

TITLE OF THE INVENTIONSINTERED SLIDING BEARING5 BACKGROUND OF THE INVENTIONField of the Invention

10 This invention relates to a sintered sliding bearing, and in particular, to a sintered sliding bearing for use in a high temperature environment, such as a bearing for a heating roller in a copying machine.

Description of the Prior Art

15 As sintered alloy sliding bearings for small size motors and household electric appliances, there have been heretofore widely used oil-impregnated sintered bearings, i.e., sintered bearings in which the pores are impregnated with a lubricating oil.

20 The oil-impregnated sintered bearings have the disadvantage that, when used in a high temperature environment of, for example, about 250°C, the impregnating oil bleeds out of the pores and then deteriorates or burns, which makes the bearings no longer usable.

25 A commonly taken measure to avoid the above disadvantage has been either the use of a sintered alloy not impregnated with oil but containing a solid lubricant such as graphite or molybdenum disulfide in the alloy matrix, or the use of a ball bearing in which a special lubricant durable at high temperatures is injected.

30 However, in the case of the sintered bearing relying upon solid lubrication, it is necessary, in order to attain sufficient lubricating effects, to add a large amount of the solid lubricant, which causes a decrease in the material strength. In addition, the solid lubrication
35 bearing shows naturally a high coefficient of friction as

compared with fluid lubrication bearings. These disadvantages narrow the application of the bearing. The solid lubrication bearing further has the disadvantage that the production cost is higher than that of the

5 oil-impregnated bearing.

The use of the ball bearing, on the other hand, has the disadvantage that it is considerably costly as compared with the common sintered sliding bearings.

10 SUMMARY OF THE INVENTION

An object of this invention is to provide a sintered sliding bearing which has excellent sliding characteristics in a high temperature environment and which is low-cost.

15 Another object of this invention is to provide a sintered sliding bearing suitable for use at high temperatures and having a long life.

A further object of this invention is to provide a sintered sliding bearing which shows low abrasion over the
20 temperature range from normal temperatures to high temperatures.

These and other objects which will be apparent from the following detailed description can be achieved according to this invention by providing a sintered
25 sliding bearing comprising a porous sintered alloy in which the pores in at least the surface layer of the sliding side are filled with a thermoplastic resin with a melt viscosity at 250°C of 10 to 2,000 centipoises (cPs.).

30 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As the porous sintered metal, there may be employed FE-Cu-C alloys, Fe alloys containing Co and/or a carbide-forming element, Cu-Sn alloys, or Al alloys

Incorporation of a solid lubricant into these sintered alloys can give more excellent sliding characteristics. A sintered metal comprising at least one from the group consisting of graphite, molybdenum disulfide, tungsten disulfide, lead, boron nitride and magnesium silicate, dispersed in the matrix of a Cu alloy or a Fe alloy is particularly preferred.

Content of the solid lubricant in the sintered alloy is preferably not higher than 20% by volume. A solid lubricant content exceeding 20%v. may cause the material strength to be too low.

Preferably, most of the pores of the sintered metal are impregnated with the thermoplastic resin. However, the bearing works well with impregnation of the pores in only the surface layer or even in only the inner surface layer, i.e., the surface layer of the sliding side, of the bearing.

The thermoplastic resin impregnating agent preferably has, in addition to a melt viscosity at 250°C of 10 to 2,000 cPs., such properties that it deteriorates with difficulty when subjected to repeated heating/cooling, and is not corrosive. Thus, such a thermoplastic resin can be designated as a "synthetic wax".

Reasons why the above-mentioned melt viscosity range is preferred are as follows. If the melt viscosity at 250°C is lower than 10 cPs., the resin is liable to bleed out of the bearing during the use at high temperatures, which shortens the life of the bearing. On the other hand, if the melt viscosity at 250°C is higher than 2,000 cPs., it is difficult to impregnate the bearing with the resin because of its excessively high viscosity even when the resin is heated to as high a temperature as possible within a range that causes no deterioration of the resin.

Examples of a thermoplastic resin which possesses the above properties are low molecular weight polyolefins such

as polyethylene and polypropylene. A polyethylene with a molecular weight (MW) of 2,000 to 9,000 is particularly preferable. A polyethylene with a MW of less than 2,000 has a low heat stability, as seen from the fact, for
5 example, that it suffers from depletion when heated. Further, its viscosity during the use at a high temperature is too low. A polyethylene with a MW of higher than 9,000, on the other hand, has too high a melt viscosity.

The sintered sliding bearing of this invention can be
10 produced, for example, by melting the thermoplastic resin having the above-mentioned melt viscosity and impregnating the pores of the sintered alloy with the melted resin.

The sintered sliding bearing of this invention, in which the pores are filled with the specific thermoplastic
15 resin instead of the oil employed in the oil-impregnated sintered bearing, shows a low coefficient of friction when it is used in a high temperature environment of, for example, 200 to 300°C, by the fluid lubricating action of the softened or liquefied resin with an appropriate
20 viscosity at the high temperature.

When the sintered alloy of the bearing of this invention further contains a solid lubricant such as graphite or molybdenum disulfide, the solid lubricant depresses abrasion during operation at normal temperatures,
25 making up for insufficient fluid lubrication by the resin at normal temperatures. Further, at high temperatures, the solid lubricant serves to lower the coefficient of friction and abrasion conjointly with the fluid lubrication by the resin.

30 As explained above, the sintered sliding bearing of this invention has excellent qualities, and further, it is low-cost as compared with ball bearings. Therefore, the sintered sliding bearing of this invention is suitable as a bearing for copying machines, high temperature apparatus, or conveying apparatus in which the bearing is

used at high temperatures, and thus it can enlarge the application field of the sintered bearing.

This invention will be further illustrated by the following examples. In the examples, the thermoplastic resin impregnating agent is designated as "wax".

Example 1

In each experiment, a sintered body having a composition by weight of 9% of Sn, 3% of Co and the remainder Cu was subjected to sizing to form a bearing with an inner diameter of 10mm, an outer diameter of 16mm and a length of 10mm and a porosity of 20% by volume. The bearing was then impregnated with one of the following waxes or oils:

1. Polyethylene wax with a MW of 4,000
2. Polyethylene wax with a MW of 2,000
3. Polyethylene wax with a MW of 1,000
4. Perfluoropolyalkylether oligomer with a MW of 7500 (PFPE; fluoro-oil)
5. Perfluoropolyalkylether oligomer with a MW of 6300 (fluoro-oil)
6. Poly- α -olefin synthetic oil.

The bearings obtained in the experiments were held in air at 250°C for 3 hours and then cooled, after which the bleeding of the wax or oil from the bearings was evaluated.

The results are shown in Table 1 together with the viscosities of the impregnating agents. In the table, the experiment number corresponds to the above impregnating agent number.

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Table 1

Experiment No.	Viscosity (cP) of Impregnating Agent		Results
	at 40°C	at 250°C	
1	-	57	no bleeding observed
2	-	10	no bleeding observed
3	-	2	bleeding observed
4	741	6	bleeding observed
5	124	6	bleeding observed
6	100	-	oil became sludge

The bearings in the experiments No. 4 and 5 which employed the conventional synthetic oils (fluoro-oils), showed considerable bleeding of the impregnating oils. This results from the fact that the oils have low viscosities, though they have relatively high molecular weights.

The bearing of the experiment No. 6 which employed a common lubricating oil, is completely unacceptable, since the oil became a sludge.

As to the bearings of the experiments No. 1 to 3, it can be understood from the results in the table that, when the polyethylene wax employed has a viscosity at 250°C of 10 cPs. or more, no bleeding of the impregnating wax occurs.

Example 2

In each experiment, a powdered mixture with a composition by weight of 9% of Sn, 3% of Co and the remainder Cu was mixed with 5% of powdered graphite, and

the resulting mixture was subjected to compacting, sintering, and sizing to form a bearing similar to that of Example 1. The obtained bearing was impregnated with one of the aforementioned waxes or oils.

- 5 Each of the obtained bearings was tested for coefficient of friction by contacting it with a shaft made of a carbon steel (S45C) and rotating in an environment of 200°C.

Test conditions were as follows:

- 10 sliding velocity: 9 m/minute; bearing pressure: 20 Kgf/cm²; operating time: 500 hours.

Test results are shown in Table 2. In the table, the experiment number corresponds to the above impregnating agent number.

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Table 2

Experiment No.	Coefficient of Friction
1	0.03
2	0.05
3	0.20
4	0.15
5	0.17
6	0.35

- 20 The bearings in the experiments No. 1 and 2 according to this invention each showed a low coefficient of friction, while the bearing in the experiment No. 3, which employed the low viscosity wax not according to this invention, and the bearings in the experiments No. 4 and 5 which employed the conventional synthetic oils each showed a high coefficient of friction.
- 25
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The cause of the high values in the experiments No. 3 to 5 is considered to be loss of the impregnating oil due to bleeding out of the bearing.

The bearing in the experiment No. 6 which employed a common lubricating oil, showed a very high coefficient of friction. The cause thereof is considered to be that the lubricating action by the oil had been practically lost and hence the sliding was effected only by the solid lubrication by graphite.

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When the experiments were carried out employing a sintered Fe alloy containing 1.5% by weight of Cu as the bearing material, the results showed a tendency similar to the above.

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Further, when the experiments were carried out varying the solid lubricant added to the bearing material, graphite gave the lowest coefficient of friction, although there was no great difference in coefficient of friction among the various solid lubricants used. The value of coefficient of friction increased in the following order: (low) graphite < molybdenum disulfide < tungsten disulfide < boron nitride < magnesium silicate < lead (high).

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CLAIMS

1. A sintered sliding bearing comprising a porous sintered alloy in which the pores in at least the surface layer of the sliding side are filled with a thermoplastic resin with a melt viscosity at 250°C of 10 to 2,000 centipoises.
2. The sintered sliding bearing according to Claim 1, wherein the thermoplastic resin is a low molecular weight polyolefin resin.
3. The sintered sliding bearing according to Claim 2, wherein the low molecular weight polyolefin resin is a polyethylene with a molecular weight of 2,000 to 9,000.
4. The sintered sliding bearing according to any one of Claims 1 to 3, wherein the sintered alloy comprises at least one selected from the group consisting of graphite, molybdenum disulfide, tungsten disulfide, lead, boron nitride and magnesium silicate, dispersed in the matrix of an alloy selected from the group consisting of Cu alloys and Fe alloys.
5. Use of a sintered sliding bearing according to Claim 1, ~~for use~~ at a temperature of from 200°C to 300°C.
6. Use according to Claim 5, ~~for use as a bearing~~ in an apparatus in which the bearing is used in an environment of from 200°C to 300°C.
7. Use according to Claim 6, wherein the apparatus is one selected from the group consisting of copying machines, and conveying apparatus.



8. Use of a sintered slide bearing, according to Claim 6, as a bearing for the heating roller of a copying machine.

9. A sintered sliding bearing substantially as hereinbefore described with reference to the foregoing examples.
