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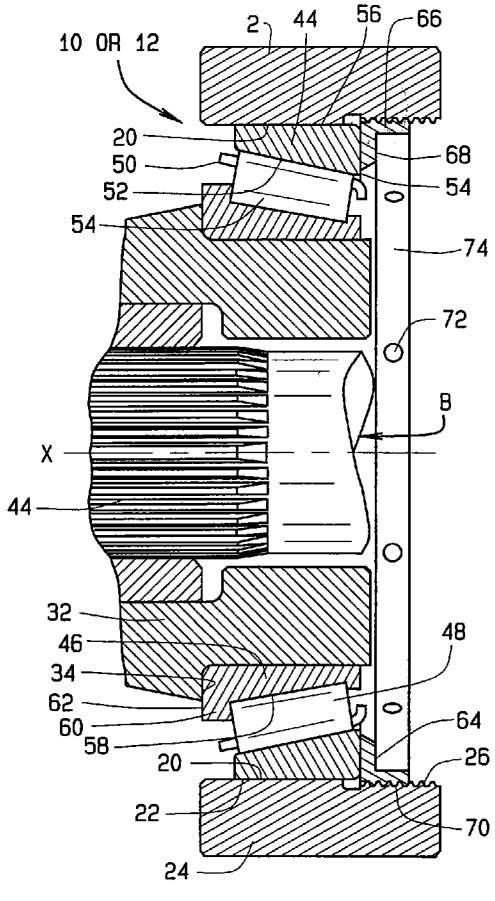
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[Continued on next page]

(54) Title: BEARING WITH SEPARATELY FORMED ADJUSTER



(57) Abstract: A shaft (32) is supported in a housing (2) on the antifriction bearings (10, 12) that are mounted in opposition. Outer races (50) of the antifriction bearings (10, 12) having raceways (60) are presented inwardly toward the an axis of rotation (X) and an inner races (52) of the antifriction bearings (10, 12) having other raceways (72) are presented outwardly toward the raceways (60) of the outer races (50). Additionally, rolling elements (54) are arranged in a row between the races (50, 52) and contacting the raceways (60, 72). An adjuster (58) formed as a separate component from the races (50, 52) and rolling elements (54) is secured to one of the races (50, 52). The adjuster (58) has an axially directed segment (80) that includes an external thread (84) presented outwardly from the axis of rotation (X), wherein the external thread 84 adjusts the secured race (50, 52) and the adjuster (58) to a desired position to that in which the secured race (50, 52) and the adjuster (58) are housed.

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European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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BEARING WITH SEPARATELY FORMED ADJUSTER

Cross-Reference To Related Applications

This application claims priority to U.S. patent application no. 60/786,948 filed on, March 29, 2006, the application being incorporated herein by reference.

Technical Field

This invention relates in general to antifriction bearings, and more particularly, to an antifriction bearing having an adjuster provided with external threads to facilitate adjustment of the bearing within a bearing seat.

Background

Antifriction bearing assemblies support shafts in a wide variety of equipment typically using two single row bearings. Each bearing has an outer race fitted into a housing, an inner race fitted around a shaft, and rolling elements organized in a single row between the two races. The rolling elements contact the races along raceways that are inclined with respect to the axis of the bearings, and the raceways of each bearing, while being inclined in the same direction, are inclined in the direction opposite to the inclination of the raceways of the other bearing. In other words, the two bearings that support the shaft are mounted in opposition. When two single row antifriction bearings of this type are mounted in opposition, the bearings may be adjusted against each other to control the setting of the bearings between end play and preload. In end play, clearances exist within the bearings themselves (between some of the rolling elements and the raceways), and while this reduces friction, it detracts from stability of the shaft supported by the bearings, that is to say, the axis of rotation is not entirely fixed. Preload, on the other hand, describes a bearing setting under an applied axial load and does not have any internal axial

clearances. Preload provides stability, but increases friction which consumes energy and, if too great, may cause bearing failure.

The setting of the antifriction bearing is controlled by the axial positions of the races within the housing. The displacement of only one of the races will change the setting for the bearing. Several basic devices exist for controlling the position of bearing races and the settings of the antifriction bearing. These control devices comprise: nuts located behind a race, shims located behind a race, or spacers separating a pair of races.

Tapered roller bearings represent one type of bearing that lends itself to adjustment, and are commonly utilized in automotive differentials. Such bearings support pinion shafts in differentials and also fit around stub shafts on the ends of the carriers that deliver torque to axle shafts. In the forward axle of a tandem axle arrangement, the tapered roller bearings support the input shaft and the through shaft. As to any one of these shafts, one bearing is adjusted against another to control the setting of the two bearings.

For example, the carrier on which a ring gear of an axle center for an automotive differential is mounted rotates within a housing, supported by two single row tapered roller bearings. The bearings are mounted with the large ends of the rollers presented inwardly toward each other (a direct mounting). The adjustment of the bearings – and the mesh of the ring gear with the pinion that drives it – is controlled by shims or nuts located behind the outer races of the two bearings.

Another way to control the axial position of an outer race is to provide it with an external thread that engages an internal thread in the housing. Thus, by rotating the threaded outer race in its threaded seat of the housing, one can adjust the setting for the bearings. U.S patent publication no. 2005/0063629-A1, published March 24, 2005, teaches adjusting bearing settings by this process and is incorporated herein by reference.

Many tapered roller bearings have outer races made from case hardened steel, so as to those outer races, the threads must be cut into the hard case. Apart from that, threaded outer races represent a specialized part that must be produced and maintained in inventory, and this increases the cost of the bearing when compared with bearings having conventionally produced races.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of an automotive differential provided with bearings, wherein some of the outer races of the bearings are secured to adjusters constructed in accordance with and embodying the present disclosure;

FIG. 2 is a fragmentary sectional view of the differential of Fig. 1 at one of the bearings that support a carrier of the automotive differential, the view illustrating an axially directed segment, a radially directed segment and an external thread of the adjuster; and

FIG. 3 is an enlarged fragmentary sectional view of an outer race of the bearing of Fig. 2 and the adjuster for that outer race.

DETAILED DESCRIPTION

The following detailed description illustrates the disclosure by way of example and not by way of limitation. The description clearly enables one skilled in the art to make and use the disclosure, describes several embodiments, adaptations, variations, alternatives, and uses of the disclosure, including what is presently believed to be the best mode of carrying out the disclosure.

Referring now to the drawings, a vehicle differential A (Fig. 1) delivers torque to two axle shafts B which extend out to road wheels (not shown) to which axle shafts B are coupled. The differential A enables the axle shafts B to rotate at different angular velocities while delivering torque to both of them, a condition encountered when the vehicle negotiates turns.

In basic terms, the differential A includes a housing 2, a pinion 4, a ring gear 6 driven by the pinion 4, and a carrier 8 to which the ring gear 6 is attached, so that the pinion 4 likewise drives the carrier 8. The differential A also includes a bearing arrangement C that supports the carrier 8 in the housing 2. The pinion 4 rotates about a longitudinal axis of rotation Y, whereas the ring gear 6 and carrier 8 rotate about a transverse axis of rotation X, this rotation is accommodated by the bearing arrangement C, which includes two single row tapered roller bearings generally shown as 10 and 12 mounted in opposition – indeed, in the direct configuration. The bearings 10 and 12 confine the ring gear 6 and the carrier 8 axially along the transverse axis of rotation X, while leaving the ring gear 6 and the carrier 8 free to rotate.

The pinion 4 lies at the end of a shaft 16 which rotates in bearings 18 mounted in the housing 2. The bearings 18, while permitting the shaft 16 and its pinion 4 to rotate about the axis of rotation Y, confine the pinion 4 radially and axially, so that the pinion 4 assumes fixed radial and axial positions along the axis of rotation Y.

Along the transverse axis of rotation X, the housing 2 has two bearing seats 20 of cylindrical configuration, for supporting the bearings 10 and 12. Each seat 20 includes a half bore 22 in the housing 2 and is closed by a cap 24 that fits over the half bore 22 and is attached firmly to the housing 2 with threaded fasteners. The caps 24 complete the bearing seats 20. Immediately beyond each bearing seat 20 the housing 2, including the cap 24, the bearing seat 20 contains an internal thread 26 (Fig. 2), the crests of which are slightly larger in diameter that the bearing seat 20.

The threads 26 at ends of the two bearing seats 20 are cut before the bearings 10 and 12 are installed in those seats 20. To produce the thread 26 at either seat 20, the cap 24 for the seat 20 is secured in the housing 2 with fasteners. Then a boring tool having a diameter

corresponding to the diameter of the crests on the thread 26 is run through the half bore 22 and cap 24. Next, the thread 26 is cut along the half bore 22 and the cap 24.

Returning to Fig. 1, bearings 10 and 12 enable the carrier 8 to rotate in the housing 2 about the axis of rotation X, yet confine it axially in the housing 2. To this end, the carrier 8 has stub shafts 28, also known as ring gear shafts, which project from shoulders 30 into the bearing seats 20 and into the bearings 10 and 12 in those seats 20.

Between its two stub shafts 28, the carrier 8 has (Fig. 1) a cross shaft 32, the axis of which is perpendicular to the axis of rotation X. The cross shaft 32 carries bevel gears 34 which mesh with beveled side gears 36, with the latter having journals 38 that project into the carrier 8 where they are free to rotate about the axis of rotation X. The journals 38 are hollow and receive the axle shafts B, with the journals 38 and the shafts B being engaged at mating splines 40.

The ring gear 6 is attached to the carrier 8 with cap screws 42, wherein the ring gear 6 meshes with the pinion 4. When the pinion shaft 16 rotates, it drives the carrier 8 through the meshed pinion 4 and ring gear 6, and the carrier 8 revolves about the axis of rotation X. The cross shaft 32 rotates with the carrier 8 and through the meshed bevel gears 34 and 36 rotates the axle shafts B. Normally the two axle shafts B rotate at the same angular velocity, but the arrangement permits one to revolve at a different velocity than the other.

Turning to Figs. 2 and 3 and referring to Fig. 1, the axes of the two bearings 10 and 12 coincide with the axis of rotation X. Each bearing 10 and 12 includes an outer race in the form of a cup 44, and an inner race in the form of a cone 46 located within the cup 44. Completing the bearings 10 and 12 are rolling elements in the form of tapered rollers 48 organized in two rows. The rollers 48 of each row are on an apex. The taper of the rollers 48 and races is such that there is pure rolling contact between the

rollers 48 and the cups 44 and cones 46. The rollers 48 of each row are separated by a cage 50 that maintains the proper spacing between the rollers 48 and further retains them in place around their respective cups 44 and cones 46 in the absence of the housing 2. The rollers 48 transmit thrust and radial loads between the cups 44 and cones 46, while reducing friction.

The cup 44 of each bearing 10 and 12 has a tapered raceway 52 which is presented inwardly toward the axis of rotation X. The cup 44 also has an end face 54 at the small end of the raceway 52. The end face 54 lies perpendicular to the axis of rotation X. The cup 44 has a smooth exterior surface 56 of cylindrical configuration, its diameter being only slightly smaller than the diameter of the bearing seats 20. Thus, the cups 44 will fit into and rotate within the bearing seats 20 with relative ease. The cups 44 may be standard production cups formed from case hardened or through hardened steel.

The cone 46 for each bearing 10 and 12 lies within the cup 44 for that bearing wherein the shaft 28 carries the cones 46. The cones 46 have a tapered raceway 58 that presents outwardly away from the axis of rotation X and toward the cup raceway 52. The cone 46 at the large end of its raceway 58 has a thrust rib 60 and at the end of the thrust rib 60 a back face 62, the back face 62 being at the small end of the raceway 58 and perpendicular to the axis of rotation X.

The tapered rollers 48 for each bearing 10 and 12 lie in a single row between the raceways 52, 58 of the cup 44 and cone 46, respectively, for that bearing 10 or 12. They contact the raceways 52 and 58 along their tapered faces, while the large end faces of the rollers 48 bear against the thrust ribs 60 of the cone 46. The thrust ribs 60 prevent the rollers 48 from moving up the raceways 52 and 58 and out of the annular space between the cup 44 and the cone 46. The rollers 48 are on apex, meaning that the

conical envelopes in which their tapered side faces lie have their apices at a common point along the axis of rotation X. The apices for the conical envelopes for the raceways 52 and 58 lie at the same point.

Each bearing 10 and 12 has an adjuster 64 secured firmly to its respective cup 44. The adjuster 64 for each bearing 10 and 12 positions against the end face 54 for the cup 44 of the bearing 10 or 12, to which it is firmly attached. Each adjuster 64 includes an axial segment 66 and a radial segment 68. The axial segment 66 has an external thread 70 cut or rolled into it, configured to engage the internal thread 26 at the end of either bearing seat 20 of the housing 2. As shown, the external thread 70 projects beyond the cylindrical exterior surface 56 of the cup 44. Accordingly, the external thread 70 projects outwardly with respect to the axis of rotation X. The axial segment 66 has apertures 72 defined through a cylindrical portion 74 of the adjuster 64 and arranged at equal circumferential intervals along the portion 74. The radial segment 68 lies against the end face 54 of the cup 44, and here the adjuster 64 is secured firmly to the cup 44, preferably by welding, although mechanical fasteners such as screws or pins that pass through the radial segment 68 and into the cup 44 will suffice as well.

Preferably, the adjuster 64 is formed in a stamping operation from low carbon sheet steel. After the stamping operation is completed, the external thread 70 is cut or rolled into the axial segment 66. U.S. patent application 11/118,311 of David L. Milam, filed April 29, 2005, discloses a process for welding low carbon steel of the adjuster 64 to high carbon steel at the end face 54 of the cup 44, either by a projection weld or by a lap seam weld or for that matter any other type of weld. U.S. patent application no. 11/118,311 is incorporated herein by reference.

Prior to setting the bearings 10 and 12 within the bearing seats 20 of the housing 2, the adjusters 64 are secured to the bearings 10 and 12. In an embodiment, securing the adjusters to bearings 10, 12 comprises

welding the adjusters 64 to the back faces 54 of the cups 44. In particular, the radially directed segments 68 of the adjusters 64 are welded to the end faces 54 of the cups 44. During the setting of the bearings 10, 12, the cone 46 for the bearing 10 fits over the left stub shaft 28 on the carrier 8, preferably with an interference fit. The back face 62 bears against the shoulder 30 from which the stub shaft 28 projects. The cage 50 holds the rollers 48 around the raceways 58 of the cone 46, so that the cone 46 and rollers 48 are installed as a unit known as a cone assembly. The cup 44 for the bearing fits into the left bearing seat 20, with the external thread 70 of its adjuster 64 engaging the internal thread 26 at the end of the left seat 20. The cone 46 for the right bearing 12 is installed on the right stub shaft 28 and the cup 44 into the right bearing seat 20 with the external threads 70 of its adjuster 64 engaging the internal threads 26 at the end of the seat 20, all in a like manner. The tapered rollers 48 for the bearing 10 taper downwardly away from the carrier 8 and so do the rollers 48 for the bearing 12. Thus, the tapered rollers 48 for the two bearings 10 and 12 taper in opposite directions such that the bearings 10 and 12 are mounted in the direct configuration.

The cones 46 and their rollers 48, that is, the cone assemblies, need to be installed over the stub shafts 28 before the caps 24 are fitted to the housing 2. Once the cones 46 are fitted to the stub shafts 28, the cups 44 are fitted around the rollers 48 that are located around the cones 46. In other words, the bearings 10 and 12 are installed around the stub shafts 28. With the bearings 10 and 12 fitted to their stub shafts 28, the carrier 8 is lowered into the housing 2 such that the bearings 10 and 12 drop into the half bores 22. Either cup 44 may require a slight rotation clockwise or counterclockwise to insure that the external thread 70 on its cup adjuster 64 engages the internal thread 26 at the end of the half bore 22 in which the cup 44 locates. A fixture (not shown) may be used to hold the cups 44

in place, thus insuring that the bearings 10 and 12 remain with the carrier 8 as it is lowered into the housing 2.

Next, the caps 24 are fitted to the housing 2 over the half bores 22 and the internal threads 26 in the caps 24 likewise engage the external threads 70 of the adjusters 64. The caps 24 are secured with the fasteners completing the bearing seats 20, which encircle the two bearings 10 and 12.

Thereupon, the bearings 10 and 12 are adjusted. To this end, the cups 44 secured to the adjusters 64 are advanced and retracted in their bearing seats 20 by rotating them. When either cup 44 is rotated, the adjuster 64 on it moves axially through the internal thread 26 at the end of the seat 20 to engage the internal threads 26 and changes the axial position of the cup 44 in its seat 20. The cups 44 are positioned such that the bearings 10 and 12 possess a light preload, and such that the correct mesh exists between the pinion 4 and the ring gear 6. The spacing between the two cups 44 controls the setting for the bearings 10 and 12. The lateral positions of the two bearings 10 and 12 along the axis of rotation X in the housing 2 controls the mesh setting. The adjustments for both settings are effected by rotating the adjusters 64 and secured cups 44 in their respective bearing seats 20.

To rotate either cup 44 in its bearing seat 20 and thus displace it axially, the adjuster 64 for that cup 44 may be engaged with a tool partially and generally shown as T (Fig. 3) at several of the apertures 72 of the adjuster 64. Rotation of the tool T imparts rotation to the adjuster 64 and its cup 44 advances or retracts in its seat 20 until the bearings 10, 12 achieve a desired position along the internal thread 26, depending on the direction of rotation. The desired position may be one of preload and may be characterized by a predetermined torque, a predetermined advancement angle, or a predetermined portion of a turn of the adjuster 64 and cup 44 within the housing 2 or any other predetermined method. Once

the cup 44 assumes the desired position within the housing 2, the cup 44 is secured against rotation by inserting a pin (not shown) through one of the radial apertures 72 in the adjuster 64 and forcing that pin into a recess or hole (not shown) that extends into the housing 2 through the internal thread 26 at the bearing seat 20. On the other hand, each cup 44 may be secured against rotation with a set screw threaded into one of the apertures 72 or else into the housing 2 or into the cap 24 that encloses the bearing seat 20 for the cup 44.

The bearings 10 and 12 may be used in any application where one machine member rotates relative to another machine member on bearings that are mounted in opposition and require adjustment. In the illustrative embodiment, an outer member of the machine comprises the housing 2 and an inner member of the machine comprises the shaft B located within the housing 2. The bearings 10 and 12 may be used to facilitate rotation between a housing and a shaft in virtually any type of machinery where a threaded adjuster might prove advantageous over other devices for adjusting bearings, such as locking nuts, shims and spacers, and also irrespective of whether the bearings 10 and 12 are mounted in the direct configuration, as in the axle center A, or in the indirect configuration.

The adjuster 64 may be used on races of other types of bearings. Indeed, the bearings 10 and 12 need not be tapered roller bearings, but may be other opposed bearings that are capable of being adjusted against each other and capable of transferring both axial loads and radial loads, such as angular contact ball bearings. Typically, such alternative bearings will have raceways that are inclined with respect to the axis of rotation X. Apart from that, the inner raceways for the bearings and need not be on discrete inner races or cones, but instead may be directly on the shafts that they support, and that holds true for the thrust ribs as well.

Moreover, the adjuster 64 provided with the external thread 70 and secured to the cup 44 may support other shafts in the axle center A, such

as the pinion shaft 16 or stub shafts 28 projected from the carrier 8 that contains the differential gearing, or the through shaft bearing. The adjuster 64 having external threads 70 may be used to support almost any shaft in a differential irrespective of whether the differential forms part of a tandem axle or a single axle, or for that matter irrespective of whether it is part of an axle at all. In this regard, it may be used in differentials for vehicles in which no solid axles exist, such in most front wheel drive automobiles. Indeed, bearings 10, 12 and adjuster 64 may be used in any housing that experiences, transfers or receives loads.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

CLAIMS:

1. An antifriction bearing for facilitating rotation about an axis, the antifriction bearing comprising:

an outer race having a raceway presented inwardly toward the axis;

an inner race having another raceway presented outwardly toward the raceway of the outer race;

rolling elements arranged in a row between the races and contacting the raceways; and

an adjuster formed as a separate component from the races and rolling elements and secured to one of the races, the adjuster having an axially directed segment, the axially directed segment having an external thread presented outwardly from the axis wherein the external thread adjusts the secured race and the adjuster to a desired position relative to a structure in which the secured race and the adjuster are housed.

2. The antifriction bearing according to claim 1 wherein the outer race has an end face and the adjuster is secured against the end face of the outer race.

3. The antifriction bearing according to claim 2 wherein the adjuster is secured to the end face by a weld.

4. The antifriction bearing according to claim 1 wherein the adjuster has a radially directed segment that is secured to the end face of the outer race.

5. The antifriction bearing according to claim 1 wherein the axially directed segment has a portion with a plurality of apertures defined therethrough, the apertures being configured for engagement by a tool designed to rotate the adjuster.

6. The antifriction bearing according to claim 1 in combination with a housing having an internal thread that is engaged by the external thread of the adjuster.

7. The combination according to claim 6 further comprising a shaft that carries the inner race of the bearing.

8. A machine comprising:

an outer member having a bore provided with an internal thread;

an inner member located within the outer member; and

first and second antifriction bearings located between the outer and inner members for enabling one member to rotate relative to the other member about an axis of rotation,

the first bearing including an outer raceway carried by the outer member and including an inner raceway carried by the inner member and rolling elements located between the raceways, the raceways of the first bearing being inclined in the same direction with respect to the axis of rotation, so that the first bearing will transfer thrust loads in one axial direction,

the second bearing including another outer raceway carried by the outer member, another inner raceway carried by the inner member, and other rolling elements located between the other outer and inner raceways, the raceways of the second bearing being inclined in the same direction with respect to the axis of rotation and in the direction opposite to the inclination of the raceways of the first bearing so that the second bearing will transfer thrust loads in an opposite axial direction; and

an adjuster secured to the outer raceway of the bearings, the adjuster having an axially directed segment, the axially directed segment having an external thread presented outwardly from the axis of rotation, the external thread of the adjuster engaging the internal thread of the outer member so that the axial position of the secured race and adjuster, and the setting of the first and second bearings can be adjusted by rotating the

adjuster relative to the internal thread to position the secured race and the adjuster to a desired axial position along the internal thread.

9. The machine according to claim 8 wherein the first bearing has an outer race with an end face and the adjuster is secured to the end face of the outer race.

10. The machine bearing according to claim 9 wherein the adjuster is secured to the end face of the outer race by a weld.

11. The machine bearing according to claim 10 wherein the adjuster has a radially directed segment that is secured to the end face of the outer race.

12. The machine bearing according to claim 8 wherein the axially directed segment has a portion with a plurality of apertures defined therethrough, the apertures being configured for engagement by a tool designed to rotate the adjuster.

13. A process for setting an antifriction bearing in a housing with a bearing seat that is aligned along an axis of rotation, the bearing seat having a bore which has an internal thread such that the antifriction bearing located on the bearing seat supports a shaft, the process comprising:

securing an adjuster to the antifriction bearing, the adjuster having an external thread presented outwardly from the axis of rotation;

inserting the antifriction bearing within the housing and around the shaft, the bearing comprising an outer race having an outer raceway that is presented inwardly toward the axis, an inner raceway being inclined in the same direction as the outer raceway for the outer race, and rolling elements arranged in a row between and contacting the outer and inner raceways; and

rotating the adjuster and the secured antifriction bearing to engage the external thread of the adjuster with the internal thread of the bearing

seat until the antifriction bearing achieves a desired axial position within the housing.

14. The process according to claim 13 wherein the outer race has an end face such that securing the adjuster to the antifriction bearing comprises welding the adjuster to the end face of the outer race.

15. The process according to claim 13 wherein the adjuster has an axially directed segment having a portion with an aperture defined therethrough such that rotating the adjuster and secured antifriction bearing comprises engaging a tool with the aperture and rotating the tool.

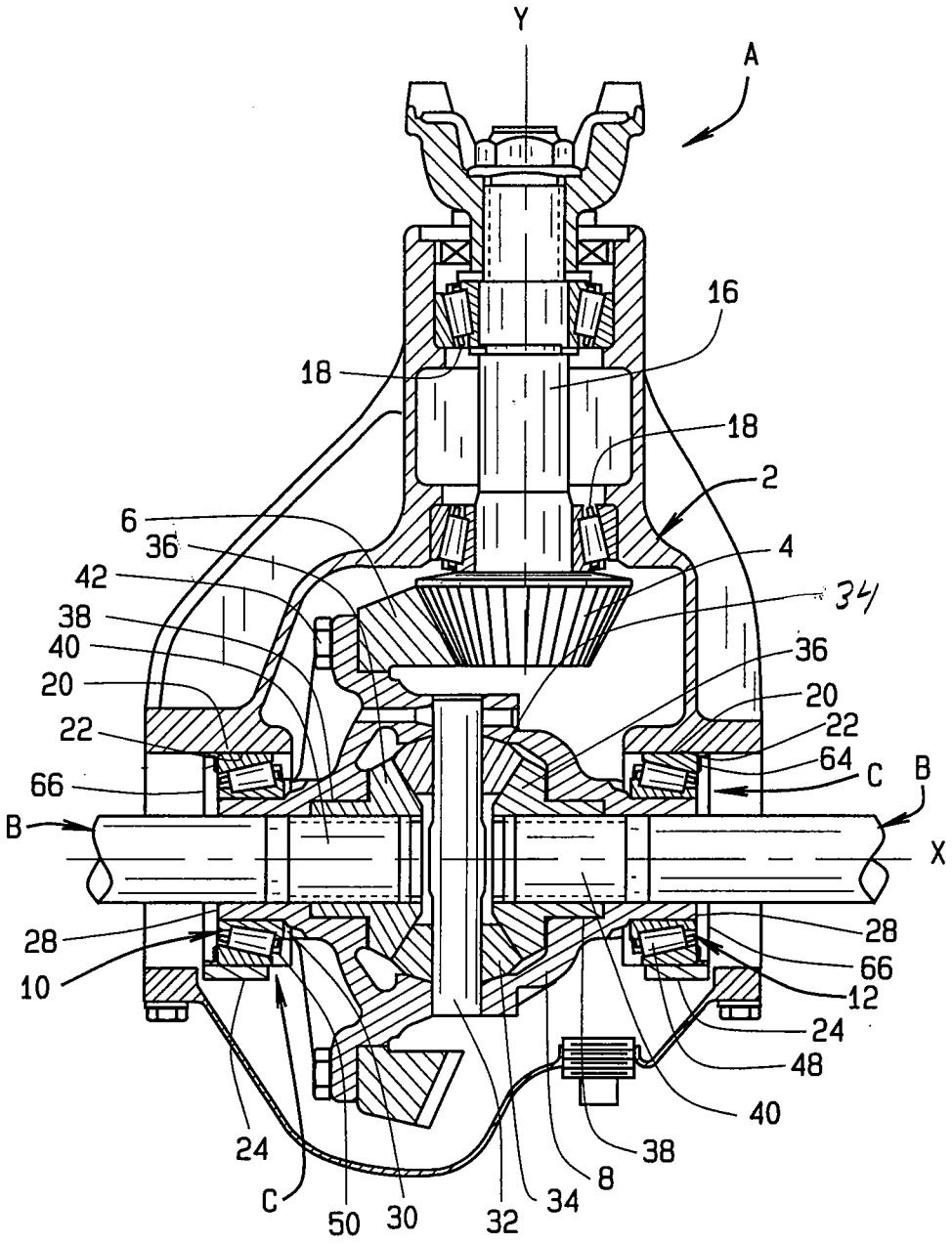

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FIG. 1

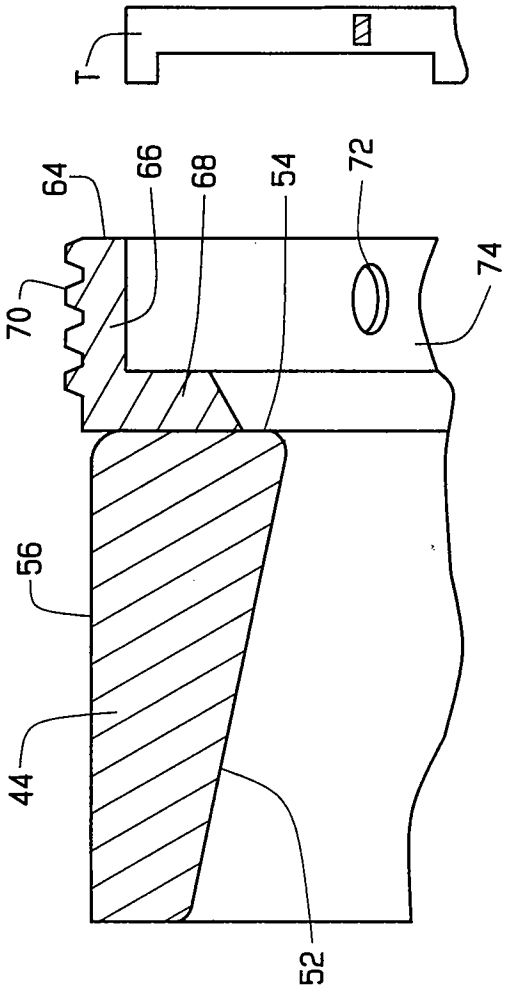

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FIG. 3

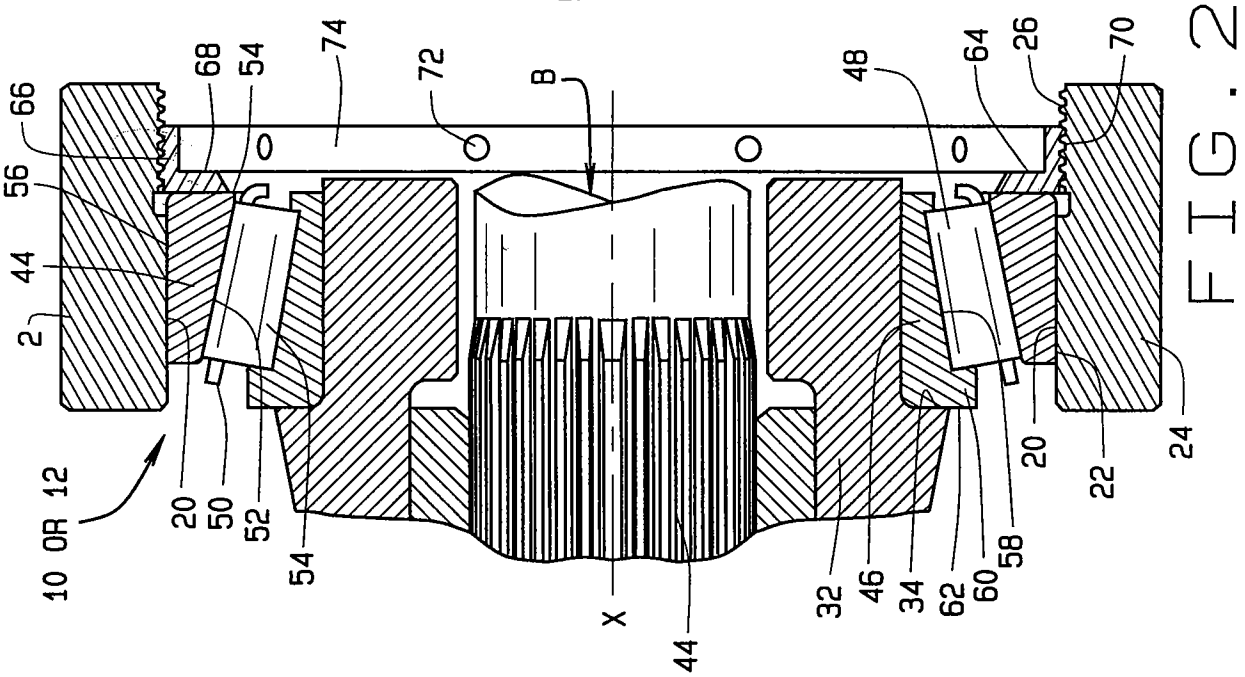

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FIG. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/065467

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16C23/06 F16C35/067 F16H1/28 F16H57/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16C F16H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 517 054 A (TIMKEN CO [US]) 23 March 2005 (2005-03-23) cited in the application	1-4, 6-11,13, 14
Y	paragraph [0029]; figure 10	5,12,15
X	WO 02/093039 A (TIMKEN CO [US]; ROSS SHARON E [US]; JOKI MARK A [US]) 21 November 2002 (2002-11-21) page 10, line 15 - line 23; figure 11	1-15
Y	GB 2 038 965 A (DANA CORP) 30 July 1980 (1980-07-30) page 2, line 51 - line 68; figures 5,6	5,12,15
A	GB 971 500 A (HUMBER LTD; ADRIAN WILLIAM WEST; JOHN LEWIS) 30 September 1964 (1964-09-30) page 2, line 19 - line 47; figure	1,4,11

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
31 July 2007	08/08/2007

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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