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#### (54) LINEAR RECIRCULATING BALL BEARING

(71) We, SKF INDUSTRIAL TRADING & DEVELOPMENT COMPANY B.V. a Company organised and existing under the laws of the Kingdom of the Netherlands, P.O. Box 50, Nieuwegein, the Netherlands, 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:-  
 This invention concerns a linear recirculating ball bearing.

The invention provides a linear recirculating ball bearing comprising a sleeve, a cage disposed within the sleeve and defining therewith a plurality of endless paths, and each path accommodating a plurality of balls for recirculation in each path between a first longitudinally extending portion in which, in use of the bearing, the balls are subject to radial loads, and a second longitudinally extending portion in which, in use of the bearing, the balls are not subject to radial loads, the sleeve having a plurality of longitudinally extending recesses in its bore one for the said second portion of each path, each recess in a section plane perpendicular to the longitudinal axis of the bearing have two side walls extending radially outwardly and converging to an apex, one side wall being longer than the other, the longer side wall of the recess for each path extending from the apex to the said first portion of that path, and the longer side wall or a plane tangential to it forming an included angle of less than 90° with a plane including the longitudinal axis of the bearing and passing through the centres of the balls in the first portion of that path. The included angle may be in the range of from 80 to 85°.

The said longer side or a plane tangential to it may be at a tangent to the balls in the first portion of the path.

In a section plane perpendicular to the longitudinal axis of the bearing, and for the

first longitudinally extending portion of each path, the sleeve may have a projection, extending radially inwardly beyond the longer side for that path.

Embodiments of the invention will be described by way of example reference being made to the accompanying drawings of which:-

*Figure 1* is a cross-section through a linear recirculating ball bearing in accordance with prior art;

*Figure 2* is a cross-section through an embodiment of a linear recirculating ball bearing according to the invention;

*Figure 3* is a longitudinal section through the bearing of *Figure 2*; and

*Figure 4* is a cross-section through a part of another embodiment according to the invention on an enlarged scale.

This invention is concerned with a linear recirculating ball bearing have a sleeve, a cage disposed within the sleeve and defining therewith a plurality of endless paths, and each path accommodating a plurality of balls for recirculation in each path between a first longitudinally extending portion in which, in use of the bearing, the balls are subject to load, and a second longitudinally extending portion in which, in use of the bearing, the balls are not subject to load. The two longitudinally extending portions of each path are interconnected by reversal portions one at each end.

In the embodiment shown in *Figure 1* which is disclosed by the prior art, a sleeve 1 has a hexagonal cross-section bore 2. Balls 4, in the first longitudinally extending portions of the paths are guided in a cage 3 and bear on the shaft 5 and on the flat surfaces 6 of the sleeve. The surfaces 6 are at right angles to the plane A-A which includes the longitudinal axis of the bearing and extends through the centre of the balls 4. At each intersection between two surfaces 6 is a second longitudinally extending portion of

the paths 7 for the balls. Annular grooves 9 are machined into the external surface 8 of the sleeve for accommodating circlips (not shown). The distance "a" between the base of the second portion of each path and the

5 base of the annular groove 9 is very small in relation to the wall thickness of the sleeve 1.

In the embodiment according to the invention shown in Figures 2 and 3, the sleeve 1 has a plurality of longitudinally extending recesses in its bore 2 one for the second portion of each path in which are balls 4'. Each recess in a section plane perpendicular to the longitudinal axis of the bearing has two side walls 10 and 11 which extend radially outwardly and converge to an apex. The longer side wall 10 of each recess is formed by a straight line which includes an angle  $\alpha$  of less than  $90^\circ$  with respect to the plane A-A including the longitudinal axis of the bearing and extending through the centre of the loaded balls 4. The distance "a" between the apex of the recess and the base of the groove 9 is substantially greater than that according to Figure 1, given the same dimensional conditions as Figure 1. (The broken line in Figure 2 indicates the corresponding surface according to Figure 1). Balls may therefore be used which are larger than those in the embodiment illustrated in Figure 1 but without resulting in any greater weakening of the wall of sleeve 1. The use of larger balls enables the load borne by the recirculating ball mechanism to be substantially increased.

The number of paths may be increased over the embodiment of Figure 1 a feature which also allows an increase in the load borne. An additional row of balls is provided in Figure 2 compared to Figure 1 although the dimensions of each row of balls are not changed.

In the embodiment shown in Figure 4, the longer side 10 of the recess is formed by a curve. In its entirety, the side is situated within a tangent 12 which includes an angle  $\alpha$  less than  $90^\circ$  with the plane A-A extending through the centre of the balls 4. Advantageously, the angle  $\alpha$  is in the range of from 80 to  $85^\circ$ .

The sleeve can be produced in a simple manner from a correspondingly sectioned extruded tube but may of course be produced by profiling the bore of a cylindrical tube by chip-forming methods. The first portion of each path can be constructed as a projection which extends radially inwardly and slightly beyond the longer side to the interior. Any known cage of sheet metal or plastics can be employed and can be purely cylindrical on the exterior or the external shape can be adapted to the internal shape of the sleeve. To prevent rotation when using cages with a cylindrical exterior, pro-

jections should be provided on the exterior of the cage engaging in corresponding recesses in the bore of the sleeve or bearing against a corresponding projection or an edge.

#### WHAT WE CLAIM IS:-

1. A linear recirculating ball bearing comprising a sleeve, a cage disposed within the sleeve and defining therewith a plurality of endless paths, and each path accommodating a plurality of balls for recirculation in each path between a first longitudinally extending portion in which, in use of the bearing, the balls are subject to radial loads, and a second longitudinally extending portion in which, in use of the bearing, the balls are not subject to radial loads, the sleeve having a plurality of longitudinally extending recesses in its bore one for the said second portion of each path, each recess in a section plane perpendicular to the longitudinal axis of the bearing having two side walls extending radially outwardly and converging to an apex, one side wall being longer than the other, the longer side wall of the recess for each path extending from the apex to the said first portion of that path, and the longer side wall or a plane tangential to it forming an included angle of less than  $90^\circ$  with a plane including the longitudinal axis of the bearing and passing through the centres of the balls in the first portion of that path.

2. A bearing as claimed in claim 1, wherein the included angle is in the range of from 80 to  $85^\circ$ .

3. A bearing as claimed in claim 1 or 2, wherein the said longer side or a plane tangential to it is at a tangent to the balls in the first portion of the path.

4. A bearing as claimed in claims 1, 2 or 3, wherein a section plane perpendicular to the longitudinal axis of the bearing, and for the first longitudinally extending portion of each path, the sleeve has a projection, extending radially inwardly beyond the longer side for that path.

5. A linear recirculating ball bearing substantially as herein described with reference to and as shown in Figures 2 and 3 or with reference to and as shown in Figure 4 of the accompanying drawings.

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FIG.1

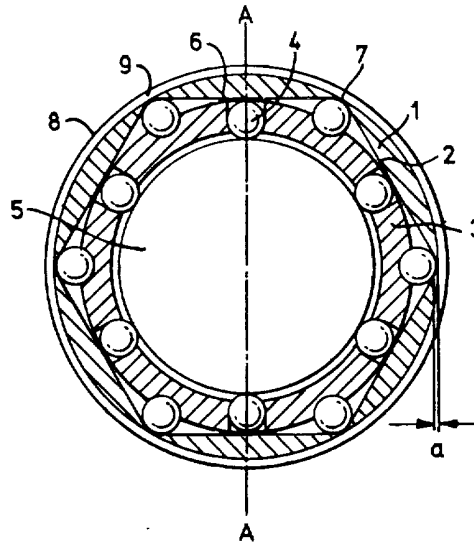


FIG.2

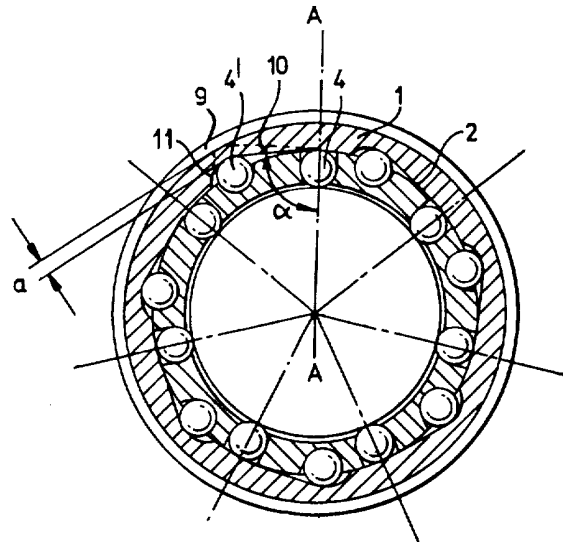


FIG. 3

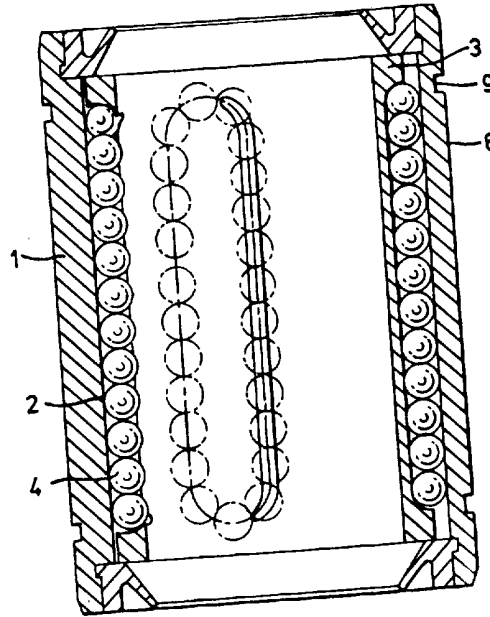


FIG. 4

