Abstract: There is provided a wheel bearing assembly including the following: a plurality of first rolling elements and a plurality of second rolling elements; an outer ring providing an outer race surface of the first rolling elements and an outer race surface of the second rolling elements at an inner periphery thereof; an inner ring providing an inner race surface of the first rolling elements at an outer periphery thereof; and an inner ring shaft providing an inner race surface of the second rolling elements. The inner ring shaft is provided with a shoulder portion, a disk mounting portion to which a brake disk is press fitted, and an inner ring mounting portion to which the inner ring is press fitted. The first and second rolling elements are in angular contact with respect to the outer and inner race surfaces and a predetermined pre-load is applied thereto.
Description

WHEEL BEARING ASSEMBLY FOR VEHICLE

Technical Field

[1] The present invention generally relates to a wheel bearing assembly for vehicles, and more particularly to a double-row wheel bearing assembly for vehicles including an inner ring shaft comprising bearing races inward of a vehicle and a brake disk mounting portion outward of a vehicle.

Background Art

[2] Axles of vehicles are classified into a drive wheel axle and a driven wheel axle. The drive wheel axle serves to transmit a driving force, which is transmitted from an engine through a transmission and reduction gears, to wheels and to support upward, downward, right, left, frontward and rearward loads applied from a road surface. A front axle of a front wheel drive vehicle or a rear axle of a rear wheel drive vehicle pertains to the drive wheel axle. The drive wheel axle is joined to a wheel via a hub flange. The driven wheel axle serves to support upward, downward, right, left, frontward and rearward loads applied from a road surface. A rear axle of a front wheel drive vehicle or a front axle of a rear wheel drive vehicle, to which a driving force of an engine is not transmitted, pertains to the driven wheel axle.

[3] Further, a braking device with a brake disk of a vehicle is configured to hydraulically press braking pads against both sides of the brake disk rotating together with a wheel to thereby stop the vehicle. Such braking device of a brake disk type includes a brake disk joined to a hub flange to be rotated together therewith and being fabricated from special cast iron, a caliper fabricated from special cast iron in a saddle shape, two brake cylinders joined to right and left sides of the caliper, a piston and a pad attached to the piston for producing a braking force by friction with the brake disk. The brake disk of the braking device is joined to a wheel bearing assembly. The wheel bearing assembly is joined to a vehicular body between a knuckle part and a drive axle. The wheel bearing assembly serves not only to support a load of a vehicle but also to facilitate rotation of a wheel.

[4] A prior art wheel bearing assembly is shown in Fig. 1, wherein a wheel bearing and a hub flange are individually provided. Another prior art wheel bearing assembly is shown in Fig. 2, wherein an outer ring 6" and a hub flange 14" are integrally formed to thereby reduce the number of relevant parts and to facilitate assembly and disassembly. However, since such a wheel bearing assembly is configured such that an inner ring 2" is fixed and an outer ring 6" is rotated, it can be applied to only a driven wheel and not be applied to a drive wheel. Still yet another prior art wheel bearing assembly is shown
in Figs. 3 and 4, wherein an inner ring 2, 2' and a hub flange 14, 14' are integrally formed.

Fig. 3 shows a wheel bearing assembly for a drive wheel. Fig. 4 shows a wheel bearing assembly for a driven wheel. The wheel bearing assembly of this type includes a small inner ring 8 and an inner ring hub 2, which are configured as two distinct parts as a typical inner ring. The inner ring hub 2 is formed at its outward end portion with a flange, to which a wheel and a brake disk is mounted.

Referring to Fig. 3, the wheel bearing assembly for a drive wheel 1 comprises the inner ring hub 2 with the hub flange 14, a plurality of first rolling elements 3, a plurality of second rolling elements 4, an outer ring 6 and a small inner ring 8. The first and second rolling elements 3 and 4 and the outer ring 6 are disposed on a radially outward surface of the inner ring hub 2 and the small inner ring 8 is then press fitted. The inner ring hub 2 and the small inner ring 8 provide an inner race surface of the first rolling elements 3 and an inner race surface of the second rolling elements 4, respectively. A brake disk 18 and a wheel (not shown) are joined by means of a hub bolt 16 to a hub flange 14, which is located at an end portion outward of a vehicle of the inner ring hub 2. A flange having through-holes, through which bolts pass when the outer ring is joined to a knuckle 12 of a vehicle, is protrusively formed in the outer ring 6.

In case of the wheel bearing assembly for a driven wheel Y shown in Fig. 4, a driving force of the drive axle is not transmitted thereto. In the wheel bearing assembly shown in Fig. 4, a bore for insertion of the drive axle is not formed in the inner ring hub 2' and a flange 22 is formed at an inward end portion of the inner ring hub 2' instead so that the small inner ring 8' cannot move away therefrom.

The brake disk/wheel bearing assembly shown in Fig. 3 or Fig. 4 is constituted in a manner that the brake disk 18, 18' is superposed on the hub flange 14, 14' and hub bolts join them together while nuts fix them together. Therefore, the brake disk 18, 18' is combined with the hub flange 14, 14 throughout many contact areas therebetween. Accordingly, there is a problem in that it is difficult to limit a run-out of the brake disk to a small extent and to increase stiffness due to the rise of assembly tolerance induced by accumulation of a manufacture tolerance of the hub and a manufacture tolerance of the brake disk. Accordingly, an upper limit of the run-out of the prior art brake disk is restricted to about 50D, for example. The brake disk having such a run-out is prone to cause a judder phenomenon induced by axial run-out defect during a brake operation. Therefore, it is difficult to basically eliminate consumer's dissatisfaction related to such a phenomenon. Further, since the brake disk 18, 18 is joined to the hub flange 14, 14 by bolts, there is a further problem in that the entire weight rises when compared to a case in which those parts are integrally formed.
Further, in said brake disk/wheel bearing assemblies, the surface, on which the brake disk and the hub flange are contacted to each other, is concaved and has a right angle, thereby making precise surface machining difficult. Further, tap holes must be machined for the purpose of attaching the brake disk. Accordingly, there is a problem with said wheel bearing assemblies in that machining process is complicated and machining time takes long and costs are high.

Also, in order to allow the wheel bearing assembly to work for an optimal life, a predetermined pre-load must be applied to bearing rolling elements. However, when said prior art wheel bearing assemblies are assembled into modules or finally assembled in a vehicle manufacturer, their pre-loads are mostly changed as they are joined to related parts, thereby adversely affecting the performance and life of the bearing.

Disclosure of Invention

Technical Problem

The present invention is directed to solving the foregoing problems of the prior art wheel bearing assemblies. It is an object of the present invention to provide a structure of a wheel bearing assembly, wherein a predetermined pre-load is not affected or is not nearly affected during final assembly into a vehicle.

It is a further object of the present invention to provide a wheel bearing assembly, wherein an engagement portion between a wheel bearing assembly and a brake disk can be easily machined.

It is another object of the present invention to provide a brake disk/wheel bearing assembly, wherein inconvenience caused by a judder phenomenon during vehicular operation is eliminated by reducing a run-out of a brake disk.

It is yet another object of the present invention to provide a brake disk/wheel bearing assembly, wherein a brake disk has a higher stiffness than the prior art and an entire weight is reduced.

Technical Solution

A wheel bearing assembly, which is constructed in accordance with one embodiment of the present invention, comprises the following: a plurality of first rolling elements arranged on a race; a plurality of second rolling elements arranged on a race farther inward of a vehicle than the first rolling elements; an outer ring providing an outer race surface of the first rolling elements and an outer race surface of the second rolling elements at an inner periphery thereof; an inner ring providing an inner race surface of the first rolling elements at an outer periphery thereof; and an inner ring shaft providing an inner race surface of the second rolling elements at an outer periphery thereof. The inner ring shaft includes: a shoulder portion located at its
one end inward of the vehicle; a disk mounting portion located at its other end, a brake disk being press fitted to the disk mounting portion; and an inner ring mounting portion located between the shoulder portion and the disk mounting portion, the inner ring being press fitted to the inner ring mounting portion. The first rolling elements and the second rolling elements are in angular contact with respect to the outer and inner race surfaces and a predetermined pre-load is applied thereto.

The present invention may be embodied as a brake disk/wheel bearing assembly. The brake disk/wheel bearing assembly, which is constructed in accordance with this embodiment, comprises the following: a plurality of first rolling elements arranged on a race; a plurality of second rolling elements arranged on a race farther inward of a vehicle than the first rolling elements; an outer ring providing an outer race surface of the first rolling elements and an outer race surface of the second rolling elements at an inner periphery thereof; an inner ring providing an inner race surface of the first rolling elements at an outer periphery thereof; an inner ring shaft providing an inner race surface of the second rolling elements at an outer periphery thereof; and a brake disk. The inner ring shaft includes: a shoulder portion located at its one end inward of the vehicle; a disk mounting portion located at its other end, a disk brake being press fitted to the disk mounting portion; and an inner ring mounting portion located between the shoulder portion and the disk mounting portion, the inner ring being press fitted to the inner ring mounting portion. The first rolling elements and the second rolling elements are in angular contact with respect to the outer and inner race surfaces. The brake disk includes a central bore. The central bore is press fitted to the disk mounting portion, thereby applying a predetermined pre-load to the first and second rolling elements.

Brief Description of the Drawings

Fig. 1 is a sectional view of a prior art disk brake-wheel bearing assembly.
Fig. 2 is a sectional view of a prior art disk brake-wheel bearing assembly.
Fig. 3 is a sectional view of a prior art disk brake-wheel bearing assembly for a drive wheel.
Fig. 4 is a sectional view of a disk brake-wheel bearing assembly for a driven wheel.
Fig. 5 is a sectional view showing an embodiment of a wheel bearing assembly constructed in accordance with the present invention.
Fig. 6 is a sectional view taken along the line B-B of Fig. 5.
Fig. 7 is an assembled view showing an embodiment of the wheel bearing assembly joined to a drive shaft and a knuckle according to the present invention.
Fig. 8 is an exploded view of an embodiment of the wheel bearing assembly according to the present invention.
Fig. 9 is a sectional view taken along the line A-A of Fig. 8.

Fig. 10 shows a brake disk being dismounted.

Fig. 11 is a sectional view showing a further embodiment of the wheel bearing assembly according to the present invention.

Fig. 12 is a sectional view taken along the line B-B of Fig. 11.

Fig. 13 is a plan view of a spline formed with a guide viewed in a direction of an arrow mark C.

Fig. 14 is an assembled view showing a further embodiment of the wheel bearing assembly joined to a drive shaft and a knuckle according to the present invention.

Fig. 15 is an exploded view of a further embodiment of the wheel bearing assembly according to the present invention.

Fig. 16 is a sectional view taken along the line A-A of Fig. 15.

Fig. 17 is an assembled view of another embodiment of the wheel bearing assembly formed with a dismounting groove according to the present invention.

Fig. 18 is an exploded view of another embodiment of the wheel bearing assembly formed with a dismounting groove according to the present invention.

Fig. 19 is a plan view showing the dismounting groove viewed in a direction of an arrow mark D.

Fig. 20 is a sectional view of yet another embodiment of the wheel bearing assembly according to the present invention.

Fig. 21 is an assembled view showing yet another embodiment of the wheel bearing assembly joined to a drive shaft and a knuckle according to the present invention.

Fig. 22 is an exploded view of yet another embodiment of the wheel bearing assembly according to the present invention.

Fig. 23 is an assembled view of an embodiment of a wheel bearing assembly for a driven wheel according to the present invention.

Fig. 24 is an assembled view of a further embodiment of a wheel bearing assembly for a driven wheel according to the present invention.

**Best Mode for Carrying Out the Invention**

Fig. 5 shows an embodiment of a wheel bearing assembly 101 according to the present invention. The wheel bearing assembly 101 comprises: first and second rolling elements 103 and 104; an outer ring 106; an inner ring 107; and an inner ring shaft 105. The outer ring 106 includes an outer race surface of the first rolling elements 103 and an outer race surface of the second rolling elements 104 on its inner periphery. An outer periphery of the outer ring 106 is formed with a flange having through-holes, through which bolts pass when mounted to a vehicular body. The inner ring 107 is disposed farther outward of a vehicle than the first rolling elements 103. The inner ring...
107 includes an inner race surface of the first rolling elements 103.

The inner ring shaft 105 includes a shoulder portion 105a, a race portion 105b, an inner ring mounting portion 105c and a disk mounting portion 105d. The shoulder portion 105a and the race portion 105b, which are formed at an inward end portion of the inner ring shaft 105, define the inner race surface of the second rolling elements 104 together. The inner ring 107 is press fitted to the inner ring mounting portion 105c, which is formed in the middle of the inner ring shaft. The inner ring 107 is press fitted in an axial direction from an outside of a vehicle (e.g., from a wheel side). Therefore, the wheel bearing may be easily assembled and parts related to the wheel bearing may be simply replaced. A stopper portion 105e is formed between the inner ring mounting portion 105c and the race portion 105b. The inner ring 107 is inserted to the inner ring shaft until its end portion is contacted to said stopper portion, whereby the inner ring is mounted to the inner ring shaft in a press fit manner. The first and second rolling elements 103 and 104 are brought into angular contact with respect to the outer and inner race surfaces. As used herein, "angular contact" means that the rolling elements (e.g., bearing balls) are brought into contact with the outer ring and the inner ring in such a manner that any line joining a contacting point, at which the rolling elements are in contact with the inner ring, and another contact point, at which the rolling elements are in contact with the outer ring, is at a predetermined angle to an axial direction of a rotating shaft. In this embodiment, since the rolling elements are brought into angular contact, the wheel bearing can support both the axial and radial loads.

With the above-described combination, the wheel bearing assembly constitutes one sub-module, which is composed of the first and second rolling elements, the outer ring, the inner ring and the inner ring shaft.

As shown in Fig. 6, a cross-section of the disk mounting portion 105d formed at the other end portion of the inner ring shaft is non-circular. Since the cross-section of the disk mounting portion becomes non-circular, a rotative force of the inner ring shaft, which is transmitted from a drive axle during drive, is transmitted to a brake disk without any slip. Further, a brake force of the brake disk is transmitted to the inner ring shaft without any slip during braking. An octagonal cross-section with its corners rounded is shown in Fig. 6 by way of an example of the non-circular cross-section. However, any other shape such as a triangular, tetragonal or splined shape can be used as the non-circular cross-section. A hub part (not shown) for mounting a brake disk 118 can be mounted to the disk mounting portion 105d. Preferably, a hub type brake disk, which is integrally formed with a hub, can be mounted (see Fig. 7).

Fig. 7 shows the wheel bearing assembly of the present invention, which is joined to a drive axle and a knuckle. The hub type brake disk 118 is press fitted to the disk mounting portion of the inner ring shaft 105. By doing so, the wheel bearing assembly
and the brake disk are integrally joined to each other to thereby constitute a module. Particularly, in case of said module, the inner ring is press fitted to the inner ring mounting portion 105c of the inner ring shaft and the brake disk 118 is press fitted to the disk mounting portion 105d. Therefore, the first rolling elements and the second rolling elements are subjected to a predetermined pre-load. The rolling elements of the wheel bearing rolling in the races defined between the outer ring and the inner ring (or the inner ring shaft) work as elastically compressed under a certain pressure. Said pressure is referred to as a pre-load, which has important influences on the performance and life of the bearing.

As shown in Fig. 7, the hub type brake disk 118 comprises a friction material-contacting surface 132, a wheel-contacting surface 134, a hub bolt-inserting hole 138, and a central bore 139, in a radially inward direction. A cross-section of the central bore 139 provided at a center of the brake disk is non-circular. Further, it corresponds to the cross-section of the disk mounting portion of the inner ring shaft in order to press fit the brake disk to the inner ring shaft (see Fig. 9).

Referring to Fig. 7, a protrusion 136 is formed between the hub bolt-inserting hole 138 and the central bore 139. The protrusion 136 serves to prevent foreign substances from entering the inside of the bearing. The protrusion primarily obstructs the foreign substances and moisture coming from the outside of a vehicle before they reach a seal of the bearing, thereby remarkably reducing the possibility that the foreign substance and moisture enter the seal and enhancing the functions of the seal. Moreover, the protrusion 136 also plays a role of allowing a post-assembly machining with regard to the machining process for the brake disk surface 132 of the wheel bearing assembly, which will be described later.

Figs. 7 and 8 show a combination between the wheel bearing assembly of the present invention and a knuckle 112 and a drive axle 140 of a vehicle. The wheel bearing assembly 101 is joined to the knuckle 112 of a vehicle at its outer ring 106 by means of a bolt 120. An inner periphery of the inner ring shaft 105 is formed with a female spline (see Fig. 6). An outer periphery of the drive axle is formed with a male spline corresponding to the female spline. The drive axle is engaged to the inner ring shaft 105 as passing therethrough and a first nut 150 is fastened to a male thread provided at an end portion of the drive axle, thereby joining the wheel bearing assembly and the drive axle together. Such engagement allows the driving force of the drive axle to be transmitted to the brake disk via the inner ring shaft.

In the above-described wheel bearing assembly, the inner ring shaft 105 serves to support the rolling elements and serves as a spindle for transmitting the driving force as engaged to the drive axle. Further, since the hub type brake disk is press fitted to the inner ring shaft to thereby construct a sub-module, an adjusted pre-load, which is
previously applied to the bearing during fabricating the brake disk/wheel bearing assembly, is not nearly changed even when the wheel bearing assembly is assembled together with any other parts of a vehicle. Furthermore, even in case of dismounting the wheel bearing assembly from the drive axle during maintenance, the bearing balls cannot be separated therefrom.

Further, since said inner ring shaft 105 does not include a hub flange unlike a conventional inner ring hub 2 (see Fig. 1a) and is directly engaged to the hub type brake disk, machining process for engagement surfaces of the hub flange and the brake disk is omitted and an accumulated error caused by such engagement does not occur. Therefore, a run-out of the disk can be limited to a small extent.

A dismounting rim 133 is formed around the wheel-contacting surface, thereby facilitating the dismounting of the brake disk from the wheel bearing assembly. As shown in Fig. 10, only the brake disk can be easily dismounted in a manner that a center of a gear puller 170 is centered on a center of the inner ring shaft and one or more hook-shaped legs 174 are hooked on the dismounting rim and a screw shaft 172 disposed at the center of the gear puller is fastened.

Fig. 11 shows a further embodiment of the wheel bearing assembly 201 according to the present invention. As shown in Figs. 11 and 12, an outer periphery of a disk mounting portion 205d of an inner ring shaft 205 is formed with a male spline. Said male spline is forcibly pressed to a female spline provided at the central bore of the hub type brake disk. Since spline engagement makes a wide contact area between engaged parts, a larger driving force can be permitted.

The inner ring shaft 205 may include a guide for guiding insertion of the brake disk to the central bore at its other end portion. Fig. 13 shows the shape of the guide, which is viewed in a direction of an arrow mark C of Fig. 11. The spline has a narrower width at the guide. Further, a diameter of the male spline may be smaller at the guide than that of any other portion thereof. When the hub type brake disk is mounted to the disk mounting portion, the guide plays an important role of guiding the brake disk to an engagement position at a leading end thereof, thereby reducing working time and facilitating the assembly. Further, when the hub type brake disk is initially seated on the spline of the inner ring shaft in order to be engaged thereto, a central axis of the inner ring shaft and a central axis of the hub type brake disk coincide with each other, thereby preventing the hub type brake disk from being slantingly fitted to the inner ring shaft and thus being wrongly assembled. While the guide shown in Fig. 13 has such a shape as steps, the guide may be embodied in any other shape such as a tapered shape.

Figs. 14 and 15 show a further embodiment of the wheel bearing assembly constructed in accordance with the present invention, which is joined to a hub type brake disk 218 and a drive axle 240. The hub type brake disk 218 includes a friction
material-contacting surface 232, a dismounting rim 233, a wheel-contacting surface 234, a protrusion 236, a hub bolt-inserting hole 238 and a central bore 239, as described above. As shown in Fig. 16, the central bore provided at a central portion of the brake disk is formed with a female spline, which is configured to mate with the disk mounting portion of the inner ring shaft in order to be press fitted thereto.

As shown in Figs. 17 and 18, a dismounting groove 260 or a dismounting hole 262 may be provided between the wheel-contacting surface and the friction material-contacting surface. The dismounting groove 260 and the dismounting hole 262 facilitate the dismounting of the brake disk from the wheel bearing assembly as well. Fig. 19 shows a shape of an entrance of the dismounting groove or the dismounting hole, which is viewed in the direction of an arrow mark D of Fig. 18. The shape of said entrance may be variously shaped in order to be hooked by a hook element. Dismounting described with reference to Fig. 10 may be applied to this case with the dismounting groove.

Fig. 20 shows another embodiment of the wheel bearing assembly 301 constructed in accordance with the present invention. The inner ring shaft 305 includes a male thread 305e at its other end portion. The male thread 305e is located outside the disk mounting portion 305d.

Figs. 21 and 22 show a combination among the wheel bearing assembly 301 shown in Fig. 20, the brake disk, the drive axle, and the knuckle. The hub type brake disk 318 is press fitted to the disk mounting portion of the inner ring shaft, and a second nut 352 is then fastened to the male thread of the inner ring shaft. Next, the inner ring shaft is joined to the drive axle and a first nut 350 is then fastened to the male thread of the drive axle.

Said second nut serves to apply a predetermined pre-load to a bearing rolling element of the hub type brake disk/wheel bearing assembly before the wheel bearing assembly is joined to the drive axle and the knuckle. In an assembly process into a module, the first nut is fastened to the male thread of the drive axle after the wheel bearing assembly is joined to the drive axle. In such a case, the second nut serves to allow the applied pre-load not to be changed in spite of fastening the first nut.

Embodiments of the wheel bearing assembly, which can be applied to a drive wheel, have been described so far. However, the wheel bearing assembly of the present invention can be applied to a driven wheel. Figs. 23 and 24 show embodiments of a brake disk/wheel bearing assembly, which are constructed in accordance with the present invention to be used for a driven wheel. As shown in Fig. 23, an inner ring shaft 405 may be configured such that a wheel bolt 450 is joined thereto instead of a drive axle. Further, as shown in Fig. 24, the wheel bearing assembly may be configured such that a male thread 501 is provided at an outward end portion of an
inner ring shaft and a nut 502 is fastened thereto.

[60] [Method of machining the wheel bearing assembly]

[61] A pad contacting surface of the brake disk is grinded or cut in a state where the brake disk is joined to the wheel bearing assembly.

[62] Machining the brake pad contacting surface of the brake disk/wheel bearing assembly according to the present invention can be carried out as follows. The outer periphery of the outer ring 106, 206, 306 is chucked about a flange surface of the outer ring of the wheel bearing assembly 101, 201, 301 in a state where the hub type brake disk 118, 218, 318 and the wheel bearing assembly 101, 201, 301 are assembled. Next, on one hand, an axial pressure equivalent to a pressure occurring during assembly into a vehicle is applied to the shoulder portion of the inner ring shaft 105, 205, 305 by means of a fixed shaft. On the other hand, another axial pressure equivalent to a pressure occurring during assembly into a vehicle is applied to a lateral side of the central portion of the brake disk 118, 218, 318. Grinding tools or cutting tools are positioned at both side surfaces of the brake disk 118, 218, 318, respectively. The both side surfaces of the hub type brake disk 118, 218, 318 are machined at a time as a spindle of the fixed shaft is rotated. Alternatively, the both side surfaces of the brake disk 118, 218, 318 may be machined at a time in a state where the wheel bearing assembly 118, 218, 318 is fitted to the drive axle and the nut is fastened and the drive axle is then rotated. Since the seal is provided in the wheel bearing assembly and the protrusion 136, 236, 336 is formed in the hub type brake disk, foreign substances such as metallic chips produced during machining do not enter a gap of the bearing even in the case of machining the surfaces of brake disk after joining the brake disk and the bearing together.

[63] As such, since the surface is machined in the state where the brake disk is firmly joined to the wheel bearing assembly, a problem in which a run-out is changed due to fastening forces during assembly is basically eliminated when compared to the case where the surface of the brake disk is first grinded and a run-out is then corrected. Such a brake disk is joined to the wheel bearing assembly. Therefore, a run-out can be controlled very precisely. In addition, according to the brake disk/wheel bearing assembly of the present invention, since there is no need to fix the brake disk to the hub flange by means of bolts before machining the surface of the disk, machining the surface of the disk can be more simply carried out than the prior art.

[64] [Run-out measuring test]

[65] A run-out of the brake disk/wheel bearing assembly, wherein the brake disk is grinded as joined to the wheel bearing assembly 101, 201, 301 according to the present invention, was measured. For measuring a run-out, the brake disk/wheel bearing assembly was secured to a jig for measuring a run-out and the wheel nut was then
fastened to the drive axle by a torque of 20 ~ 26kgf-m (which is equivalent to a torque to be actually applied when assembled into a vehicle). A gauge was disposed on the surface of the disk and a change of the gauge was measured as the brake disk was rotated. According to the measurement, the run-out was less than 2OD.

[66]  [Stiffness test]

[67]  A test for evaluating stiffness of the hub type brake disk and the wheel bearing assembly constructed with the present invention was conducted.

[68]  The stiffness testing method is as follows. A pre-load applying jig is mounted to the wheel bearing assembly with the brake disk joined thereto and the wheel nut is then fastened by a torque of 20 ~ 26kgf-m (which is a fastening torque to be actually applied when assembled into a vehicle). The brake disk/wheel bearing assembly is joined to a bearing fixing jig and is fixed thereto by fastening a nut. A slope measuring jig is seated on an inner end portion of the outer ring of the bearing and gauges are equipped. A load is applied to an end portion of the knuckle by means of a load applying device. Relative slopes between the central axis of the hub type brake disk and the central axis of the outer ring are calculated using the values of both gauges.

[69]  According to the test conducted as described above, it appeared that the stiffness of the wheel bearing assembly constructed in accordance with the present invention was enhanced by 20% when compared to a prior art wheel bearing assembly, as can be seen in Table 1 below.

[70]  Table 1

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<td>3.25</td>
<td>4.56</td>
<td>5.98</td>
<td>7.53</td>
<td>9.19</td>
<td>10.98</td>
<td>12.89</td>
<td>14.91</td>
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<td>4.8</td>
<td>7.4</td>
<td>10.0</td>
<td>12.5</td>
<td>15.4</td>
<td>18.2</td>
<td>21.7</td>
<td>24.8</td>
<td>28.2</td>
<td>Fastening force: 23kgf-m</td>
</tr>
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<td>6.0</td>
<td>7.8</td>
<td>9.8</td>
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<td>16.8</td>
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<tr>
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<td>19</td>
<td>22</td>
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<td>22</td>
<td>22</td>
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<td>Enhanced by about 20%</td>
</tr>
</tbody>
</table>

[71]  According to present invention, there is provided the wheel bearing assembly, wherein the hub type brake disk is press fitted to the inner ring shaft. Therefore, the predetermined pre-load can be applied to the bearing rolling elements in advance and
the predetermined pre-load is not affected or is not nearly affected during final assembly into a vehicle. Consequently, a pre-load most suitable for performance and the life of the rolling elements can be applied. Besides, such a pre-load can be maintained during an assembly process through only assembly without any other adjustment on the pre-load. Further, the engagement portion between the wheel bearing assembly and the brake disk can be easily machined by providing the inner ring shaft without a hub flange. Furthermore, the run-out of the brake disk can be reduced by grinding the surface of the brake disk when the brake disk is firmly fixed to the wheel bearing assembly. Also, inconvenience caused by judder phenomenon during vehicular operation can be eliminated. In addition, the entire weight is reduced and the brake disk has a higher stiffness than the prior art, thereby providing a comfortable ride.

[72] The above-described embodiments should not be construed as limiting the scope of the present invention. It will be understood by those skilled in the art that various changes in form and details may be made from the above-described embodiments without departing from the scope of the present invention. Accordingly, all matters contained in the above description should be construed exemplarily and not be construed as limiting the scope of the present invention.

Industrial Applicability

[73] The present invention may be applied to a wheel bearing assembly of a disk brake type so as to be mounted to a drive wheel or a driven wheel.
Claims

[1] A wheel bearing assembly, comprising:

a plurality of first rolling elements arranged on a race;

a plurality of second rolling elements arranged on a race farther inward of a vehicle than the first rolling elements;

an outer ring providing an outer race surface of the first rolling elements and an outer race surface of the second rolling elements at an inner periphery thereof;

an inner ring providing an inner race surface of the first rolling elements at an outer periphery thereof; and

an inner ring shaft providing an inner race surface of the second rolling elements at an outer periphery thereof,

wherein the inner ring shaft includes:

a shoulder portion located at one end thereof inward of the vehicle;

a disk mounting portion located at the other end thereof, a disk brake being press fitted to the disk mounting portion; and

an inner ring mounting portion located between the shoulder portion and the disk mounting portion, the inner ring being press fitted to the inner ring mounting portion, and

wherein the first rolling elements and the second rolling elements are in angular contact with respect to the outer and inner race surfaces and a predetermined preload is applied thereto.

[2] The wheel bearing assembly of Claim 1, wherein the disk mounting portion of the inner ring shaft has a non-circular cross-section.

[3] The wheel bearing assembly of Claim 2, wherein the non-circular cross-section is a spline shape.

[4] The wheel bearing assembly of any one of Claims 1 to 3, wherein the inner ring shaft includes a male thread at the other end thereof.

[5] A brake disk/wheel bearing assembly, comprising:

a plurality of first rolling elements arranged on a race;

a plurality of second rolling elements arranged on a race farther inward of a vehicle than the first rolling elements;

an outer ring providing an outer race surface of the first rolling elements and an outer race surface of the second rolling elements at an inner periphery thereof;

an inner ring providing an inner race surface of the first rolling elements at an outer periphery thereof;

an inner ring shaft providing an inner race surface of the second rolling elements at an outer periphery thereof; and
a brake disk,
wherein the inner ring shaft includes:
a shoulder portion located at one end thereof inward of the vehicle;
a disk mounting portion located at the other end thereof; and
an inner ring mounting portion located between the shoulder portion and the disk
mounting portion, the inner ring being press fitted to the inner ring mounting portion,
wherein the first rolling elements and the second rolling elements are in angular
contact with respect to the outer and inner race surfaces,
wherein the brake disk includes a central bore, and
wherein the central bore is press fitted to the disk mounting portion to thereby
apply a predetermined pre-load to the first and the second rolling elements.

[6] The brake disk/wheel bearing assembly of Claim 5, wherein the disk mounting
portion of the inner ring shaft has a non-circular cross-section.

[7] The brake disk/wheel bearing assembly of Claim 6, wherein the non-circular
cross-section is a spline shape.

[8] The brake disk/wheel bearing assembly of Claim 7, wherein the spline-shaped
disk mounting portion includes a guide at the other end thereof, the guide
guiding insertion of the brake disk into the central bore.

[9] The brake disk/wheel bearing assembly of any one of Claims 5 to 7, wherein the
inner ring shaft includes a male thread at the other end thereof, and
wherein a nut is fastened to the male thread to thereby apply the predetermined
pre-load to the first rolling elements and the second rolling elements.

[10] The brake disk/wheel bearing assembly of Claim 9, wherein the inner ring shaft
includes a female spline-shaped central bore, a splined drive shaft being inserted
into the female spline-shaped bore.

[11] The brake disk/wheel bearing assembly of any one of Claims 5 to 7, wherein the
brake disk has a protrusion at a side thereof opposed to the outer ring, the
protrusion protruding so as to surround the outer ring.

[12] The brake disk/wheel bearing assembly of any one of Claims 5 to 7, wherein the
brake disk further includes a means configured to be engaged to a dismounting
tool when dismounted from the wheel bearing.
A. CLASSIFICATION OF SUBJECT MATTER

B60B 35/18(2006.01)i, B60B 35/00(2006.01)i

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)

IPC 8 B60B 35, F16C 19, F16C 33, F16 D 1, F16D 65

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

Korean Utility Models and applications for Utility Models since 1975

Japanese Utility Models and applications for Utility Models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS (KIPO internal) & keywords "wheel", "bearing", "assembly"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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* Further documents are listed in the continuation of Box C  

** See patent family annex

* Special categories of cited documents
  "A" document defining the general state of the art which is not considered to be of particular relevance
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  "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search  
08 MAY 2007 (08 05 2007)

Date of mailing of the international search report  
09 MAY 2007 (09.05.2007)

Name and mailing address of the ISA/KR

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