

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN OR RELATING TO A TAPERED ROLLER BEARING ASSEMBLY

(71) We, WALDES KOHINOOR, INCORPORATION, 47—16 Austel Place, Long Island City 1, New York 11101, United States of America, a corporation organized and existing under the laws of the State of New York, United States of America, 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 improvements in a tapered roller bearing assembly.

It is well known to those skilled in the art that to get maximum bearing life from bearings, and particularly tapered roller bearings comprising axially-spaced sets of oppositely tapered roller bearings in which correspondingly axially-spaced stepped diameter shaft portions are journaled, as are used in many and varied shaft applications, it is necessary to have an accurate bearing setting. That is to say, tapered roller bearings set without proper running clearance, either too tight or too loose, between the outer-end face thereof and such bearing retention means as is employed, will not give the life that was designed into them. Conversely, proper bearing setting insures equal load distribution over all the work bearing surfaces and hence makes for longer bearing life.

In the past, the setting of tapered roller bearing on shafts was considered to be a job to be undertaken only by experienced personnel employing special measuring devices designed to insure accurate setting, and thus accurate initial setting, and subsequent resettings of such bearings on the journal portion of a shaft as might be required in the field was very difficult if not altogether impossible of attainment.

More recently, however, it became more or less standard practice in the art to effect the mounting of tapered roller bearings on a shaft and at the same time to achieve accurate setting thereof by providing the shaft with a reduced-diameter, outer-end length portion

which is separated from the journal portion thereof on which the bearing is directly mounted by a rectangular shoulder disposed at a distance outwardly from an inner reference shoulder, usually also provided on the shaft to define the innermost line of the bearing sets, which is greater than the overall width of the bearing by the small amount which exactly equals the running clearance to be provided the bearing according to the particular design requirements of the installation. A thread cut in the peripheral surface of said reduced-diameter outer-end portion of the shaft for the length thereof provides for the threading thereon of a self-locking nut which is run squarely up against the aforesaid outer shoulder, thus to provide not only a bearing retention means but also a shoulder so located as to provide the proper running clearance between the outer-end face of the bearing and said retention means (screw-on nut).

According to the present invention, there is provided an assembly comprising tapered roller bearings mounted on a shaft provided with a conventional journal portion terminating in an outer shoulder and a reduced-diameter outer-end portion which extends outwardly beyond said shoulder, a washer mounted on said reduced-diameter outer-end portion of the shaft and operative when held in abutting engagement against said shoulder to form a bearing-retention shoulder so disposed axially with respect to the retained bearing as to establish a predetermined clearance between the outer end face of the bearing inner race and the inner face of said washer means; and a spring ring mounted on said reduced-diameter outer end of said shaft outwardly of said washer for holding said washer in abutting engagement with said outer shaft shoulder.

Preferably, the washer comprises a stamping of annular shape fashioned from sheet metal, said stamping being provided with a circular central opening of which the diameter is slightly greater than that of the shaft outer-end portion, whereby it may be assembled and posi-

tioned thereon by being slipped over said outer-end portion and shifted axially therealong to its shoulder-abutting position as aforesaid.

- 5 Advantageously, the spring ring comprises a bevelled spring ring assembled in stressed condition in a circumferential groove provided therefor in the peripheral surface of said outer-end shaft portion outwardly of said shaft
10 shoulder, said spring ring being so arranged that in tending to return to its unstressed condition it is operative to exert inward axial force on the outer face of said washer of such magnitude as to hold said washer in forceful
15 abutting engagement against said shoulder.

- Expediently, the circumferential groove is defined in part by side walls and one of said side walls has an inclination complementary to that of the bevel of said spring ring, said one
20 side wall co-operating with said bevel in rendering said spring ring operative to exert inward force on the outer face of the washer as aforesaid.

- Embodiments of the invention will now be more particularly described with reference to the accompanying drawings, in which

- Fig. 1 shows a side elevational view, partially in section, of a tapered roller bearing mounted on a shaft and retained thereon by means of a retaining assembly according to the prior art;

- Fig. 2 shows a side elevational view, partly in section, of a tapered roller bearing assembly embodying the present invention;

- 35 Fig. 3 shows a front-end elevational view of the mounted tapered roller bearing assembly shown in Figure 2;

- Fig. 4 shows an enlarged fragmentary view, partly in section, taken along line 4—4 of Figure 3;

- 40 Fig. 5 shows a front elevation looking on to a bevelled spring ring component of roller bearing retention means employed in Figs. 2 to 4;

- 45 Fig. 6 shows an enlarged section taken on line 5—5 of Fig. 5;

- 50 Figs. 7A and 7B show front elevation and vertical sections, respectively, of a washer component of the bearing retention means employed in Figs. 2—4;

- Fig. 8 shows a part-sectional view similar to Fig. 4 but employing an alternative modified configuration of the washer component and shaft end portion, and

- 55 Fig. 9 shows a front elevation of the modified washer component employed in the bearing mounting assembly of Fig. 8.

- For a proper understanding of the means for mounting and retaining tapered roller bearings in an assembly embodying the present invention, such will be compared with the previously known assembly shown in Figure 1. More particularly, reference numeral 10 (Figure 1) designates the bearing-journale
60 end of a shaft which extends into a hollow
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housing 12, which includes axially spaced, stepped-diameter journal portions 14 and 16 interconnected by a tapered portion 18. The stepped-diameter journal portions 14 and 16 are journaled for relative rotation in the inner races of correspondingly spaced, tapered roller bearing sets, generally designated by the reference numerals 20 and 22, the outer races of which are a press fit in respective bore-wall surfaces of the housing 12.

The shaft 10 is provided at its relatively outer end with a reduced-diameter end portion 24, the reduction in diameter of which results in the formation of an outer rectangular shoulder 26 which, as previously explained, is so located along the length of the shaft that, when bearing retention means operating as a shoulder is positioned square against same, proper running clearance for the tapered roller bearing assembly is also insured. Also, as earlier stated, the bearing retention means employed in the prior-art bearing mounting means shown in Figure 1 comprises a lock nut 28 which is threaded on to the reduced diameter end of the shaft (for which purpose said shaft end is provided with screw threads throughout substantially its full length) to a position in which it is disposed tight and square against said shoulder 26.

From the description up to this point, it will be seen that the present method of mounting a tapered roller bearing on the outer-end journal portion of a shaft, axle and the like requires the provision of an exteriorly threaded, reduced-end portion of substantial axial length at the extreme outer end of said shaft, plus the provision of bearing retention means in the form of a lock nut which must be carefully threaded thereon to prevent cross-threading of the threads of each and thereafter run up square and wrenched tight against the outer shoulder 26 of the shaft.

As distinguished therefrom, the tapered roller bearing assembly embodying the present invention substitutes for the threaded-on lock nut of the previously known bearing mounting means just described a simple sheet-metal washer capable of being readily slipped over the reduced-diameter end of the shaft 24a and thereupon of being merely pushed axially therealong into engagement with a shaft shoulder corresponding in all respects to the aforementioned shoulder 26, against which it is thereafter positively held by the biasing action exerted thereon in axial inward direction by a beveled spring ring of the type disclosed in United Kingdom Patent No. 619,078 which is sprung into a groove cut or otherwise machined in the reduced-diameter end of the shaft just outwardly of the so-positioned washer.

More particularly, and as depicted in Figs. 2—4 inclusive, illustrative of a bearing retained on a shaft in accurately set position by retention means embodying the present in-

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vention, the details of which are illustrated in Figure 5—7B inclusive, such retention means comprises a plain sheet-metal wash 30 (Figure 7A), whose central opening as defined by its inner circular edge 32a has a diameter slightly greater than that of the diameter of the reduced-diameter end of the shaft, whereby it can be readily slipped over said end and shifted axially therealong to a position in which it abuts the aforesaid shaft shoulder 26, and whose outer diameter is substantially greater than that of the diameter of the journal portion 16 of said shaft, whereby its outer rim or edge portion 32b projects radially beyond said journal portion, thus to form a shoulder thereon.

The washer 30 is positively held against the shaft shoulder 26 by force exerted thereon in an axial direction by a bevelled spring ring 34 sprung into a circumferential groove 36 provided therefor in the peripheral surface of the reduced-diameter outer-end portion of the shaft at a location along the latter as insures tight interface engagement being established between the inner face of said ring 34 and the outer face of the washer 30.

As the structure and manner of functioning of a bevelled spring ring (as herein designated 34) when sprung into a shaft groove (as herein designated 36) are well known no detailed description thereof is believed necessary. Suffice it to say, that when said ring 34 is sprung into its groove, it is spread and thereby stressed, following which it tends to close circumferentially, i.e. to contract to its unstressed state. Being of so-called bevelled construction, said ring 34 is provided on its face which is remote or distant from the washer 30 and along its inner edge with an inclined surface 34a and the side wall 36a of the groove 36 against which said ring surface 34a engages is complementally inclined. Thus, any circumferential closing or contraction of the ring causes it to move in axial direction against the washer 30 with a force which, with proper design of the ring, can be of the magnitude to hold said washer tight against said shaft shoulder 26.

From the above, it will be appreciated that the spring ring and washer-type bearing retention means as aforesaid provides both a simple and practical means of mounting tapered roller bearings on shafts, as compared to the screw-on lock nut type of bearing retention means of the prior art. Further, and as noted in the foregoing, the spring ring and washer-type bearing retention means is also less costly than the prior screw-on lock nut means, since its employment requires a much shorter length of reduced-diameter shaft end than does said lock nut means and similarly requires no cutting of threads in the reduced-diameter end of the shaft. Yet another advantage of a tapered roller bearing assembly embodying the invention is that the washer which is employed in place of the threaded screw-on lock nut as pre-

viously used may be readily and inexpensively fabricated by stamping same in quantity from sheet-metal stock, and in this connection it is worthy of mention that tolerances in the thickness of said sheet-metal stock can be held to commercial sheet-metal tolerances since the bevelled spring ring which is used therewith in an embodiment of the invention is entirely capable of taking up the tolerances in washer thicknesses as well as in groove location.

Yet another practical feature of the tapered roller bearing assembly embodying the invention is that bevelled spring rings as used therein may be readily assembled and thereafter re-assembled in their grooves, being for this purpose provided with apertured ears with which the tips or points of the plier-type assembly and disassembly tools may be readily coupled. Accordingly, bearing retention means employing such a bevelled spring ring may be dis-assembled and re-assembled time after time even under field conditions, with assurance not only of adequate bearing retention but also of accurate bearing setting.

To provide for the condition of heavy loading which might cause undesirable rotation of the washer 30 and possibly also of the ring 34 with respect to the shaft or shaft end, the use of the somewhat modified configuration of shaft and washer inner edge of Figures 8 and 9 is suggested. According thereto, the reduced-diameter outer-end portion 24a of the shaft 10 is provided with a "flat" 40 and the washer 38 is provided along its inner edge with a matching "flat" designated 40a which extends as a chord across its otherwise circular inner edge. By the provision of these matching flats, said washer 38 is in effect keyed to the shaft end and is thus restrained against relative rotation with respect thereto. Otherwise the Figure 8 form of bearing mounting and retention means is structurally and functionally identical with that previously described in connection with Figure 2—4 inclusive.

Advantages of the tapered roller bearing assembly as herein proposed over the known lock-nut form of tapered roller bearing assembly are as follows: A much shorter length of reduced-diameter shaft end portion and no screw threading of said shaft end portion is required; the replacement of the lock-nut retention means by a simple inexpensive stamped washer, the tolerances in the thickness of which can be held to commercial sheet-metal tolerances since the bevelled spring ring component of the retention means has only to take up these tolerances and the groove-location tolerances which a properly designed bevelled spring ring can easily do; and the ability of the spring ring and washer form of bearing retention means embodying the invention to perform as intended time-after-time, even under adverse conditions.

WHAT WE CLAIM IS:—

1. An assembly comprising tapered roller 130



* C L M S *

vention, the details of which are illustrated in Figure 5—7B inclusive, such retention means comprises a plain sheet-metal wash 30 (Figure 7A), whose central opening as defined by its inner circular edge 32a has a diameter slightly greater than that of the diameter of the reduced-diameter end of the shaft, whereby it can be readily slipped over said end and shifted axially therealong to a position in which it abuts the aforesaid shaft shoulder 26, and whose outer diameter is substantially greater than that of the diameter of the journal portion 16 of said shaft, whereby its outer rim or edge portion 32b projects radially beyond said journal portion, thus to form a shoulder thereon.

The washer 30 is positively held against the shaft shoulder 26 by force exerted thereon in an axial direction by a bevelled spring ring 34 sprung into a circumferential groove 36 provided therefor in the peripheral surface of the reduced-diameter outer-end portion of the shaft at a location along the latter as insures tight interface engagement being established between the inner face of said ring 34 and the outer face of the washer 30.

As the structure and manner of functioning of a bevelled spring ring (as herein designated 34) when sprung into a shaft groove (as herein designated 36) are well known no detailed description thereof is believed necessary. Suffice it to say, that when said ring 34 is sprung into its groove, it is spread and thereby stressed, following which it tends to close circumferentially, i.e. to contract to its unstressed state. Being of so-called bevelled construction, said ring 34 is provided on its face which is remote or distant from the washer 30 and along its inner edge with an inclined surface 34a and the side wall 36a of the groove 36 against which said ring surface 34a engages is complementally inclined. Thus, any circumferential closing or contraction of the ring causes it to move in axial direction against the washer 30 with a force which, with proper design of the ring, can be of the magnitude to hold said washer tight against said shaft shoulder 26.

From the above, it will be appreciated that the spring ring and washer-type bearing retention means as aforesaid provides both a simple and practical means of mounting tapered roller bearings on shafts, as compared to the screw-on lock nut type of bearing retention means of the prior art. Further, and as noted in the foregoing, the spring ring and washer-type bearing retention means is also less costly than the prior screw-on lock nut means, since its employment requires a much shorter length of reduced-diameter shaft end than does said lock nut means and similarly requires no cutting of threads in the reduced-diameter end of the shaft. Yet another advantage of a tapered roller bearing assembly embodying the invention is that the washer which is employed in place of the threaded screw-on lock nut as pre-

viously used may be readily and inexpensively fabricated by stamping same in quantity from sheet-metal stock, and in this connection it is worthy of mention that tolerances in the thickness of said sheet-metal stock can be held to commercial sheet-metal tolerances since the bevelled spring ring which is used therewith in an embodiment of the invention is entirely capable of taking up the tolerances in washer thicknesses as well as in groove location.

Yet another practical feature of the tapered roller bearing assembly embodying the invention is that bevelled spring rings as used therein may be readily assembled and thereafter re-assembled in their grooves, being for this purpose provided with apertured ears with which the tips or points of the plier-type assembly and disassembly tools may be readily coupled. Accordingly, bearing retention means employing such a bevelled spring ring may be disassembled and re-assembled time after time even under field conditions, with assurance not only of adequate bearing retention but also of accurate bearing setting.

To provide for the condition of heavy loading which might cause undesirable rotation of the washer 30 and possibly also of the ring 34 with respect to the shaft or shaft end, the use of the somewhat modified configuration of shaft and washer inner edge of Figures 8 and 9 is suggested. According thereto, the reduced-diameter outer-end portion 24a of the shaft 10 is provided with a "flat" 40 and the washer 38 is provided along its inner edge with a matching "flat" designated 40a which extends as a chord across its otherwise circular inner edge. By the provision of these matching flats, said washer 38 is in effect keyed to the shaft end and is thus restrained against relative rotation with respect thereto. Otherwise the Figure 8 form of bearing mounting and retention means is structurally and functionally identical with that previously described in connection with Figure 2—4 inclusive.

Advantages of the tapered roller bearing assembly as herein proposed over the known lock-nut form of tapered roller bearing assembly are as follows: A much shorter length of reduced-diameter shaft end portion and no screw threading of said shaft end portion is required; the replacement of the lock-nut retention means by a simple inexpensive stamped washer, the tolerances in the thickness of which can be held to commercial sheet-metal tolerances since the bevelled spring ring component of the retention means has only to take up these tolerances and the groove-location tolerances which a properly designed bevelled spring ring can easily do; and the ability of the spring ring and washer form of bearing retention means embodying the invention to perform as intended time-after-time, even under adverse conditions.

WHAT WE CLAIM IS:—

1. An assembly comprising tapered roller

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bearings mounted on a shaft provided with a conventional journal portion terminating in an outer shoulder and a reduced-diameter outer-end portion which extends outwardly beyond said shoulder, a washer mounted on said reduced-diameter outer-end portion of the shaft and operative when held in abutting engagement against said shoulder to form a bearing-retention shoulder so disposed axially with respect to the retained bearing as to establish a predetermined clearance between the outer end face of the bearing inner race and the inner face of said washer means; and a spring ring mounted on said reduced-diameter outer-end of said shaft outwardly of said washer for holding said washer in abutting engagement with said outer shaft shoulder.

2. An assembly as claimed in claim 1, wherein said washer comprises a stamping of annular shape fashioned from sheet metal, said stamping being provided with a circular central opening of which the diameter is slightly greater than that of the shaft outer-end portion, whereby it may be assembled and positioned thereon by being slipped over said outer-end portion and shifted axially therealong to its shoulder-abutting position as aforesaid.

3. An assembly as claimed in either claim 1 or claim 2, wherein said spring ring comprises a bevelled spring ring assembled in stressed condition in a circumferential groove provided therefor in the peripheral surface of said outer-end shaft portion outwardly of said shaft shoulder, said spring ring being so arranged that in tending to return to its unstressed condition it is operative to exert inward axial force on the outer face of said washer of such magnitude as to hold said

washer in forceful abutting engagement against said shoulder. 40

4. An assembly as claimed in claim 3, wherein said circumferential groove is defined in part by side walls and one of said side walls has an inclination complementary to that of the bevel of said spring ring, said one side wall co-operating with said bevel in rendering said spring ring operative to exert inward axial force on the outer face of the washer as aforesaid. 45

5. An assembly as claimed in any one of the preceding claims, wherein said washer and said reduced-diameter outer end portion of the shaft are provided with co-operating means for preventing relative rotation of the washer with respect to said shaft outer-end portion on which said washer means is mounted. 50 55

6. An assembly as claimed in claim 5, wherein said co-operating means comprises a "flat" on the surface of the shaft outer end portion and a mating "flat" on the inner edge of said washer means. 60

7. An assembly comprising tapered roller bearings mounted on a shaft provided with a conventional journal portion terminating in an outer shoulder and a reduced-diameter outer-end portion which extends outwardly beyond said shoulder, substantially as hereinbefore described with reference to Figs. 2 to 7 of the accompanying drawings. 65

8. An assembly as claimed in claim 7, when modified substantially as hereinbefore described with reference to Figs. 8 and 9. 70

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