Specification

1. Title of the Invention:

Magnetic Disk Unit

2. Claims:



(1) A magnetic disk unit comprising a lubricant supply to reduce friction between a magnetic disk and a magnetic head with the lubricant between the disk and head, a magnetic disk unit comprising:

a clamp assembly to fix the magnetic disk to a spindle motor;

a material impregnated with lubricant being disposed between the clamp assembly and magnetic disk;

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* C L M S *

a thin film permeable by lubricant between the material impregnated with lubricant and the disk; and

an assembly to hold and fix the material impregnated with lubricant and the thin film between the clamp assembly the disk;

wherein lubricant in the material impregnated with lubricant is supplied little by little on a disk surface through the thin film.

(2) A magnetic disk unit according to claim 1, a structure in the spindle motor of the clamp assembly being unified with the spindle motor, and a holding structure of the material impregnated with lubricant being unified with the spindle motor.

(3) A magnetic disk unit according to claim 1, comprising an adjustment mechanism to adjust pressure to the disk by the clamp assembly to adjust the lubricant supply to a disk surface through adjustment of the pressure on the disk

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surface by the clamp assembly against the thin film.

(4) A magnetic disk unit according to claim 1, comprising:

a thin film having notches on the outer circumference; and

convex parts being formed in accordance with the notches;

wherein in the thin film is fixed on the disk by the clamp assembly through mating of the notches of the thin film with the convex parts.

(5) A magnetic disk unit according to claim 1, comprising:

a thin film comprising through-holes;

convex parts being formed in accordance with through-holes on mating positions of the clamp assembly with the through-holes;

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wherein the thin film is fixed on the disk with the clamp assembly through mating of the through-holes of the thin film with the convex parts of the clamp.

(6) A magnetic disk unit according to claim 1, comprising:

a magnetic head in the magnetic disk unit, sliding legs near the magnetic head, sliding legs contacting the magnetic disk surface and sliding on the magnetic disk surface, and being on a ski-liquid-contact magnetic head carrier, performing recording and playback through the sliding legs sliding on the disk surface.

(7) A magnetic disk unit according to claim 1, comprising a film made of porous plastic or a porous sintered metal.

(8) A magnetic disk unit according to claim 1, comprising a material impregnated with lubricant made of porous plastic or a porous sintered metal.

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3. Detailed Description of the Invention:

[0001]

[Field of the invention] .

The present invention relates to a magnetic disk unit and, more specifically, to a magnetic disk unit having a structure to reduce friction between a magnetic disk and magnetic head by supplying lubricant between the magnetic disk and magnetic head, wherein the magnetic disk unit comprises a lubricant supply for supplying an adequate volume of lubricant over a long period.

[0002]

[Prior art]

A magnetic disk unit comprises a rotary disk having concentric data tracks storing information, a head reading data from or writing data tracks, and an actuator moving the head to the desired track and connected to a head carrier to keep the head in the center of the track during reading or writing.

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Theretofore, in many disk units, an air bearing slider has mainly been used as a head carrier. This air bearing method uses air between a disk and head, and makes the head run on the disk by floating the head a predetermined distance from the disk surface.

[0003]

However, among recent magnetic disk units requiring higher recording and playback density, new units have appeared that reduce the gap between the magnetic disk and magnetic head and get higher recording density with a reduced recording and reading radius. One example of them is a head contact method in which the head records and plays back almost in contact between the head and disk, allowing the head to read and write with narrower gap between the disk than in the prior air-bearing method. Using this structure, it is possible to attain higher recording density than with a floating head using the prior air-bearing method.

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[0004]

However, this contact magnetic disk unit poses the possibility of disk or head damage by contact friction between the magnetic disk and head. A structure is proposed to avoid this damage, supplying adequate lubricant to the disk and keeping the lubricant between the disk and head. A ski-liquid-contact is also proposed, forming sliding legs being comprised of plurals of convex parts, contacting these legs to the lubricant film on the magnetic disk surface to make the head slide on the disk with less friction. However, these methods require various tasks, such as lubricant volume adjustment and replacing lubricant.

[0005]

One lubricant supply type for a magnetic disk recently proposed is a lubricant circulation type which draws the lubricant supplied to a disk surface from a supply assembly, and supplies it to the disk surface from the supply assembly. However, these withdrawal types require a bigger scale for the whole unit, going against trends in down-sizing.

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[0006]

Furthermore, problems arise in positioning and space for a lubricant supply source. In the limited space on the magnetic disk unit, it is required to supply lubricant uniformly and stably to the disk surface over a long period.

[0007]

An example of a previously proposed lubricant supply is one disposing a nozzle tip for lubricant supply to supply the lubricant from an upper position to the predetermined location on the inner circumference of the disk surface, but this has problems in the aspects of uniform lubricant supply and down-sizing.

[0008]

[Problems to be attained by the invention]

The present invention has an object of providing a magnetic disk unit which can adjust lubricant supply

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and, still more, supply lubricant stably and uniformly to the entire disk surface.

[0009]

Still more, another object of the invention is to provide a lubricant supply suitable to down-sizing without wasting space, and contributing to down-sizing of a magnetic disk unit.

[0010]

[Means for attaining the problems]

A magnetic disk unit of the invention can supply lubricant uniformly to a disk surface, and easily control the supply volume. The invention comprises a material impregnated with sufficient lubricant to supply the disk surface over a long period, a thin film supplying a predetermined volume of lubricant to the disk surface, the lubricant permeating little by little from the material impregnated with lubricant, and a clamp assembly fixing the material impregnated with lubricant and the thin film with the disk.

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[0011]

In a preferable embodiment of the invention, the material impregnated with lubricant is held in a space prepared in a clamp assembly, the thin film permeable by the lubricant is fixed on the disk in compression with a pressure component formed at an edge of the clamp assembly. This compressed quantity, controls the supply of lubricant to the disk surface.

[0012]

Still more, for relatively fixing the thin film to the clamp, an embodiment of the invention forms a mating structure between the thin film and clamp, such as a plurality of convex parts on one side and a plurality of concave parts on the other, fixes both with this mating, and hence enabling them to keep their positions in spite of high-speed disk rotation, external shock, or change on environmental temperature.

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[0013]

[Embodiment]

A detailed description of the invention is made referring to attached drawings. Figure 1 is a sectional view showing an embodiment of a lubricant supply disposed around a spindle motor in the center of a disk according to a magnetic disk unit of the invention. A magnetic disk 10 mates its center hole with a spindle motor 12, and the two are held by clamping from both sides of the magnetic disk 10. In this embodiment, the lower clamp is unified with a spindle motor 12.

[0014]

A clamp ring 16 on the magnetic disk 10 has a concave part to hold a material impregnated with lubricant 14, for example, a sponge and so on. A concave part is also formed on the spindle motor 12 below the disk to hold the material impregnated with lubricant 14. As lubricant, high viscosity lubricant, such as perfluoro-polyether (PFPE) and so on, is used to supply lubricant

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little by little to the disk surface over a long period. This lubricant is supplied to the upper and lower disk surfaces through thin films 20. The thin films have a predetermined elasticity, and are fixed with a predetermined pressure to the disk surfaces by the clamp assembly. The pressure is controllable by a screw mechanism 18. A film material is, for example, porous plastic or porous sintered metal, which has predetermined elasticity, and through which lubricant is permeable over a long period. Lubricant supply is controlled through adjustment of the thin film pressure.

[0015]

Figure 2 shows the second embodiment of the invention. The same components are indicated by the same numbers. This has each material impregnated with lubricant 14 on both sides of the disk 10, and the upper thin film 20 and the lower thin film 22 are fixed between the magnetic disk 10 and the material impregnated with lubricant 14 by the clamp assembly. The thin film of the second embodiment has the structure shown in Figure 3, which shows a top view of the lower thin film 22 of

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the disk in Figure 2. As shown in Figure 3, a plurality of through-holes 24 is formed in the thin film 22. These through-holes 24 are also formed in the upper thin film 20. The plurality of these through-holes 24 is mated with the convex part 26 formed at the clamp ring 16 on the upper side, and the plurality of convex parts 26 of the clamp assembly unified with the spindle motor. Hence, the plurality of convex parts 26 mating with through-holes 24 formed in the thin film 20 and 22 is unified with the clamp ring 16 and the spindle motor on the lower side of the magnetic disk 10.

[0016]

The height of this convex part 26 formed in the clamp ring 16 and the spindle motor 12 is lower than the thicknesses of the thin films 20 and 22, and flat parts of the thin films 20 and 22 excluding through-holes 24 are fixed with pressure between a flat part of the clamp except the convex part and the disk. Hence, with the clamp assembly fastened to the disk surface with a screw mechanism, the thin film pressure becomes

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controllable by adjusting the degree of fastening, also enabling the lubricant supply controllable.

[0017]

Figure 4 is a sectional view of another embodiment of the invention. The thin films 30 and 32 in Figure 4 have a plurality of notches on the outer circumference. Figure 5 shows a top view of the thin film 32 on the spindle motor, the lower side of the disk. As shown in Figure 5, a plurality of notches is formed around the thin film 32. These notches correspond to the through-holes in Figure 3. Hence, convex parts are formed in accordance with the notches of the thin film 30 at the clamp ring 16 on the upper side of the magnetic disk 10, and convex parts are formed in accordance with the notches of the thin film 32 at the clamp ring 16 on the spindle motor. The height of these convex parts is lower than the thicknesses of the thin films the same as in the embodiment forming the through-holes. Hence, pressure on the thin film is controlled with the fastening degree of the clamp, and permeability of the lubricant is stabilized.

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[0018]

Figure 6 is a top view showing the inside of the magnetic disk unit without a cover, and the magnetic disk 10 is fixed by the ring-shaped clamp ring 16. A thin, continuous film of a comparatively high viscosity lubricant is maintained on the surface of the magnetic disk 10. A magnetic head carrier 34 is installed on a suspension 36 to push a magnetic head carrier 34 to keep contact to the lubricant film on the surface of the magnetic disk 10.

[0019]

Figure 7 shows an embodiment of a magnetic head carrier, and a plurality of sliding legs 40, 42, and 44 is formed on a sliding plate 43. The magnetic head carrier can be made of ferrite, or the usual materials for making an air-bearing slider, such as ceramic materials of alumina and titan carbide. The magnetic carrier 34 has a flat face forming each sliding leg. The sliding leg 44 is set nearby the back of the magnetic head carrier. Sliding legs have nearly round edges to enable the magnetic head carrier to slide on

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the lubricant film without relation to the direction of movement of the magnetic head carrier are frustums of a circular cone extending from the flat face 43. If the magnetic carrier is on a rotary actuator making the carrier move along a nearly arced route, the carrier can slide, and the direction of movement of the magnetic head carrier against the disk varies based on the radial direction of the carrier.

[0020]

The boundary between the magnetic head carrier and the disk with the lubricant film is shown in Figure 8. In a preferable embodiment, the magnetic disk 10 has a surface film 70 of conventional amorphous carbon on the top layer, and is usually about 250 Å thick. Under the surface film 70 is a magnetic layer 72 like the usual sputtered magnetic layer of cobalt alloy. Liquid lubricant is set on the surface film 70 in a layer 74 about 10 - 200 Å thick. Figure 8 shows a part of the sliding leg 40 on the lubricant film 74. A contacting edge of the sliding leg 40 is about 100 microns in diameter, the cone angle is about 10 degrees, and the etching depth is about 4000 Å. A converter is at the

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edge of the sliding leg 44 in back of the magnetic head carrier 34 and maintains a gap as wide as the lubricant film is thick, (e.g., 20 - 100 Å,) from the upper surface of the disk. In operation, a suspension 36 (Figure 6) pushes the magnetic head carrier 34 to make the sliding legs 40, 42, and 44 contact the lubricant film 64, and, since the lubricant film is incompressible, it functions as a gap adjustment layer between the magnetic head carrier 34 and the magnetic disk 10. A comparatively small angle (10 degrees in Figure 8) between the contact edge of the sliding leg 40 and the magnetic disk increases slidability of the magnetic head carrier almost without generating barriers against the lubricant passing under the contact edge of the sliding leg 40 in the start of the disk drive.

[0021]

[Advantages of the invention]

According to the invention, in a head contact of a magnetic disk unit with lubricant, it is possible to supply the lubricant uniformly to a magnetic disk over

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a long period; it is easy to control the lubricant supply; it is kept in position through a mating structure; and it is provides a lubricant supply structure advantageous in saving space.

4. Brief Description of the Drawings:

Figure 1 is a sectional view showing a structure of an embodiment of a lubricant supply composed around a spindle of a magnetic disk unit according to the invention;

Figure 2 is a sectional view showing the structure of an another embodiment of a lubricant supply composed around a spindle of a magnetic disk unit according to the invention;

Figure 3 is a top view of a thin film in the structure shown in Figure 2;

Figure 4 is a sectional view showing the further embodiment of a lubricant supply composed around a

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spindle of a magnetic disk unit according to the invention;

Figure 5 is a top view of a thin film in the structure shown in Figure 4;

Figure 6 is a top view of a magnetic disk unit;

Figure 7 is a top schematic diagram showing the bottom of a magnetic head and a magnetic head carrier that are used in the invention; and

Figure 8 is a sectional view showing a boundary between a magnetic head carrier and a magnetic disk.

[Description of symbols]

10	Magnetic disk
12	Spindle motor
14	Material impregnated with lubricant
16	Clamp ring
18	Screw mechanism
20, 22	Thin film
24	Through-hole

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26	Convex part
30, 32	Thin film
34	Magnetic head carrier
36	Suspension
40, 42, 44	Sliding leg
46....	Magnetic head

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