Characteristic of Modified Spiral Bearing and its Seals Effect through Geometries and Dimension Modification

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1. Introduction

Bearing is a simple and important item used to reduce the friction between parts during relative movements. Fluid dynamic bearing (FDB) is a type of fluid film bearing that is being used in the industry right now due to its outstanding damping characteristic compared to a conventional ball bearing [1]. Besides that, Liu et al. [2] found that the FDB improved the load capacity for miniature spindle motors and small-form-factor data storage applications. Fluid dynamic bearing is widely used in high speed or in high precision applications. The design of bearing has the function to extend bearing life in machinery, reduce friction, energy losses and wear, and minimize the maintenance expenses and downtime of machinery which usually caused by bearing failures [3]. This research, focuses on the optimum design of a fluid dynamic bearing named modified spiral design. Other researchers studied about the optimum design of FDB to reduce non-repeatable runout (NRRO) and repeatable runout (RRO) [4]. However, the objectives this paper is to improve the pressure distribution inside the bearing and identify any alternative lubricant for FDB to minimize the temperature of a hard disk drive (HDD). Most HDD depend on oil as the lubricant to reduce the absorption on the surface with the aid the magnetics field [5]. The lubricant will be pushed to the inner vicinity of the groove and generates pressure to the bearing surface, levitating the bearing. The authors focus on a model of bearings with a diameter of 64 mm. The current conventional spiral design in this research has 12 number of grooves while the modified spiral has 24 number of grooves, shown respectively in Figure 1. The details of the design comparison are summarized in Table 1. Both designs are classified into two, for bearing with seal and without seal. For the difference in those two designs, bearing with seal and bearing without seal design, are shown in cross-sectional figures, schematically in Figures 2 and 3.

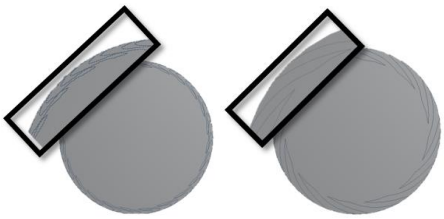

Figure 1 Modified spiral design and conventional spiral design

2. Design and Parameters

In this paper, the authors focus on FDB which is applied to a thrust hydrodynamic bearing of a HDD. The modified spiral groove design with a smaller diameter was also proposed by Ibrahim et al. [6] using modification method of groove geometries with air as its lubricants. However, no experimental analysis verifications were discussed in the paper.

Table 1 Parameter of designs for spiral groove and modified spiral groove

Parameters		Spiral Groove	Modified Spiral Groove
Number of grooves	N[mm]	12	24
Outer radius	R_1[mm]	32	32.0
Inner radius	R_2[mm]	25.6	25.6
Seal radius	R_s[mm]	27.52	29.76
Groove depth	H_g[μm]	5.0	8.0
Rotational speed	n[rpm]	10,000	10,000

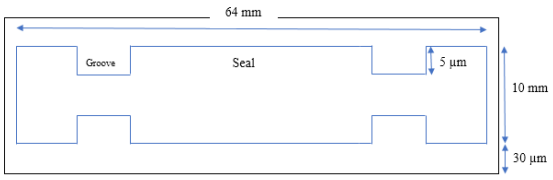

Figure 2 Schematic cross-sectional diagram for bearing with seal design

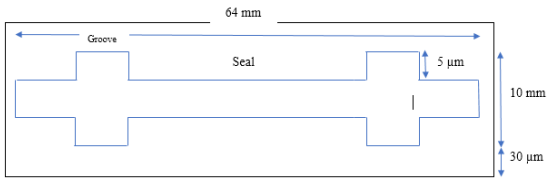

Figure 3 Schematic cross-sectional diagram for bearing without seal design