

- 1 -

SPECIFICATION

TITLE OF THE INVENTION

BEARING STRUCTURAL BODY

BACKGROUND OF THE INVENTION

5 The present invention relates to a bearing structural body including a bracket as a supporting body for inserting a sleeve, which is used for a fluid bearing etc., under pressure and/or a yoke press-fitted in the outer periphery of the bracket.

10 Recently, rotary structural bodies such as motors or the like utilized in multimedia appliances are required to be compact with high accuracy and rotate at high speed to cope with the miniaturization and enriched performance of the multimedia appliances. While fluid bearings are
15 often used for bearings of the motors, the bearings alike are required to be processed/assembled with enhanced accuracy in order to make the motors more compact, highly accurate, and high-speed. At the same time, improved productivity is a target to be achieved to reduce costs.

20 The structure of a conventional fluid bearing will be described below.

 Fig. 14 is a sectional view of a motor as a representative product using a fluid bearing. The fluid bearing is constituted of a shaft 13 having a groove 13a

and a sleeve 1 grooved similarly to the shaft and supporting the shaft, as shown in Fig. 14. A turntable 15, a magnet 14, etc. are fixed to the shaft 13. The shaft 13 rotates while being supported by the sleeve 1 and a bearing 5 16 in a thrust direction to the sleeve 1. The sleeve 1 is fixed to the inner periphery of a bracket 11. A yoke 10 with a coil 12 is fixed to the outer periphery of the bracket 11.

Conventionally, in the fluid bearing in the 10 structure of Fig. 14, the cylindrically formed sleeve 1 is press-fitted into the bracket 11 having a cylindrical inner peripheral face 11a as shown in Fig. 15, and then an inner peripheral face 1a of the sleeve 1 is ground to remove a distortion thereof generated on the occasion of the 15 press-fitting, thereby to secure a roundness and a cylindricity. Grooves are processed afterwards. When the yoke 10 is press-fitted to the bracket 11, a distortion of the bracket 11 caused by the press-fitting of the yoke 10 increases the distortion of the inner peripheral face 1a of 20 the sleeve 1. As such, the inner peripheral face of the sleeve 1 is forced to be processed in a state with the yoke 10 press-fitted to the bracket 11.

In comparison with a manner of press-fitting the sleeve 1 into the bracket 11 after completely processing 25 the sleeve, e.g., after finishing the inner peripheral face

or forming the grooves, the conventional fluid bearing of the above structure needs large and complicate production facilities with increasing steps of processes, that is, the prior art is disadvantageous in terms of cost and productivity. In the case where the sleeve 1 is press-fitted into the bracket 11 having the cylindrical inner peripheral face, the distortion of the bracket at press-fitting expands in a direction of an outer diameter as a whole as indicated by an arrow B in Fig. 16 which is a sectional view of the bracket 11. As a result of this, a strong tensile force acts uniformly in a circumferential direction of the bracket 11, whereby a considerably large compression force is applied to the sleeve even when the bracket 11 changes the diameter slightly. Processing irregularities resulting from this irregularity in a fitting margin greatly influence the distortion of the inner peripheral face 1a of the sleeve 1 although the sleeve is required to be accurate to support the shaft. Therefore, the inner peripheral face of the sleeve 1 should be ground or grooved after the sleeve 1 is press-fitted to the bracket 11 to increase the accuracy. For example, when the brass sleeve 1 of an inner diameter of 2mm and a fitting margin of 30m in the outer periphery is to be press-fitted into the iron bracket 11 of an inner diameter of 6mm and a thickness of 1mm, the inner diameter of the

sleeve 1 is distorted approximately 10m exceeding a tolerance of 1m. The fitting margin should be made uniform in the order of m so as to restrict the distortion within the tolerance. Although parts manufactured with good productivity while inferior in processing accuracy as compared with those obtained by cutting such as sheet metal press are necessitated for the bracket 11 to achieve the improvement of productivity and cost reduction, a satisfactory processing accuracy cannot be fulfilled by the above parts, causing an obstacle to the progress of improved bearings. Moreover, the compression force added to the sleeve 1 when the yoke 10 is pressed in the outer periphery of the bracket 11 further exhibits the obstacle remarkably. Therefore, in order to realize the improvement of productivity aimed for cost reduction while securely maintaining the high accuracy and high-speed rotation of the fluid bearing, it is certainly necessary to keep a more uniform and minute space between the sleeve 1 and the shaft 13 irrespective of the variation of the fitting margin of the sleeve 1 and the bracket 11.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide a bearing structural body capable of restricting a distortion at an inner diameter of a sleeve

which is caused when the sleeve is press-fitted in a bracket and/or also when a yoke is press-fitted into an outer periphery of the bracket in addition to press-fitting of the sleeve, and eliminating subsequent trouble of treating an inner face or grooving after press-fitting.

In accomplishing these and other aspects, according to a first aspect of the present invention, there is provided a bearing structural body comprising:

a bearing sleeve; and

a bracket as a supporting body for the bearing sleeve, the bracket having a plurality of first projecting parts formed in a circumferential direction of a part of an inner peripheral face thereof to which the sleeve is to be press-fitted, which continue in an axial direction thereof and project in a diametrical direction thereof,

the bracket having a plurality of second projecting parts provided in a circumferential direction thereof at a part of an outer peripheral face of the bracket where a yoke is to be press-fitted or in a circumferential direction of an inner peripheral face of the yoke which is to be press-fitted to the outer peripheral face of the bracket, the projecting parts continuing in the axial direction and projecting in the diametrical direction in a manner not to overlap in a radial direction thereof with

the first projecting parts formed at the inner peripheral face of the bracket,

the sleeve, the bracket, and the yoke being fixed by press-fitting with use of elastic deformation.

5 According to a second aspect of the present invention, there is provided a bearing structural body according to the first aspect, wherein the first and second projecting parts are constituted of flat parts formed at the inner and outer peripheral faces of the cylindrical
10 bracket or the inner peripheral face of the yoke.

 According to a third aspect of the present invention, there is provided a bearing structural body according to any one of the first and second aspects, wherein the first and second projecting parts are linear
15 ribs projecting in the diametrical direction of the inner and outer peripheral faces of the bracket or the inner peripheral face of the yoke.

 According to a fourth aspect of the present invention, there is provided a bearing structural body according to any one of the first through third aspects,
20 wherein the first projecting parts are located at an approximately intermediate position between the adjacent two second projecting parts in the circumferential direction.

According to a fifth aspect of the present invention, there is provided a bearing structural body according to any one of the first through fourth aspects, wherein a number of each of the first and second projecting parts is the same.

According to a sixth aspect of the present invention, there is provided a bearing structural body according to the fifth aspect, wherein a number of each of the first and second projecting parts is any number of five through seven.

According to a seventh aspect of the present invention, there is provided a bearing structural body according to the sixth aspect, wherein a number of each of the first and second projecting parts is six.

According to an eighth aspect of the present invention, there is provided a bearing structural body according to any one of the first through seventh aspects, wherein all of the first projecting parts have the same thickness as each other, and all of the second projecting parts have the same thickness as each other.

By the above construction of the aspects of the present invention, the distortion of the inner diameter of the sleeve generated when the sleeve is press-fitted to the bracket and/or also when the yoke in addition to the sleeve

is press-fitted to the outer periphery of the bracket can be controlled.

BRIEF DESCRIPTION OF THE DRAWINGS

5 These and other aspects and features of the present invention will become clear from the following description taken in conjunction with the preferred embodiments thereof with reference to the accompanying drawings, in which:

10 Fig. 1 is a perspective view of a sleeve and a bracket according to Embodiment 1 of the present invention;

 Fig. 2 is a sectional view of the sleeve and the bracket according to Embodiment 1 of the present invention;

 Fig. 3 is a perspective view of a sleeve and a bracket according to Embodiment 2 of the present invention;

15 Fig. 4 is a sectional view of the sleeve and the bracket according to Embodiment 2 of the present invention;

 Fig. 5 is a perspective view of a sleeve and a bracket and a yoke according to Embodiment 3 of the present invention;

20 Fig. 6 is a sectional view of the sleeve and the bracket according to Embodiment 3 of the present invention;

 Fig. 7 is a perspective view of a sleeve and a bracket and a yoke according to Embodiment 4 of the present invention;

Fig. 8 is a sectional view of the sleeve and the bracket according to Embodiment 4 of the present invention;

Fig. 9 is a perspective view of a sleeve and a bracket and a yoke according to Embodiment 5 of the present invention;

Fig. 10 is a sectional view of the sleeve and the bracket and the yoke according to Embodiment 5 of the present invention;

Fig. 11 is a perspective view of a sleeve and a bracket and a yoke according to Embodiment 6 of the present invention;

Fig. 12 is a sectional view of the sleeve and the bracket and the yoke according to Embodiment 6 of the present invention;

Fig. 13 is a sectional view of the whole of the bearing according to Embodiment 3;

Fig. 14 is a sectional view of a motor using a fluid bearing;

Fig. 15 is a perspective view of a sleeve and a bracket in the prior art; and

Fig. 16 is a sectional view of the sleeve and the bracket in the prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Before the description of the present invention proceeds, it is to be noted that like parts are designated by like reference numerals throughout the accompanying drawings.

5 Preferred embodiments of the present invention will be described with reference to the drawings.

EMBODIMENT 1

10 In Fig. 1, a reference numeral 2 represents the bracket 11 of Fig. 13. Flat parts are provided on an inner peripheral face 2a of a cylinder having a slightly larger inner diameter than an outer diameter of the sleeve 1, thereby to constitute a plurality of projecting parts 3 in the bracket 11. A diameter of an inscribed circle to the projecting parts 3 is smaller than a diameter of the sleeve 1, and consequently, a difference of the diameters becomes a fitting margin. Fig. 2 is a sectional view of Fig. 1, in which an arrow A indicates a deformation of the bracket when the sleeve is press-fitted into the bracket. The projecting parts 3 can be formed by using the die-cast method with recesses corresponding to the projecting parts formed on molds for, for example, zinc die-cast or by pressing sheet metal.

20 When the sleeve 1 is press-fitted into the thus-constructed bracket 2, different from the deformation or distortion generated in the prior art that the total

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body is deformed uniformly in the direction of the outer periphery thereby to bring about the uniform tensile force in the circumferential direction, each projecting part 3 is greatly deformed at a point P between the projecting parts 3 towards the outer periphery as indicated by the arrow A in Fig. 2. Although the point P between the projecting parts 3 is illustrated in Fig. 2 to be deformed large in the direction of the outer diameter as indicated by the arrow A in Fig. 2, the point P may be deformed both in the direction of the outer diameter and in a direction of an inner diameter depending on a thickness of the bracket 2, a count of projecting parts 3, or the fitting margin. Owing to the presence of the projecting parts 3 as above, eventually, a part of the bracket between the projecting parts 3 is subjected not only to tensional elastic deformation, but to bending. Since the bending is caused with a smaller force than the tensional distortion, a change of a press-fitting force of the sleeve 1 to a change of the fitting margin is inhibited, and accordingly the distortion of an inner peripheral face 1a of the sleeve 1 influenced by the variation of the fitting margin due to processing irregularities, etc. is suppressed. For instance, when the brass sleeve 1 having the 2mm inner diameter and 30m fitting margin is to be press-fitted in the iron bracket 2 of the 6mm inner diameter and 1mm

thickness, and if three projecting parts 3 are formed an equal distance in the constitution of the embodiment, the distortion in inner diameter of the sleeve 1 can be restricted to be not larger than the tolerance of 1m
5 although the prior art generates approximately 10m distortion.

EMBODIMENT 2

In Embodiment 1, the projecting parts 3 are obtained by forming flat parts in the inner peripheral face
10 2a of the bracket 2. On the other hand, according to Embodiment 2, a linear rib is projected from the inner peripheral face of the bracket 2 thereby to constitute a projecting part 4, as shown in Figs. 3 and 4.

Although the three projecting parts are spaced an
15 equal distance in Embodiments 1 and 2, it is not necessary to separate the projecting parts equally.

EMBODIMENT 3

It is generally practiced to press-fit the yoke
10 at the side of the outer periphery of the bracket. At this time, in addition to the projecting parts 3 formed in the inner peripheral face 2a of the bracket 2 as shown in Fig. 5, linear ribs 5 as projecting parts are formed to project from an outer peripheral face 2b of the bracket 2 alternately with the projecting parts 3 in a manner not to
20 overlap with the projecting parts 3 in a radial direction,
25

as is clear from Fig. 6. Influences onto a change of the inner diameter of the sleeve 1 when the yoke 9 is press-fitted can be also inhibited in this method.

Fig. 13 is a sectional view of the whole of the bearing according to Embodiment 3. In Fig. 13, reference numeral 112 denotes a winding formed on a stator core of the yoke 10, 113 a shaft rotatably supported by the bearing, 114 a rotor magnet, 120 a terminal pin, 121 a stopper for removal, 123 an insulator, 124 a thrust plate, 125 a printed circuit board, 126 a rotor frame to which the magnet 114 is fixed, and 127 an adhesive sheet for attaching the board 125 onto the bracket 2.

EMBODIMENT 4

As shown in Fig. 7, the projecting parts 5 at the outer peripheral side of the bracket indicated in Fig. 5 may be obtained by forming flat notches 2c on the cylindrical outer peripheral face 2b.

Six projecting parts are provided via an equal distance both at the inner periphery and at the outer periphery of the bracket 2 according to each of Embodiments 3 and 4. However, the distance may not be necessarily equal.

EMBODIMENT 5

Referring to Fig. 9, projecting parts 7 are formed at an inner peripheral face 9a of the yoke 9. The

yoke 9 with these projecting parts 7 are press-fitted to the bracket 2, as in Fig. 10, so that the projecting parts 7 are alternately disposed with the projecting parts 7 and the projecting parts 3 at the inner peripheral face 2a of the bracket 2 not to overlap with each other in the radial direction. Influences onto a change of the inner diameter of the sleeve 1 because of the press-fitting of the yoke 9 are thus restricted.

EMBODIMENT 6

As shown in Fig. 11, projecting parts 8 may be constituted of flat parts formed at the cylindrical inner peripheral face 9a of the yoke 9, similar to the projecting parts 3 formed at the inner peripheral face 2a of the bracket 2 in Embodiment 1.

According to Embodiments 5 and 6, although the six projecting parts are provided via an equal distance both at the inner periphery of the bracket 2 and the inner periphery of the yoke 9, and the yoke is press-fitted to the bracket 2 so that the projecting parts are alternately arranged with an equal distance, the equal distance may not be always required.

Although a count of the projecting parts is not specifically limited, three or more are preferable in order to hold the sleeve 1 stably and make axial centers of the sleeve 1 and the bracket agree with each other. When the

yoke in addition to the sleeve 1 is press-fitted to the outer periphery of the bracket 2, the projecting parts 3, 4, 5, 6, 7, 8 are formed at the inner and outer peripheral faces of the bracket or in the inner peripheries of the bracket 2 and the yoke 9. At that time, a count of the projecting parts is not necessarily the same between the inner and outer peripheries of the bracket 2 or between the inner peripheries of the bracket 2 and the yoke 9 so long as the projecting parts are disposed alternately not to overlap in the radial direction between the inner and outer peripheries of the bracket 2 or between the inner peripheries of the bracket 2 and the yoke 9. Meanwhile, if the count of the projecting parts is too small, the projecting parts holding the sleeve 1 may be expanded in a direction of the outer periphery when the yoke 9 is press-fitted, with decreasing a holding force to the sleeve 1. In contrast, if too many projecting parts are formed, the projecting parts holding the sleeve 1 may be greatly distorted in a direction of the inner periphery because of the press-fitting of the yoke 9, deforming the sleeve 1 large. Therefore, a relation of the count of the projecting parts and the holding force for the sleeve 1 which depends on dimensions, materials, and a fitting margin should be examined through analysis of numerical values or experiments, and then a size of the projecting

part should be determined to suppress the deformation of the sleeve 1 even at the press-fitting time of the yoke 9, yet maintain a sufficient strength for preventing the yoke 9 and the sleeve 1 from removing from the bracket 2. Most preferably, the count and positions of the projecting parts should be determined to make the press-fitting of the yoke least influence a positional change of the projecting parts on the bracket 2, whereby influences resulting from processing irregularities are decreased and the structural body becomes easy to design. For example, in the case where the bracket 2 is made of iron and has a 6mm inner diameter and a 1mm thickness, experimental results show it preferable to provide six projecting parts via an equal distance both in the inner periphery and in the outer periphery of the bracket 2 if not only the sleeve 1, but the yoke 9 or 10 is press-fitted to the bracket. As another example, in Fig. 6, when the inner diameter of the bracket 2 with no inner projecting part 3 is 5.8mm, the thickness of the inner projecting part 3 is 0.025mm, and when the outer diameter of the bracket 2 with no outer projecting part 5 is 6.9mm, the thickness of the outer projecting part 5 is 0.05mm.

More especially, it is preferable that the projecting parts (first projecting parts 3, 4 formed in the circumferential direction of a part of the inner peripheral

face thereof to which the sleeve 1 is to be press-fitted, which continue in the axial direction thereof and project in the diametrical direction thereof, are located at an approximately intermediate position between the adjacent
5 two second projecting parts 5, 6 in the circumferential direction, the second projecting parts 5, 6 being provided in the circumferential direction thereof at a part of the outer peripheral face of the bracket 2 where the yoke 9 is to be press-fitted or in the circumferential direction of
10 the inner peripheral face of the yoke 9 which is to be press-fitted to the outer peripheral face of the bracket 2, the projecting parts 5, 6 continuing in the axial direction and projecting in the diametrical direction in a manner not to overlap in the radial direction thereof with the first
15 projecting parts 3, 4 formed at the inner peripheral face of the bracket 2. The approximately intermediate position between the adjacent two second projecting parts 5, 6 at which the first projecting parts 3, 4 are located is defined by holding the approximately same center angle θ as
20 shown in Fig. 6.

It is also more preferable that a number of each of the first and second projecting parts is the same. Moreover, the number of each of the first and second projecting parts is any number of five through seven,
25 especially, six, more preferably. If the number is less

than five, it is possible that, for example, when the sleeve 1 is press-fitted into the bracket 2 and then a holding force to the sleeve 1 is acted thereon by each of the projecting parts, a pressing force might be acted on
5 each of positions between which a position the holding force is acted on is located, thus increasing the holding force excessively. On the other words, the projecting parts holding the sleeve 1 may be expanded in the direction of the outer periphery when the yoke 9 is press-fitted,
10 with decreasing the holding force to the sleeve 1. If the number is greater than seven, it is possible that when the sleeve 1 is press-fitted into the bracket 2 and then the holding force to the sleeve 1 is acted thereon by each of the projecting parts, an outwardly resilience force might
15 be acted on each of positions between which a position the holding force is acted on is located, thus reducing the holding force. On the other words, the projecting parts holding the sleeve 1 may be greatly distorted in the direction of the inner periphery because of the
20 press-fitting of the yoke 9, deforming the sleeve 1 large. Contrarily, when the number is any number of five through seven, such pressing forces and resilience forces are not acted, thus suitably applying the holding force thereto. The range of the number can be also applied to the
25 relationship between the bracket 2 and the yoke 9.

It is preferable that all of the first projecting parts have the same thickness as each other, and all of the second projecting parts have the same thickness as each other, thus applying the approximately uniform forces thereto.

As described hereinabove, according to the present invention, in press-fitting and fixing the fluid bearing sleeve to the bracket with the use of elastic deformation of the members, the bracket as the supporting structural body for the sleeve is provided with a plurality of circumferential projecting parts continuing in the axial direction of the inner peripheral face thereof to which the sleeve is press-fitted, so that the distortion in inner diameter of the sleeve caused by the press-fitting of the sleeve can be restricted. Moreover, in press-fitting the yoke in addition to the sleeve to the outer periphery of the bracket, the using bracket or yoke is provided with projecting parts at the outer peripheral face of the bracket or the inner peripheral face of the yoke alternately not to overlap in the radial direction with the projecting parts at the part of the inner peripheral face of the bracket to which the sleeve is press-fitted, so that the influence onto the distortion in inner diameter of the sleeve by the pressing of the yoke is restricted. Accordingly, the fluid bearing can be manufactured with

improved productivity while the high accuracy and high-speed rotation thereof are maintained.

5 The entire disclosure of Japanese Patent Application No. 8-117579 filed on May 13, 1996, including specification, claims, drawings, and summary are incorporated herein by reference in its entirety.

10 Although the present invention has been fully described in connection with the preferred embodiments thereof with reference to the accompanying drawings, it is to be noted that various changes and modifications are apparent to those skilled in the art. Such changes and modifications are to be understood as included within the scope of the present invention as defined by the appended claims unless they depart therefrom.

WHAT IS CLAIMED IS:

1. A bearing structural body comprising:

a bearing sleeve (1); and

a bracket (2) as a supporting body for the
5 bearing sleeve, the bracket having a plurality of first
projecting parts (3,4) formed in a circumferential
direction of a part of an inner peripheral face thereof to
which the sleeve is to be press-fitted, which continue in
an axial direction thereof and project in a diametrical
10 direction thereof,

the bracket having a plurality of second projecting
parts (5,6,7,8) provided in a circumferential direction
thereof at a part of an outer peripheral face of the
bracket where a yoke (9,10) is to be press-fitted or in a
15 circumferential direction of an inner peripheral face of
the yoke which is to be press-fitted to the outer
peripheral face of the bracket, the projecting parts
continuing in the axial direction and projecting in the
diametrical direction in a manner not to overlap in a
20 radial direction thereof with the first projecting parts
formed at the inner peripheral face of the bracket,

the sleeve, the bracket, and the yoke being fixed by
press-fitting with use of elastic deformation.

2. A bearing structural body according to claim 1,
25 wherein the first and second projecting parts are



constituted of flat parts formed at the inner and outer peripheral faces of the cylindrical bracket or the inner peripheral face of the yoke.

3. A bearing structural body according to any one of
5 claims 1-2, wherein the first and second projecting parts are linear ribs projecting in the diametrical direction of the inner and outer peripheral faces of the bracket or the inner peripheral face of the yoke.

4. A bearing structural body according to any one of
10 claims 1-3, wherein the first projecting parts are located at an approximately intermediate position between the adjacent two second projecting parts in the circumferential direction.

5. A bearing structural body according to any one of
15 claims 1-4, wherein a number of each of the first and second projecting parts is the same.

6. A bearing structural body according to claim 5, wherein a number of each of the first and second projecting parts is any number of five through seven.

20 7. A bearing structural body according to claim 6, wherein a number of each of the first and second projecting parts is six.

8. A bearing structural body according to any one of claims 1-7, wherein all of the first projecting parts have



the same thickness as each other, and all of the second projecting parts have the same thickness as each other.

