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PATENT SPECIFICATION

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(72) Inventor RONALD ALFRED ERNEST WOOD

(19)

(54) CAGE FOR A ROLLING ELEMENT BEARING

(71) We, RANSOME HOFFMANN POLLARD LIMITED, a British Company of New Street, Chelmsform, Essex, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a cage for a rolling element bearing and to a rolling element bearing incorporating such a cage.

Cages for rolling element bearings are known per se. Such cages generally have an annular wall and a plurality of spaced pockets for receiving the rolling elements. Each of the pockets is usually formed between the annular wall and a pair of prongs which extend generally axially out from the annular wall. In the case of a ball bearing, each pocket is formed by a part-spherical recess in the wall and by the two prongs which also define part spherical surfaces. For a roller bearing, each pocket is defined by part cylindrical surfaces on the prongs, by a portion of the flat side surface of the annular wall, and by circumferentially extending lugs or lips at the ends of the prongs.

In rolling element bearings, the known cages tend to splay out, during operation, owing to the centrifugal forces. This causes the free ends of the prongs to contact the raceway of the outer ring of the bearing and leads to problems discussed in detail hereinafter.

A general object of the present invention is to provide an improved form of cage for a rolling element bearing.

According to the present invention there is provided a cage for use in a rolling element bearing; said cage comprising a main annular wall and a plurality of pockets of part-spherical shape for receiving balls acting as the rolling elements, each of the pockets being formed between the main wall and a pair of prongs extending axially outwards from the main wall, wherein at least some of the prongs each have an additional end projection not solely forming part of the pocket-defining surfaces and arranged when the cage is assembled in the bearing or in use to become disposed or positioned between corresponding lands of the bearing rings beyond the balls associated therewith.

A cage made in accordance with the invention may comprise a main annular wall, a plurality of part-spherical pockets spaced around the main wall for receiving and locating balls, each of the pockets being defined partly by the main wall and partly by a pair of prongs extending generally axially outwards from said main wall, wherein each prong is formed with an additional projection remote from the main wall which does not solely form part of the associated pocket defining surfaces and is arranged such that when the cage is assembled in the bearing the projections extend beyond the balls to lie between the lands of the bearing rings to limit the splay of the cage when the bearing is in operation.

Since the pockets are part spherical, the prongs are curved to follow the contour of the balls. The projections may then form continuations of the prongs and may taper to narrow in a direction axially outwards from the main wall. Since the ends of the projections lie beyond the balls, as the cage splays out, during operation of the bearing, the ends of the projections can only contact the land of the outer bearing ring. This then leads to considerably less cage splay than is the case with known cages. This arises for two reasons, namely because the total length of the prongs plus the projections is such that the projections contact the outer ring axially further from the annular wall of the cage than do the ends of the prongs of the known cages, and because the ends of the projections contact the land of the outer ring rather than the raceway which is recessed in the outer ring. To facilitate the entry of the balls into the pockets during assembly the side faces of the projections may be relieved or curved.

The present invention also provides a rolling element bearing comprising inner and outer rings, balls disposed between the rings and engaging in raceways thereof to permit relative rotation and a cage with a main annular wall and a plurality of pockets of part-spherical shape in which the balls are received, the pockets each being formed between the main wall and a pair of prongs extending axially outwards from the main wall wherein at least some of the prongs are prolonged to each have an end projection not solely forming part of the pocket-defining surfaces and positioned between lands of the bearing rings beyond the balls associated therewith.

The invention may be understood more readily and various other features of the invention may become apparent from consideration of the following description.

In the accompanying drawings, Figures A and B show, respectively part of a typical prior art ball bearing in cross-section and part of a cage therefor.

The bearing shown in Figure A has an outer ring 1, an inner ring 2 and a plurality of balls 4 therebetween located and retained by a cage 3. As shown in Figure B, the cage 3 has a main wall 8 with a plurality of pockets each defined by a recess 5 in the wall 8 and by a pair of curvilinear short prongs 7 with ends 7a. During operation of the bearing the cage 3 tends to splay out from the normal position shown in full lines in Figure A to the new position shown in dotted lines. As can be appreciated under certain conditions the ends 7a of the prongs 7 can contact the track or raceway 1a of the ring 1. The cage 3 can thus become damaged or distorted. The damage or distortion of the cage 3 caused by the ends 7a contacting the raceway 1a causes the balls 4 to become loose and this aggravates the situation and may cause further permanent distortion or breakage of the cage 3. It is usual to manufacture cages 3 of the type described from a relatively soft, flexible, resilient synthetic plastics material, such as Nylon 66. This is generally desirable since the balls 4 can be then easily inserted into the pockets 5 by slightly deforming the prongs 7 apart. The inherent flexibility also enables the cage 3 to cope in general with misalignment and dynamic loads. Nevertheless with such materials, the problem caused by the splay of the cage 3 and the contact with the raceway 1a is additionally aggravated when heat is generated by the operation of the bearing since the heat causes softening of the plastics material. It has been found that even with a relatively low bearing speed of about 500 r.p.m., the splay of the cage 3 is significantly great to cause the problems discussed.

Embodiments of the invention will now be described, by way of examples only, with reference to the numbered figures of the accompanying drawings, in which:—

Figure 1 is a cross-section of part of a ball bearing corresponding to Figure A but employing a first form of cage made in accordance with the invention;

Figure 2 is a perspective view of part of the cage of the bearing of Figure 1;

Figure 3 is an elevation of part of the cage of Figure 2;

Figure 4 is an end elevation of a second form of cage made in accordance with the invention and suitable for use with the ball bearing of Figure 1;

Figure 5 is a section taken on the line A—A of Figure 4; and

Figure 6 is an end elevation of a third form of cage made in accordance with the invention and suitable for use with the ball bearing of Figure 1.

Figure 1 shows a ball bearing having an outer ring 11, an inner ring 12 and a plurality of balls 14 therebetween located and retained by a cage 13. The cage 13 can be moulded or machined from Nylon 66, for example. As shown in Figures 2 and 3 the cage 13 is of integral construction with a main wall 16 of annular shape and a plurality of spaced-apart pockets for receiving the balls 14. Each pocket is defined partly by the curved wall of a recess 15 in the main wall 16 and partly by continuations of the curved wall on the inner faces of a pair of prongs 17 extending axially outwardly from the main wall 16. In accordance with the invention the prongs 17 are modified to possess end portions or projections 18. The projections 18 are continuations of the prongs 17 and are slightly tapered to narrow in the direction outwardly from the main wall 16. For comparison purposes the normal end faces of conventional prongs (7 Figure B) are denoted with dotted lines X in Figure 3.

As shown in Figure 1, the projections 18 extend into the space between the lands 11*b* and 12*b* of the rings 11 and 12. Thus, when the cage 13 splays out during operation of the bearing it moves from the position shown in full lines in Figure 1 to the position shown in dotted lines. Thus the projections 18 tend to contact the land 11*b* of the outer ring 11 and there is no contact with the raceway 11*a* of the outer ring 11.

It will be readily apparent, by comparing Figures A and 1 that the cage 13 is subjected to considerably less splay than the standard prior art cage 3. This enables the cage 13 to be made from a soft and flexible plastics material such as Nylon 66 with its attendant advantages but mitigates the problem of early bearing failure arising from distortion of the cage 13.

Figures 4 and 5 show a modified form of cage 23 suitable for use in the ball bearing of Figure 1. In Figures 4 and 5 the prongs are denoted 27 and the projections are denoted 28. In contrast to Figures 2 and 3 the inner side faces 29 of the projections 28 are flat and are relieved at *a* so as to clear the diameter of the associated ball 14 (not shown). The ball can then snap into the pocket past the mouth *b* thereof.

Figure 6 depicts a further modified cage 33 where the projections are denoted 38. The cage 33 is similar to the cage 23 shown in Figures 4 and 5 except that the sides 39 of the projections 38 are curved instead of flat. This curving of the sides 39 ensures sufficient clearance with respect to the balls to enable the balls to snap into the pockets and is thus equivalent to the relieving *a* in Figure 5.

End seals are normally fitted to bearings to prevent the ingress of dust. However, these seals often have a much shorter life than that of the bearings themselves. Consequently, it often happens that a seal fails and dust enters the bearing causing bearing failure before the failure of the seal is noted. A further advantage of the cages provided with the projections 18, 28, and 38 is that they increase turbulence within the bearings and so help to sweep out any dust that might otherwise enter the bearing.

Another advantage of the cages provided with the projections 18, 28 and 38 is that the restricted splay permits the bearings employing such cages to operate at higher speeds than those filled with conventional cages.

WHAT WE CLAIM IS:—

1. A cage for use in a rolling element bearing; said cage comprising a main annular wall and a plurality of pockets of part-spherical shape for receiving balls acting as the rolling elements, each of the pockets being formed between the main wall and a pair of prongs extending axially outwards from the main wall, wherein at least some of the prongs each have an additional end projection not solely forming part of the pocket-defining surfaces and arranged when the cage is assembled in the bearing or in use to become disposed or positioned between corresponding lands of the bearing rings beyond the balls associated therewith.

2. A cage according to claim 1 wherein the projections form continuations of their associated prongs.

3. A cage according to claim 1, wherein the projections taper to narrow in a direction axially outwards from the main wall.

4. A cage according to claim 1, 2 or 3, wherein the projections have relieved flat side faces to facilitate the introduction of the balls into the pockets.

5. A cage according to claim 1, 2 or 3, wherein the projections have curved side faces to facilitate the introduction of the balls into the pockets.

6. A cage according to any one of claims 1 to 5, and moulded from a flexible resilient synthetic plastics material such as nylon 66.

7. A cage according to any one of claims 1 to 5, and machined from a flexible resilient synthetic plastics material such as Nylon 66.

8. A cage for use in a ball bearing of the type employing bearing rings with balls therebetween; said cage comprising a main annular wall, a plurality of part-spherical pockets spaced around the main wall for receiving and locating the balls, each of the pockets being defined partly by the main wall and partly by a pair of prongs extending generally axially outwards from said main wall, wherein each prong is formed with an additional projection remote from the main wall which does not solely form part of the associated pocket defining surfaces and is arranged such that when the cage is assembled in the bearing the projections extend beyond the balls to lie between the lands of the bearing rings to limit the splay of the cage when the bearing is in operation.

9. A cage for a rolling element bearing; the cage being substantially as described with reference to, and as illustrated in Figures 2 and 3 of the accompanying drawings, or Figures 2 and 3 as modified by Figures 4 and 5 or by Figure 6 of the accompanying drawings.

10. A rolling element bearing comprising inner and outer rings, balls disposed between the rings and engaging in raceways thereof to permit relative rotation and a cage with a main annular wall and a plurality of pockets of part-spherical shape in which the balls are received, the pockets each being formed between the main wall and a pair of prongs extending axially outwards from the main wall wherein at least some of the prongs are prolonged to each have an end projection not solely forming part of the pocket-defining surfaces and positioned between lands of

the bearing rings beyond the balls associated therewith.

11. A rolling element bearing substantially as described with reference to and as illustrated in any one or more of Figures 1 to 6 of the accompanying drawings.

BROOKES & MARTIN,
Chartered Patent Agents,
High Holborn House,
52/54 High Holborn,
London WC1V 6SE,
Agents for the Applicants.

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1594582 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

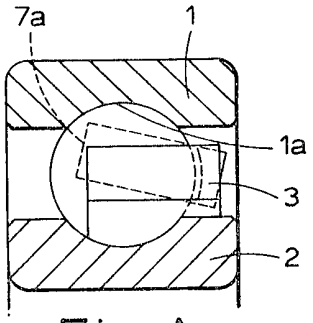

Fig. A.

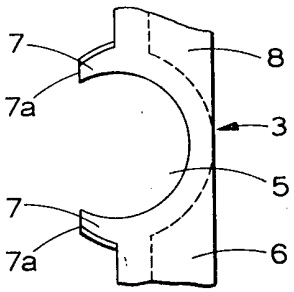

Fig. B.

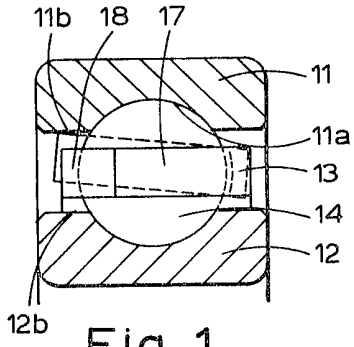

Fig. 1.

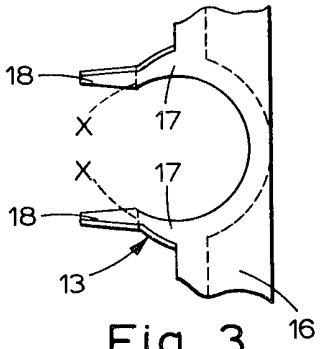

Fig. 3.

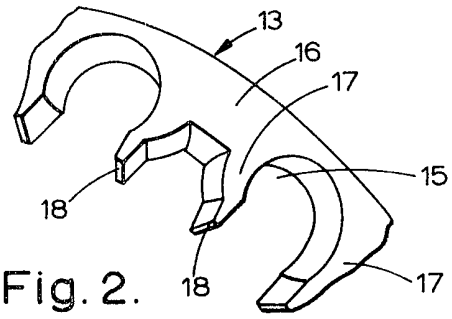

Fig. 2.

1594582 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

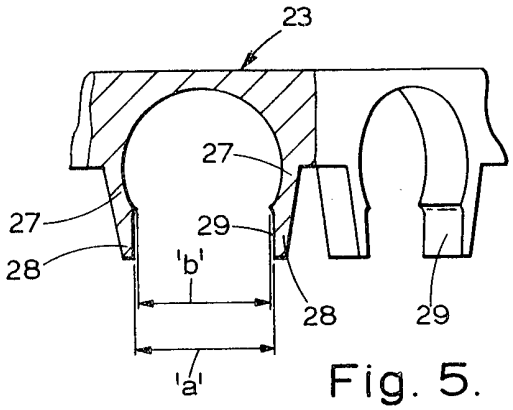

Fig. 5.

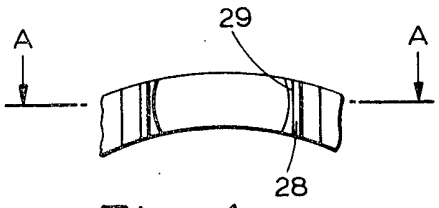

Fig. 4.

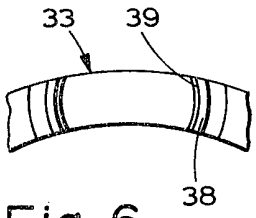

Fig. 6.