Helical-groove Bearing with Long Life for Fan Motors

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1 Summary

Fan motors have been used in personal computers, game machines, and image equipment in recent years, and the market for fun motors has been expanding. Because fan motors are used for a long time under high temperatures (from 80 to 100 °C), the bearings used in the fan must have high durability. The key factor to lengthen the life of sintered bearings is decreasing oil dissipation during operation. To achieve this, we developed oil that has a low evaporation at a high temperature. Furthermore, a bearing with helical grooves to prevent oil flow was developed. The developed bearing showed about twice of the durability of the conventional bearing under high temperature. This indicates that the developed bearing is suitable for fan motors and can be substituted for the conventional bearings widely used in fan motors.

2 Features of Technology

- Helical-groove bearing controls the flow of oil that exists in the boundary with the motor shaft. It can reduce oil flow from the motor chassis with its sealing function.
- Because our new impregnating oil has low evaporation loss in high-temperature environments, it is well-suited to motors in high-temperature environments.
- Bearings combining these two technologies exhibit more than twice of the durability of conventional bearings.

3 History of Development

Bearings for fan motors are classified according to their length of life span. Rolling bearings are used for long-life motors, and sintered bearings are used for motors with a relatively short life.

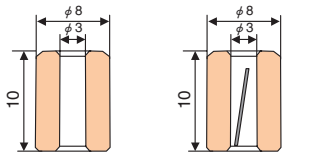
As the axis rotates, impregnating oil in the sintered bearing seeps out through the pores and forms a film of oil between the axis and the bearing. This maintains good lubrication during the operation of the axis. When the axis stops, the oil returns again to the inside of the bearing through the pores. Therefore, a major problem to increase the life of sintered bearings is to reduce the rate of oil dissipation.

In recent years, bearings with durability of more than 50,000 hours are being sought for long-life motors. To meet this demand, it is necessary to develop sintered bearings that achieve less oil dissipation than before. Mainly because of high temperatures and friction heat, impregnating oil in fan motors loses viscosity and dissipates by leaking out of the bearings and evaporation. To resolve these problems, we have developed a helical-groove bearing with sealing function and impregnating oil with low evaporation loss.

4 Content of Technology

(1) Helical-groove Bearings for Fan Motors

Figure 1 shows the outline of (a) conventional sintered bearing and (b) the developed helical-groove bearing developed. By making oil flow toward the motor's closure side, the developed helical-groove bearing prevents oil from leaking out of the discharge side. Also, the inclination angle and the area ratio of the helical groove affect lubricating ability of the bearings. The sealing ability of oil is good when the inclination angle is about 10°. The retaining ability of oil is good when the area ratio is about 10°. Also, by making the grooves pass through the closure side of the motor and not pass through the discharge side, the seal quality is increased.[1)]



(a) Conventional sintered bearing (b) Helical-groove sintered bearing

Figure 1 Sintered bearing for fan motor

The specifications of the developed helical-groove bearing are: 10° angle of inclination, 10% groove area ratio, and three grooves.

(2) Evaporation Properties of New Impregnating Oil

General impregnating oils of sintered bearings for motors are mainly polyalphaolefin base synthetic oils. However, because evaporation loss for these oils occurs in high temperature, they cannot be used for motors in high-temperature use. Thus we selected polyol ester which shows less evaporation loss. We also investigated additives to prevent oxidation in high-temperature environments and improve the durability of impregnating oils. **Figure 2** shows the evaporation loss of impregnating oils at over 150 °C. Compared to the conventional oil, the evaporation loss of developed oil was reduced by about 40%. It is well-suited for motors in high-temperature use.

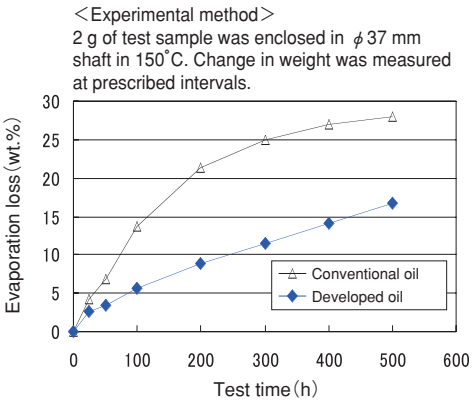


Figure 2 Relationship between test time and evaporation loss of oil

(3) Durability of Actual Fan Motor

Results of durability testing of an actual fan motor are shown in **Figure 3**. It shows the relationship between test time and the change in motor current. For conventional sintered bearings (a) with conventional oil, the motor current's rate of change exceeded 10% after 5,000 hours. For conventional sintered bearings (a) with the developed oil, it took 7,000 hours. In contrast, for helical-groove bearings (b) with the developed oil, the rate of change in motor current was less than 5% after 9,500 hours, demonstrating superior durability. **Figure 4** shows the rate of oil loss in bearings under the same conditions. It indicates that reduction in oil loss lowers the rate of change in the motor current. In other words, reduction in oil loss contributes to the life of the bearings. Because helical-groove bearings (b) with developed oil show lower leakage to outside the bearings and lower evaporation loss, total loss of oil loss is estimated to be decreased. The durability of the combination shows more than twice of conventional products, and can be applied to the motors for long-time use.

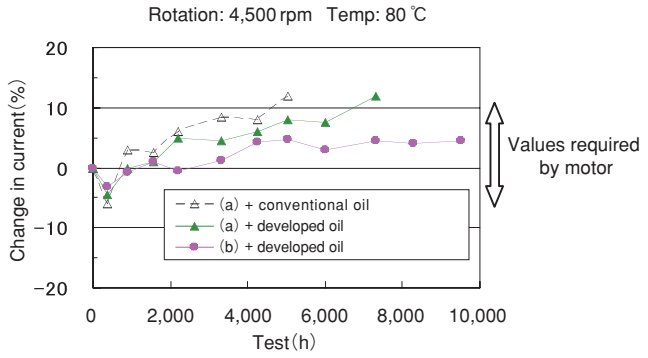


Figure 3 Relationship between test time and change rate of motor current

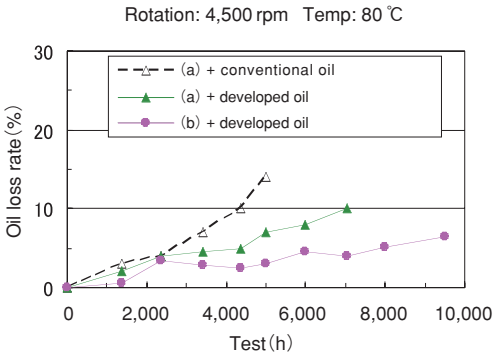


Figure 4 Relationship between test time and oil loss

5 Future Developments

Expanding our technology to rolling bearings used by fan motors for long-time use.

【References】

1) Yanase, Tsuyoshi: "Development of Long-Life Bearings for Fan Motors," Hitachi Powdered Metals Technical Report, No.9, pp.20-23 (2010)