</td>
</tr>
<tr>
<td>A</td>
<td>US 3 876 266 A (ROZENTALS ALFREDS) 8 April 1975 (1975-04-08) column 4, line 48 - column 5, line 21; figure 3</td>
<td>7,8,12,13</td>
</tr>
<tr>
<td>X</td>
<td>DE 15 75 374 Al (SKF SVENSKA KULLAGERFAB AB) 18 December 1969 (1969-12-18) pages 1,2; figure 3</td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>US 4 362 344 A (LEDERMAN FREDERICK E) 7 December 1982 (1982-12-07) figure 2</td>
<td>2,4</td>
</tr>
</tbody>
</table>

D. Further documents are listed in the continuation of Box C

X See patent family annex

Special categories of cited documents:

'A' document defining the general state of the art which is not considered to be of particular relevance

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'T1' document of particular relevance claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search:

27 October 2009

Date of mailing of the international search report:

03/11/2009

Name and mailing address of the ISA:

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Maukonen, Kai Ie
<table>
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<tr>
<th>Patent document cited in search report</th>
<th>Publication date-</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
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</thead>
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<tr>
<td>DE 102006034729 B3</td>
<td>31-01-2008</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>US 3876266 A</td>
<td>08-04-1975</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>DE 1575374 A1</td>
<td>18-12-1969</td>
<td>AT 286717 B</td>
<td>28-12-1970</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CH 464613 A</td>
<td>31-10-1968</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SE 331005 B</td>
<td>07-12-1970</td>
</tr>
<tr>
<td>US 4362344 A</td>
<td>07-12-1982</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>

Form PCT/ISA/210 (patent family annex) (April 2005)