

SINTERED OIL-RETAINING BEARING

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A sintered oil-retaining bearing is disclosed, which is characterized in that it is a sintered oil-retaining bearing with protrusions formed from at least one portion of its inside sliding face. It is effective to use a special fiber composite excellent in wear resistance and the lubrication characteristics as the protrusions.

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The present invention relates to a sintered oil-retaining bearing capable of maintaining good operability over a wide temperature range from a high temperature to a low temperature and to a method for the production thereof.

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Ordinarily, in a sintered oil-retaining bearing, the rotation axis is maintained in a good lubricating state by means of fluid lubrication or mixed lubrication of the boundary with fluid through an oil film of the lubricating oil impregnated into the bearing.

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A lubricating oil is indispensable for such a bearing, but the oil to be used is restricted as regards the temperature range, generally from minus 20°C to plus 60°C, for example.

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Recently, however, in the case of mechanical parts, bearings for micromotors, etc. used in relation to cars, the requirements for oil-retaining bearings are that they are usable at minus 30°C to minus 40°C

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and yet capable also of use up to about plus 80°C.

5 In this situation, problems have occurred with conventional sintered oil-retaining bearings when in use at temperatures of about minus 30°C, a metallic sound like "kiin" generates on starting together with an extraordinary rise in current value.

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 The cause of these phenomena can be attributed inter alia to loss of fluid lubrication because of solidification or increased viscosity of the lubricating oil due to the low temperature, deformation or contraction of the bearing-mounting material and contraction of the bearing itself at low temperatures. However, even if these factors could be eliminated taking the deformation and contraction into account, it was experimentally confirmed that the phenomena of the metallic sound and the increased current value did not disappear.

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 As a result of extensive investigations in view of this situation, a sintered oil-retaining bearing which does not generate said extraordinary phenomena even during use within a temperature range from minus 60°C to plus 80°C has been developed according to the invention.

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30 Thus, the invention provides a sintered oil-retaining bearing characterised in that it is a sintered oil-retaining bearing provided with a protrusion formed from at least one portion of the inside sliding face. It is effective to use a special fiber composite with excellent wear-resistance characteristics and lubrication characteristics as the protrusions.

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With reference to the accompanying drawings, Fig. 1 is a chart showing the results of torque tests at ordinary temperature, Fig. 2 is a chart showing the results of torque test at high temperature, and Fig. 3 is a chart showing the results of a wear test.

According to the invention, by projecting the protrusion, that is, fibers being special composite from at least one portion of inside sliding face of sintered oil-retaining bearing, the rotation axis rotates while contacting with these protrusions, thereby it becomes possible to avoid mutual direct contact of metals between the rotation axis and the bearing and to suppress the metallic sound and the increase in current value during operation. Further, since heat is generated from a minute area of the protrusions through the friction between rotation axis and protrusion, the oil dissolves out locally to function more effectively. Hence, even if the protrusion is not necessarily formed completely from the inside sliding face, an effect would be exerted.

Furthermore, the invention can be applied to any matrix such as ordinary Cu-type, Fe-type or Fe-Cu type.

Moreover, upon the production of sintered oil-retaining bearing in which fibers are projecting from inside face in this way, said special composite is first added to the component of mother material. At this time, the effect would not be maximized if the additional level is too high or too low, so the addition in optimum amount is of importance. Further, when adding, it is also important to give a special treatment for allowing the special composite to diffuse

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10 uniformly over the inside face of the bearing.

The invention is illustrated by the following Examples.

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Example 1

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The mounting test of ten DC12V brushless motors with rated number of revolutions of 3000 rpm, diameter of rotation axis of 2.5 mm and rated current of less than 70 mA was performed, and the generation of metallic sound from bearing portion and the current value of the motor were measured. The results are shown in Table 1.

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For comparison, the same test was performed with conventional Cu-type sintered oil-retaining bearing, and the results are shown in Table 1.

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To take the measurements, the motor was cooled for 30 minutes for every set temperature shown in Table 1, then it was run, and thereafter measurements were made for 30 minutes.

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The value of the current in the table is an average value of ten bearings according to the invention and ten conventional bearings respectively.

Table 1

Bearing	Clearance	Measurement temperature	Ordinary temperature	-20°C	-30°C	-40°C	-50°C	-60°C
Inventive bearing	7-9 μm	Measurement item						
		Current value mA	60	60	60	55	55	55
Conventional bearing	7-9 μm	Metallic sound	No	No	No	No	No	No
		Current value mA	55	60	60-65	60	60	60
		Metallic sound	No	No	Yes	Yes	Yes	Yes

As evident from Table 1, with the bearing according to the invention, it can be seen that the generation of metallic sound, which occurs with conventional bearings, is nonexistent even if the temperature is as low as -60°C and the level of current value is also lower over that of conventional bearings.

Further, in the case of conventional bearing, an extraordinary current of 200 to 250 mA was observed temporarily for an initial 5 to 10 seconds when the motor started to drive at temperature of -30°C or lower. This high current decreases gradually as the motor is accelerated to the values in Table 1. In the case of the bearing according to the invention, however, such phenomenon of extraordinary current was not recognized.

Example 2

The torque test of bearing with inner diameter of 2mm, outer diameter of 5 mm and whole length of 3mm was performed for 2000 hours at normal temperature under the conditions of number of revolutions of 3000 rpm and load of 500 gf, and the results are shown in Fig. 1. Besides, conventional Cu type bearing was also produced with same dimensions and the torque test was performed under same conditions, the results of which are indicated in Fig. 1.

According to Fig. 1, it can be seen that the bearing according to the invention is more stable in torque and friction coefficient compared with a conventional bearing.

Example 3

5 The same Cu-type bearing according to the invention as in Example 2 was produced and the torque test was conducted for 2000 hours under the conditions of number of revolutions of 2000 rpm, load of 500 gf and testing environmental temperature of 60°C or 80°C, 10 the results of which are shown in Fig. 2.

15 According to Fig. 2, it can be seen that the characteristics of the bearing according to the invention do not change even if the temperature of use is as high as 80°C.

Example 4

20 Using same Cu-type bearing of the invention as in Example 2 and a Cu-type conventional bearing with the same dimensions, the friction test was conducted under the following conditions to examine the wear level of bearing at each time. The results are shown in Fig. 3. 25 Namely, using life tester, continuous running was conducted for 2000 hours at ordinary temperatures under the conditions of number of revolutions of 3000 rpm and load of 400 gf.

30 As evident from Fig. 3, the bearing of the invention shows little increase in wear level after 50 hours and is of stable quality. Whereas, with the conventional bearing, the wear level increases as the running time increases.

35 As described, in accordance with the invention, a sintered oil-retaining bearing capable of use over a

5 wide temperature range from minus 60°C to plus 80°C
without any problem has been obtained. Further, with
respect to the use in higher temperature domain than
this temperature, it is possible to use even at 150°C
or higher by using an oil with good high-temperature
10 characteristics. Moreover, the bearing of the
invention has such characteristics that the value of
torque generating thereon does not change from its
initial value even after a life of 2000 hours and yet
the friction coefficient does not change even by normal
15 and reverse rotations of axis. In addition, the
bearing of the invention shows very low wear level.
Based on these and other features, the invention exerts
remarkable effects industrially.



CLAIMS:

- 5 1. A sintered oil-retaining bearing provided on at least a part of the inside sliding surface of the bearing with protruding fibres which are incorporated in the metal of the bearing and which project from the inside surface.
 - 10 2. A sintered oil-retaining bearing according to claim 1, wherein the fibres are uniformly distributed over the inside surface of the bearing.
 - 15 3. A sintered oil-retaining bearing according to Claim 1 or 2, comprising a matrix composed of a Cu-type, Fe-type or Fe-Cu type.
 - 20 4. An improved process for producing an oil-retaining bearing according to any of claims 1 to 3, wherein composite fibres are added to the mother material component.
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