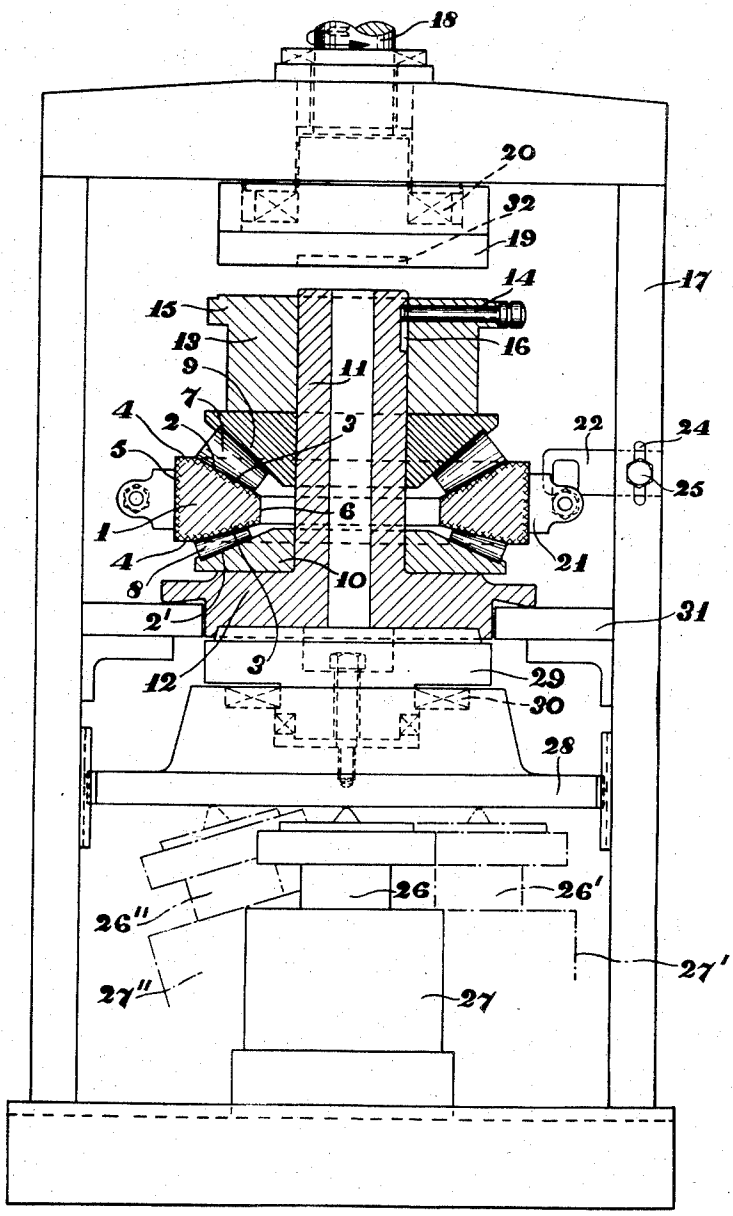
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MANUFACTURE OF RACE MEMBERS OF ROLLER AND BALL BEARINGS

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MANUFACTURE OF RACE MEMBERS OF ROLLER AND BALL BEARINGS

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The invention relates to the manufacture of the race members of roller and ball bearings, and it has for its object the inhibition of their permanent distortion under working conditions.

The usual method of manufacture of such components consists of grinding to finished dimensions steel rings which have been previously soft formed and then hardened on the working surfaces by suitable heat treatment. Such grinding may be done in one or several operations, and a commonly used method is to employ a first or so-called rough grinding sequence which removes the major part of the grinding allowance on the ring, followed by a final grinding sequence which has for its object the production of the desired finished dimensions with the minimum possible removal of material from the various surfaces. These two sequences may be combined in one or they may involve several separate grinding operations, and it is also well known practice sometimes to interpose at some suitable stage between the first and final grinding operations, some form of stabilising treatment, such as low temperature heat treatment or freezing treatment, or both, which has for its object the relieving of stresses which may have been induced in the ring by the previous grinding operations. It is common experience that the components of bearings which have been manufactured by such known methods may take a permanent set under working conditions to such a degree that the bearing becomes unfit for further service long before the working surfaces of the components have otherwise suffered any serious damage or deterioration.

This invention concerns a novel sequence of operations involving mechanical pre-stressing of the bearing rings, in combination with grinding, which results in finished race members that can withstand the service for which they are designed without suffering permanent distortions.

According to the invention, a method of processing a race member of a roller or ball bearing comprises the steps of soft forming and heat treating the member to produce a hardened working surface or surfaces, rough grinding the said member, part-finish grinding the member to leave the latter of an over-finished size with sufficient excess material on the working surface or surfaces to allow for subsequent removal of superficial distortions, mechanically pre-stressing the member to cause a permanent set to occur therein, and completing the finish grinding of the member so as to remove superficial distortions created by the permanent set, thereby producing a finished race member of the correct dimensions but in a pre-stressed condition.

The mechanical pre-stressing of the race member may conveniently be effected by the use of slave rollers or balls which are caused to roll under load around a working surface of the member under conditions simulating actual working conditions.

By the use of the present invention the range of pressure which a bearing race member can sustain elastically is extended by building up in it residual stresses as a result of plastic deformation, this result being obtained by introducing into the final grinding operation the step of mechanically stressing the race member to cause a permanent set to occur therein.

Thus, in place of the usual final grinding operation, the following sequence is carried out:

First, a final grinding is given to all those surfaces in which the effect of the subsequent permanent set can be neglected, such as the surfaces which are not track surfaces and which do not require an accurate finish; but all other surfaces, such as track and housing-fitting surfaces, from which it is desired to elimniate distortions due to the permanent set, are only partially finish ground so that they are left of an over-finished size, the excess-size allowance being sufficient to enable superficial distortions to be ground out by a finish grinding operation.

Secondly, a mechancal pre-stressing is applied to the race member so as to produce a permanent set, as, for example in the manner hereinafter more fully described.

Thirdly, a finish grinding is given to the over-size surfaces so as to remove therefrom the superficial distortions created by the permanent set, thus leaving a finished race member of the correct dimensions but in a mechanically pre-stressed condition.

The mechanical stressing operation is conveniently effected by applying a load to the working tracks of the partially finished race member through slave rollers or balls which are caused to roll around the tracks in a way similar to that followed by the rolling elements of the finished bearing. The load applied must be not less than the highest load that the componet is designed to withstand in service, and is also so determined that in its nature and direction it corresponds to the working conditions which the bearing must meet. This applied load may be continuous or pulsating in character, and applied in any appropriate direction; all as may be necessitated in order to simulate actual working conditions.

When this load is applied, the ring distorts and takes a permanent set. The load is maintained for a time sufficient to ensure that all the permanent set develops which can be engendered by the particular applied load. This permanent set creates distortions in the ground surfaces which are partly finished, and these distortions are then eliminated by the final finish grinding operation.

The accompanying drawing is a sectional view through a convenient form of appliance whereby the required mechanical pre-stressing can be applied, according to the invention, to a race ring, having two track surfaces, for use in a tapered-roller bearing. In this drawing the race ring to be treated is indicated at **1** and is carried in a split housing **21**. The race ring **1** has two conical race surfaces **2**, **2'**, at opposite sides. The over-size surface portions left after the partial finish grinding are indicated by criss-cross hatching at **3**, **3**, **4**, **4**, and **5** whilst the inner peripheral surface at **6**, which does not require an accurate finish, has had a final grinding prior to pre-stressing of the ring.

The pre-stressing of the race ring **1** is effected by means of two rows of tapered slave rollers **7**, **8**, applied to the respective track surfaces **2**, **2'**, and engaged by the conical surfaces of slave race rings **9**, **10**, respectively.

The slave race rings **9**, **10**, are fitted and located around a cylindrical inner member **11** of the pre-stressing appliances shown in the drawing, the lower ring **10** being supported upon a base shoulder or flange **12** carried by the member **11**. Fitted over the said inner member **11** is an outer cylindrical member **13** the lower end of which engages the upper slave race ring

9. The two members 11, 13, are coupled together for collective rotation or oscillation, as by means of a locking pin 14 carried by a top flange 15 of the outer member and engaging a slot 16 in the inner member, the length of the slot being such that a limited relative axial movement is permitted between the members 11, 13.

The members 11, 12 and 13 are mounted in a stationary frame or fixture 17 and rotation or oscillation can be applied to the outer member 13 through the medium of a driven shaft 18 and friction pad 19 thereon, a bearing 20 being provided between said pad and the top of the frame. By reason of the locking pin 14, rotation or oscillation is also imparted to the inner member 11. Axial load is applied to the inner member 11, 12, during its rotation, by means of hydraulic pressure applied to its underside by a ram 26 in a hydraulic cylinder 27 acting upon a slidably-guided member 28 between which, and a member 29 engaging the inner member 11, 12, bearings 30 are interposed. The hydraulic cylinder and ram can be adjusted into different positions and may either be centrally disposed, as shown by full lines, or shifted to one side, as shown by dotted lines at 26', 27', or tilted as shown by dotted lines 26'', 27''. By adjusting the cylinder and ram to one or other of these positions the load may be applied centrally or eccentrically or at any desired angle, in order best to simulate working conditions. Normally the inner member 11, 12, rests on a support 31, but when the hydraulic pressure is applied the whole assembly carried on said member is raised by the ram, and the top face of the outer member 13 comes into contact with the pressure pad 19, the top end of the inner member 11 entering a recess 32 therein. Due to the applied load a slight relative axial movement will take place between members 11, 13, this being permitted by the slot 16. When the pad 19 is rotated or oscillated, the slave race rings 9, 10, are rotated and the slave rollers 7, 8, caused to roll under load around the respective track surfaces 2, 2', of the stationary bearing member 1, thereby stressing the said member, the load being maintained until a permanent set develops, so that the member then has built up in it residual stresses as a result of the plastic deformation.

When the assembly, including the race ring 1, has been raised by the hydraulic ram, and the member 13 has been lifted into contact with the pad 19, the one side of the split race-ring housing 21 moves into engagement with an arm 22 secured to the frame 17 by a clamping screw 25 in a slot 24 in the frame, so that the housing 21 and race ring 1 are prevented from turning during rotation of the members 11, 12, 13 and the slave race rings 9, 10. The arm 22 can engage a portion of the housing 21 to act as a stop in the vertical direction and cause a tendency for the race-ring 1 to tilt, enabling a greater load to be applied to one side of the circumference of the ring 1 than to the other. The position of the arm may be varied by adjusting the screw 25 in the slot 24; and, if desired, a portion of the arm may be bevelled to co-operate with the housing 21 in order to exert a lateral reaction on the latter and on the race ring. An arm similar to arm 22 may be employed also at the opposite side of the frame, and when the motion of the housing is oscillatory these arms are arranged to engage the housing to prevent rotation in both directions.

After pre-stressing the member 1, as above described, until a permanent set is produced, the over-size portions 3, 4, 5, of the member are finish ground so as to remove

the superficial distortions created by the permanent set and produce a finished bearing member of the correct dimensions.

To pre-stress a race ring with only one track instead of two as shown at 1, two such rings are substituted for the two-track ring 1. In this case the split housing 21 is designed to accommodate two rings instead of one.

In a modification, a converse arrangement of the bearing race member 1 and slave race rings 9, 10, may be employed. Thus, the ring marked 1 may be a slave race ring, and the rings 9, 10, may be the actual bearing race rings to be pre-stressed.

I claim:

1. A method of processing a race member of a roller or ball bearing comprising the successive steps of forming and heat treating the said member to produce a hardened working surface, rough grinding the said member, part-finish grinding the member to leave the same of an over-finished size with sufficient excess material on the working surface to allow for subsequent removal of superficial distortions, applying to the oversize race member while in a cold state by slave rolling a load having substantially greater pressure than the maximum load to which the race member is designed to withstand in use and under conditions simulating actual working conditions so as to pre-stress and plastically deform the member beyond its elastic limit to cause a permanent set to occur therein, and completing the finish grinding of the member so as to remove superficial distortions created by the permanent set, thereby producing a finished race member of the correct dimensions but in a pre-stressed condition.

2. A method in accordance with claim 1, wherein the step of mechanically pre-stressing the member to cause a permanent set therein is carried out by the use of slave rolling members which are caused to roll under load around the working surface of the member under conditions simulating actual working conditions.

3. A method in accordance with claim 1, wherein the step of mechanically pre-stressing the member to cause a permanent set therein is carried out by the use of slave rolling members which are caused to roll around the working surface of the bearing race member by the application thereto, under load, of at least one slave race member between which and the bearing race member relative rotation is created.

4. A method of processing a roller or ball bearing race member having working surfaces on opposite sides, in accordance with claim ?, wherein the mechanical pre-stressing of the race member is effected by mounting and holding the latter between two rows of slave rolling members, one applied to each working surface, and each row engaged by a slave race member, the two slave race members being rotated whilst an axial load is applied to them.

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