SEGMENTED ROLLING ELEMENT BEARING

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ABSTRACT

A rocker arm assembly including a rocker arm, a bearing support member, and a bearing assembly. The bearing assembly is supported on the support member and engages the rocker arm. The bearing assembly includes a race defining a raceway having a stop member coupled thereto, and a plurality of rolling elements positioned on the raceway such that the movement of the rolling elements on the raceway is limited by the stop member.
SEGMENTED ROLLING ELEMENT BEARING
CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Application No. 60/946,620 filed Jun. 27, 2007. The prior application listed in this paragraph is hereby incorporated by reference in its entirety.

BACKGROUND

[0002] The present invention relates to bearings.

SUMMARY

[0003] Rocker arms are one example of an application in which bearings are used to support an oscillating member. Typically, the bearings contain a full complement of rolling elements to support the oscillating member and to provide the desired anti-friction capabilities.

[0004] In one embodiment, the invention provides a rocker arm assembly that includes a rocker arm, a bearing support member, and a bearing assembly. The bearing assembly is supported on the bearing support member and engages the rocker arm. The bearing assembly includes a race defining a raceway having a stop member coupled thereto, and a plurality of rolling elements positioned on the raceway such that the movement of the rolling elements on the raceway is limited by the stop member.

[0005] The invention also provides a rocker arm assembly that includes a rocker arm, a bearing support member that has two support arms extending in opposite directions along an axis, and two bearing assemblies. One bearing assembly is supported on each support arm and engages the rocker arm. Each bearing assembly includes a cylindrical race defining a raceway and a plurality of rolling elements positioned on the raceway. The raceway has a stop member coupled thereto that defines an extent of travel of the rolling elements on the raceway that is less than three-hundred-sixty degrees.

[0006] The invention also provides a bearing assembly including a cylindrical race which contains a complement of rolling elements with a limited travel path. The number of rolling elements is chosen in order to be sufficient to support a generally unidirectional radial load. Less than a full complement of rolling elements is used, thereby reducing the number of rolling elements in comparison to typical prior art bearings used in similar applications, resulting in lower production costs and lower weight while still providing suitable anti-friction capabilities.

[0007] For convenience, a rocker arm will be described in the remainder of this application, though it is contemplated that such a roller bearing could be used for a wide range of other applications.

[0008] Other aspects of the invention will become apparent by consideration of the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a perspective view of a rocker arm assembly.
[0010] FIG. 2 is an exploded view of the rocker arm assembly of FIG. 1.
[0011] FIG. 3 is an exploded view of a bearing assembly.

[0012] FIG. 4 is a perspective view of the bearing assembly of FIG. 3.
[0013] FIG. 5 is a perspective view of the bearing assembly of FIG. 3.
[0014] FIG. 6 is a perspective view of the bearing assembly of FIG. 3 with the inner race removed.
[0015] FIG. 7 is a side view of the bearing assembly of FIG. 3 with the inner race removed.
[0016] FIG. 8 is an alternative embodiment of the bearing assembly of FIG. 7 with the inner race removed.

DETAILLED DESCRIPTION

[0017] Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of “including,” “comprising,” or “having” and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Unless specified or limited otherwise, the terms “mounted,” “connected,” “supported,” and “coupled” and variations thereof are used broadly and encompass both direct and indirect mountings, connections, supports, and couplings. Further, “connected” and “coupled” are not restricted to physical or mechanical connections or couplings.

[0018] Referring to FIGS. 1 and 2, a rocker arm assembly 1 is shown that includes a rocker arm 4, a bearing support member 8, and two bearing assemblies 10. Each bearing assembly 10 provides a rolling element bearing to be used in oscillatory applications. More specifically, the bearing assembly 10 is applicable to generally unidirectionally-loaded applications with an oscillatory motion, wherein the load can be supported by a partial annular complement (i.e., less than full complement) of rolling elements. In the illustrated embodiment, the bearing assemblies 10 are positioned between the rocker arm 4 and the bearing support member 8 such that the rocker arm 4 rotates with respect to the bearing support member 8. U.S. Pat. Nos. 5,437,209; 5,433,178; 5,329,891; 5,313,916; 5,297,509; 5,195,475; Re. 33,870; 5,074,261; and 4,314,731 illustrate rocker arms in which the bearing assembly of the present application can be used. Specifically, U.S. Pat. No. 5,329,891 discloses the rocker arm 4 and bearing support member 8 illustrated in FIGS. 1 and 2. The entire contents of these patents are hereby incorporated by reference.

[0019] Both the bearing assemblies 10 shown in FIGS. 1 and 2 are substantially similar and therefore, only one bearing assembly 10 will be discussed in detail with respect to FIG. 3. The bearing assembly 10 includes an outer ring or race 20 defining an outer raceway 21 (see FIGS. 6 and 7) that contains the partial annular complement of rolling elements 23. The partial annular complement of rolling elements 23 could range from a few rolling elements 23 in a narrow circumferential segment to a compleent where the segment of rolling elements 23 extends beyond 200 degrees and further to nearly 360 degrees depending on the specific application. For example, a rocker arm may see about 20 degrees of oscillation and the complement of rolling elements 23 can be sized accordingly.
The illustrated outer race 20 is substantially cylindrical and cup-shaped, and includes a shaped opening 25 (e.g., generally D-shaped) operable to receive a like shaped protrusion or support arm 26 of the bearing support member 8 (see FIG. 2). In the illustrated embodiment, the bearing support member 8 includes two support arms 26 that extend in opposite directions along an axis A-A (see FIG. 2). The specific shape of the shaped opening 25 depicted in FIGS. 1-7 is not limiting and one skilled in the art would recognize the shaped opening 25 could be shaped or configured to receive a number of different protrusions, shafts, or load bearing member profiles. The cup-shape of the outer race 20 helps to axially constrain the rolling elements 23 within the outer race 20 in one direction.

FIG. 3 also illustrates an inner ring or race 28 positioned within the outer race 20 to define an inner raceway 30 for the rolling elements 23. The illustrated inner race 28 includes a flange 32 to axially constrain the rolling elements 23 in a second direction.

In the illustrated embodiment, the outer raceway 21 includes at least one stop member 22 coupled thereto, located in the rolling element 23 pathway, and operable to limit the extent of travel of the rolling elements 23 along the outer raceway 21. FIGS. 3-7 show multiple stop members 22a-c. The stop members 22a and 22b have the multiple functions of limiting the circumferential travel or movement of the rolling elements 23 in the load zone, and centering the support arm 26 or shaft (via the centering of the inner race 28) within the outer race 20, thereby constraining the rolling elements 23 in a radial direction during a free-state and/or assembled state before an application load is applied. The stop member 22c also helps center support arm 26, the inner race 28, or the shaft during a free-state and/or assembled state before an application load is applied. With regard to this application, the centering of the inner race 28 does not necessarily indicate maintaining the inner race 28 axially aligned with the outer race 20. For example, the stop member 22c limits the extent to which the inner race 28 may move in the vertical direction (as viewed in FIG. 7) such that the bearing assembly 10 is held together as a unit while the bearing assembly 10 is not assembled with the rocker arm assembly 1, and the rolling elements 23 are held within the bearing assembly 10 by the flange 32. In other embodiments, the inner race 28 may be substantially axially aligned with the outer race 20 at all times.

In the illustrated embodiment, the stop members 22a and 22b define therebetween an included angle, in which the rollers are located, of about two-hundred degrees. Based on the illustrated diameter of the rollers, the number of rollers used, and the diameters of the raceways 21 and 30, this correlates to between about eighteen and about twenty degrees (18.8 degrees as illustrated) of possible oscillation of the outer race 20 relative to the inner race 28. In other embodiments, the included angle may be between two-hundred and two-hundred-twenty degrees. In yet other embodiments, the included angle can be any desired angle such that the extent of travel of the rollers around the raceways 21 and 30 is less than three-hundred-sixty degrees to achieve the desired oscillation capabilities.

The outer race 20 can be manufactured in a variety of ways including machining, forming or drawing to produce the general configuration shown in FIGS. 3-7. The stop members 22a-c, though shown as generally semi-cylindrical projections or protrusions, are not limited as to their shape, size, number, or location. Furthermore, the stop members 22a-c may be integrally formed as a single piece with the outer race 20 as shown, or attached as a separate piece or pieces. Alternatively, the stop members 22 can be coupled to the raceway 30 of the inner race 28. For example, FIG. 8 illustrates an alternative bearing assembly embodiment 10', wherein like parts are given like reference numbers designated as prime ('). As shown in FIG. 8, the stop members 22a-c are replaced with a single stop member 22d in the form of a plug or insert that is a separate piece coupled to the raceway 21. Those skilled in the art will understand that the plug 22d can be sized to define any desired included angle for the roller pathway between its distal ends. Likewise, the plug 22d could alternatively be secured to the inner raceway 30.

The invention is not limited to cylindrical raceways and could be practiced with a radial segment of race that is less than 360 degrees. Also, FIGS. 3-7 show cylindrical rolling elements 23 but the concept could easily be used with spherical rolling elements (e.g. balls) or other rolling element types not listed. Alternative embodiments of the present invention could eliminate the inner race 28 to receive a shaft or the support arm 26 in direct contact with the roller elements 23. This embodiment would look similar to the arrangement shown in FIGS. 6 and 7.

Thus, the invention provides, among other things, a bearing assembly capable of supporting a unidirectional oscillatory load with a less than full annular complement of rolling elements contained by at least one stopping element or member coupled to a race.

Various features and advantages of the invention are set forth in the following claims.

What is claimed is:
1. A rocker arm assembly comprising:
a rocker arm;
a bearing support member; and
a bearing assembly supported on the bearing support member and engaging the rocker arm, the bearing assembly including:
a race defining a raceway, the raceway having a stop member coupled thereto; and
a plurality of rolling elements positioned on the raceway such that the movement of the rolling elements on the raceway is limited by the stop member.
2. The rocker arm assembly of claim 1, wherein the bearing assembly further comprises a second race, the plurality of rolling elements positioned between the two races.
3. The rocker arm assembly of claim 1, wherein the stop member is positioned and configured to center the bearing support member with respect to the first race.
4. The rocker arm assembly of claim 1, wherein the bearing assembly further comprises a second stop member coupled to the raceway, positioned and configured to center the bearing support member with respect to the first race.
5. The rocker arm assembly of claim 1, wherein the stop member is integrally formed with the race.
6. The rocker arm assembly of claim 5, wherein the stop member is a projection formed in the raceway.
7. The rocker arm assembly of claim 1, wherein the stop member is a plug secured to the raceway.
8. The rocker arm assembly of claim 1, wherein the bearing assembly further comprises a second stop member, the first and second stop members defining extents of travel of the rolling elements positioned therebetween.
9. The rocker arm assembly of claim 8, wherein the first stop member and the second stop member define an included angle of between about 200 degrees and about 220 degrees to limit the extent of travel of the rolling elements around the raceway.

10. The rocker arm assembly of claim 1, wherein the race is substantially cup-shaped.

11. The rocker arm assembly of claim 1, wherein the plurality of rolling elements is less than a full complement of rolling elements relative to the raceway.

12. The rocker arm assembly of claim 1, wherein the bearing support member includes two support arms extending in opposite directions along an axis, and wherein the rocker arm assembly includes two bearing assemblies, one bearing assembly on each support arm.

13. A rocker arm assembly comprising:
   a rocker arm;
   a bearing support member having two support arms extending in opposite directions along an axis; and
   two bearing assemblies, one bearing assembly on each support arm and engaging the rocker arm, each bearing assembly including:
   a cylindrical race defining a raceway, the raceway having a stop member coupled thereto; and
   a plurality of rolling elements positioned on the raceway;
   wherein the stop member defines an extent of travel of the rolling elements on the raceway that is less than three-hundred-sixty degrees.

14. A bearing assembly comprising:
   a cylindrical race defining a raceway, the raceway having a stop member coupled thereto; and
   a plurality of rolling elements positioned on the raceway such that the movement of the rolling elements on the raceway is limited by the stop member.

15. The bearing assembly of claim 14, further comprising a second race, the plurality of rolling elements positioned between the two races.

16. The bearing assembly of claim 15, wherein the stop member is positioned and configured to center the second race with respect to the first race.

17. The bearing assembly of claim 15, wherein the raceway includes a second stop member coupled thereto, positioned and configured to center the second race with respect to the first race.

18. The bearing assembly of claim 14, wherein the stop member is integrally formed with the race.

19. The bearing assembly of claim 18, wherein the stop member is a projection formed in the raceway.

20. The bearing assembly of claim 14, wherein the stop member is a plug secured to the raceway.

21. The bearing assembly of claim 14, further comprising a second stop member, the first and second stop members defining the extents of travel of the rolling elements positioned therebetween.

22. The bearing assembly of claim 21, wherein the first stop member and the second stop member define an included angle of between about 200 degrees and about 220 degrees to limit the extent of travel of the rolling elements around the raceway.

23. The bearing assembly of claim 14, wherein the race is substantially cup-shaped.

24. The bearing assembly of claim 14, wherein the plurality of rolling elements is less than a full complement of rolling elements relative to the raceway.

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