

3221 HDD用小型スラスト空気軸受の特性解析と最適設計 -パラメトリックスタディ-

Characteristics Analysis and Optimum Design of Small Size Thrust Air Bearing for Hard Disk Drive - Parametric Study

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Grooved thrust air bearings are widely used for very high speed and lightly loaded machinery. The revolutionary spin is relatively extremely high and is very applicable to meet future expectation because of their low friction, low operational noise and environmentally friendly. With the country's aim in increasing the HDD storage capacity, eventually it will lead to higher revolutionary HDD bearing. Currently HDD bearings depend on hydrodynamic oil bearings. To cope with the increasing of storage capacity demand, higher revolutions of bearing will become necessary; hence oil-lubricated bearing will face its major problem, which is high friction torque and bearing stiffness reduction. As a substitution, the thrust air bearing has been highly expected to be the next new version of high revolutionary bearings. However the stiffness of thrust air bearing is relatively weak and it is important to improve the bearing stiffness to fully utilize the air-lubricated bearing. This paper shows the possibility of the new version of air-lubricated bearings to be exchanged with the conventional oil-lubricated bearings by showing the comparison applied for HDD.

Keywords: HDD (Hard Disk Drive), Optimum Design, Thrust Air Bearing, Groove Geometry, Air Film Thickness, Bearing Stiffness, Dynamic Characteristics

1. Introduction

In the field of informative multimedia, the need of increasing hard disk capacity is unstoppable. Currently, in gaining the higher storage capacity and higher data transfer speed, the revolutions of the disk depend on fluid film bearings. In order to furthermore upgrade the revolutions of the hard disk, a higher revolutionary bearing is a necessity. At the moment, oil-lubricated fluid film bearings are widely being used.

Japan government has its own annual aims for the storage capacity goals [1]. In order to cope with the storage capacity demands, current oil bearings designs are nearly coming to its limit where high revolutions leads to high friction losses and wear problems. Therefore, a much higher revolutionary air bearing as the next bearing is highly expected.

2. Comparison of Spiral Grooved Thrust Oil Bearing and Thrust Air Bearing

To make the comparison, spiral grooved bearing has been chosen. The bearing used in calculations is shown in Fig. 1, where the sample of bearing location in HDD spindle motor is shown in Fig. 1(a). The groove geometry for spiral groove is shown in Fig. 1(b). The pressure distribution for oil and air bearing under room temperature of 20°C is shown in Fig. 1(c). From the calculations, it is understood that the value for pressure

distribution in oil bearing and air bearing is totally different.

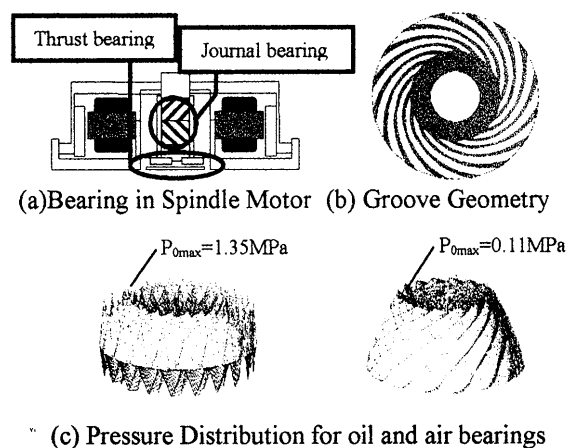


Fig.1 Spiral Grooved Bearing

Table 1 Comparison of Oil and Air Bearing for HDD

Lubricant	Advantages	Disadvantages
Oil	High stiffness High damping	Oil leakage High friction torque
Air	Low friction torque Maintenance free	Low stiffness Low damping