DESCRIPTION

Magnetic head supporting mechanism

Field of the Invention

The present invention relates to a magnetic head supporting mechanism for supporting a magnetic head in a magnetic disk device. In the magnetic disk device of this invention, a plurality of magnetic disks are mounted to a spindle motor unit with predetermined spaces. Data are recorded on and reproduced from these magnetic disks through magnetic heads. In particular, the present invention is intended to provide a structure for mounting a tail end of a suspension arm having a magnetic head at a tip end thereof, directly to a rotatable rotary body.

Background of the Invention

Fig. 3 is a perspective view depicting a structure of a widely used fixed magnetic disk device of the prior art. In Fig. 3, one or plural pieces of magnetic disk 5 are mounted to a spindle motor unit 3. The spindle motor unit comprises a spindle motor and a support member for securing the one or plural pieces of magnetic disk. Individual magnetic disks 5 are fixed in such positions where they are stacked one after another with a predetermined space, if a plurality of the magnetic disks 5 are fixed. A magnetic head 7 is fixed to a first end of a suspension 8. A second end of the suspension 8 is fixed to a tip end of an arm piece 9 formed integrally with a rotary body 6, as shown in Fig. 4. The rotary body 6 is mounted in a rotatable manner around a rotational center axis 12 provided on a base 1. Further, the rotary body 6 is provided with a coil 10 fixed

to a side opposite to the arm piece 9. The coil 10 and a permanent magnet (not show in the figure) arranged on the base 1 compose a voice coil motor. In other words, the rotary body 6 is rotated reversibly by the voice coil motor. The magnetic head 7 moves to any position along a radius on the magnetic disk 5 by a rotary movement of the rotary body 6. Then, the spindle motor 3 rotates. The magnetic head 7 floats by a predetermined distance from the magnetic disk 5 due to airflow generated by the rotation between a surface of the magnetic disk 5 and the magnetic head 7. A flying height of the magnetic head from the magnetic disk is dependent upon a balance between a flotation force produced by the airflow and a depressing force placed on the magnetic head toward the magnetic disk by the suspension. Here, the depressing force given to the magnetic head by the suspension toward the magnetic disk is called "gram load". The data on the magnetic disk 5 is read steadily through the magnetic head 7, when the magnetic head and the magnetic disk maintain the predetermined flying height. Data is also recorded steadily on the magnetic disk 5 through the magnetic head 7. A cover 11 is provided to prevent entry of dust from outside of the magnetic disk device.

There are two kinds of structure of the prior art, with which to integrate a rotary body, an arm piece, and a suspension carrying a magnetic head attached to a tip end thereof. A structure shown in Fig. 5A and 5B is the one used to mount the suspension to the arm, which is integral with the rotary body. On the other hand, a structure shown in Fig. 6 is the other used to mount a suspension arm, which is constructed of a suspension and an arm in advance as a single piece, to the rotary body.

First, a description will be given of the structure shown in Fig. 5A and 5B.

Fig. 5A and 5B are sectional views depicting a method of mounting the suspension 8 to the arm piece 9. The arm piece 9 is integrally constructed with the rotary body 6. A mount plate 13 is attached to a portion of the arm piece 9 where the suspension 8 is mounted. The mount plate 13 is provided with a boss 14 of a cylindrical shape. The suspension 8 is held in a predetermined position with a mounting jig (not show in the figure), while the boss 14 is inserted into a hole 9a formed in the arm piece 9. A steel ball 15 is pressed into a hole 14a in the boss 14 until it passes through, while they are held by the mounting jig. In this embodiment, an inner diameter of the hole 9a in the arm piece 9 is slightly larger than an outer diameter of the boss 14, and a diameter of the steel ball 15 is slightly larger than an inner diameters of the hole 14a in the boss 14. The inner diameter of hole 14a in the boss 14 is expanded when the steel ball 15 is pressed into it. The outer diameter of the boss 14 also expands at the same time. As a result, the boss 14 is swaged to the hole 9a, and thereby the suspension 8 is assembled integrally with the arm piece 9.

However, the following problems arise in the above-described supporting device of the magnetic head. First, there occasionally is a case in the method of swaging the suspension to the arm integrated with the rotary body, that the suspension may tilt, warp, and so on during swaging. A gram load can vary due to the tilting, warping, etc. It normally requires a certain length of swaging margin (a dimension "L" shown in Fig. 5B) necessary to keep a mounting strength. However, a spacing between stacked magnetic disks becomes narrower as a number of the disks increases. A swaging margin necessary to keep the mounting strength cannot be secured in such cases.

Hence, the other method may be used, in which a suspension arm constructed

in advance with a suspension and an arm into a single piece is mounted to a rotary body.

With reference to Fig. 6, the structure in which a suspension arm (hereinafter referred to simply as "SA") 16 constructed as a single piece with a suspension and an arm is mounted to a rotary body 17, will be described next.

Fig. 6 is a sectional view depicting a method of the prior art for mounting the SA 16 to the rotary body 17. The rotary body 17 is provided with grooves 18a, 18b, and 18c formed in planes perpendicular to its rotational center axis 12. A magnetic head 7 is attached to a first end of the SA 16, and a spacer 20 is bonded to a second end of it. A number of them are then inserted into the grooves 18a, 18b, and 18c in the rotary body 17, and they are secured with adhesive.

The above method also gives rise to problems as described below.

First, it is anticipated that corrosion occurs in the head media due to gases evolved from the adhesive. Besides, it needs to mount a maximum of two suspension arms in one of the grooves, 18b, as shown in Fig. 6. There is a possibility in this case, that one of the suspension arms may warp or deform when a magnetic head on the other arm is replaced. The warpage or deformation may cause a variation in gram load of the magnetic head, which is critical in the magnetic disk device. In addition, mounting by adhesion is a time-consuming work involving a control for an amount of application, a drying time, and so on of the adhesive material. Moreover, it is difficult to remove the suspension arm when a need arises to replace it. The above method is not suitable for mass production, in principle, since the suspension arm is a component that requires replacement.

Summary of the Invention

In order to obviate the above-described problems, a magnetic head supporting mechanism of the present invention comprises:

a. a rotary body having a plurality of grooves formed in it;

b. a suspension arm carrying a magnetic head attached to a first end thereof; and

c. a waveform washer press-fit in the groove of the rotary body together with a second end the suspension arm.

The suspension arm ("SA") is secured to the rotary body by a compression force in an axial direction of the waveform washer (hereinafter referred to simply as "WW"). This structure per se is simple, and an assembly work is also simple. In addition, the SA can be mounted on and removed from the rotary body easily as compared to the structure of the prior art. Furthermore, the WW presses the SA upon a surface of the groove in the rotary body. This structure obviates tilting, warpage, and the like of the SA, so long as an accuracy of the groove is attained properly. The second end of the SA fits along the surface of the groove.

Accordingly, the present invention obviates the problems associated with mounting such as a variation in gram load, and tilting, warpage, and the like of the SA. Further, it can avoid evolution of gases, since it does not use adhesive. Consequently, the present invention can provide the magnetic head supporting mechanism of high reliability.

Furthermore, the magnetic head supporting mechanism of this invention will be described more specifically.

The magnetic head supporting mechanism, wherein magnetic heads are supported by a rotatable rotary body via their respective SA's for recording and

reproducing respective data on a plurality of magnetic disks that are stacked at predetermined spaces and driven to rotate, the magnetic head supporting mechanism comprises:

a. the rotary body of a spindle-like shape having a plurality of grooves in an outer periphery of it;

b. a plurality of the SA's, each of which carries a magnetic head attached to a first end of it; and

c. WW's of a semi-annular shape.

The plurality of grooves are provided individually in each of planes perpendicular to an axial direction of the rotary body. The second end of the SA and the WW are inserted in each of the plurality of grooves so that the SA is secured to the rotary body by the compression force in the axial direction of the WW.

Further, a bottom surface of the groove is formed in a circular shape in the magnetic head supporting mechanism of the present invention. In addition, the second end of the SA is formed with a cutout in a shape of circular arc to fit to the bottom surface of the groove.

Also, the second end of the SA formed with the cutout of circular arc is a semi-annular shape, and the WW is constructed in a shape that presses the semi-annular portion with at least three points. This structure of the WW thus presses the second end of the SA having the semi-annular shape with at least three points against the rotary body.

Brief Description of the Drawings

Fig. 1A is a sectional side view depicting an essential portion of a magnetic

disk device employing a magnetic head supporting mechanism of an exemplary embodiment of the present invention;

Fig. 1B is an enlarged view of a portion encircled in Fig. 1A;

Fig. 1C is a drawing depicting a dimension of a waveform washer shown in Fig. 1A under an unloaded condition;

Fig. 2A is a perspective view depicting an assembling process of the magnetic head supporting mechanism of the exemplary embodiment of this invention;

Fig. 2B is an enlarged view of a portion encircled in Fig. 2A;

Fig. 2C is a perspective view depicting the magnetic head supporting mechanism of the exemplary embodiment of this invention after it is assembled;

Fig. 3 is a perspective view depicting a structure of a stationary type magnetic disk device of the prior art;

Fig. 4 is a perspective view depicting a magnetic head supporting mechanism of the prior art;

Fig. 5A and 5B are sectional side views depicting an essential portion of the magnetic head supporting mechanism of the prior art during assembly; and

Fig. 6 is a side view depicting an another example of an essential portion of the magnetic head supporting mechanism of the prior art.

Description of the Preferred Embodiments

A magnetic head supporting mechanism of the present invention will be described hereinafter with reference to the accompanying drawings.

(An Exemplary Embodiment)

With reference to Fig. 1A, 1B, 1C, 2A, 2B, and 2C, an exemplary embodiment of this invention will now be described hereinafter. In Fig. 1A, 1B,

1C, and Fig. 2A, 2B, 2C; like reference numerals have been used throughout to designate components having like functions as those shown in Fig. 3, Fig. 4, Fig. 5A, 5B, and Fig. 6.

Fig. 1A, 1B, and 1C are drawings depicting essential portions of a magnetic disk device employing a magnetic head supporting mechanism according to an exemplary embodiment of this invention. Two pieces of magnetic disk 5 are secured to a spindle motor unit 3 in a manner to be stacked with a predetermined space. As the magnetic disks 5 are secured, they rotate together when the spindle motor unit 3 rotates. A cylindrically shaped rotary body 17 is mounted rotatably around a rotational center axis 12 by a voice coil motor (not show in the figures) in the like manner as that shown in Fig. 3 and Fig. 4. The rotary body 17 is provided with four grooves 18 in planes perpendicular to an axial direction of it. A magnetic head 7 is attached to a first end of each of SA's 16. A second end of it is formed with a semi-annular portion 16b projecting right and left, and having a cutout 16a of semi-circular arc (refer to Fig. 2).

This second end of the SA 16 is inserted into the groove 18 together with a WW 19. The WW 19 also has a semi-annular shape in like manner as the cutout 16a of semi-circular arc. In this embodiment, a radius of a circular arc of the semi-annular portion 16b and a radius of a circular arc of the semi-annular shape of the WW 19 are approximately same. Furthermore, the radii of these circular arcs are nearly equal to a radius of a cylindrical portion of the groove 18. A dimension L1 (refer to Fig. 1C) in an axial direction orthogonal to an annular surface of the WW 19 under an unloaded condition is larger than a dimension L2 (refer to Fig. 1B) in an axial direction of a space formed after the second end of the SA 16 is inserted in the groove 18.

Therefore, the WW 19 provides a compression force to press the SA 16 against the rotary body 17, when the SA 16 and the WW 19 are inserted in the groove 18. This compression force is capable of securing and holding the SA 16 to the rotary body 17.

If a spring constant of the WW 19 in the axial direction is denoted by "*k*" (kg/mm), and a smaller of a coefficients of static friction between the WW 19 and the rotary body 17, and a coefficients of friction between the WW 19 and the SA 16 is denoted by "μ", then a compression force "*P*" is given by:

$$\text{compression force } P = k \times (L1 - L2). \cdots\cdots (1)$$

On the other hand, if a safety factor of 2 is taken into account, a retaining force "*F*" for securing the SA 16 is obtained by:

$$\text{retaining force } F = \mu / 2 \times P = \mu / 2 \times k \times (L1 - L2). \cdots\cdots (2)$$

There is described hereinafter an outline of capability in not causing the head to slip in position, even if an impact of 500G is impressed.

If a mass of the SA 16 is given as 0.0015 (kg), and it is impressed with an impact of 500G, then a retaining force necessary to avoid the magnetic head 7 from slipping in position is given by:

$$F = \text{mass} \times \text{magnitude of impact} = 0.75 \text{ (kg)}.$$

In general, material of the rotary body 17 is aluminum or stainless steel (SUS). A coefficient value of friction "μ" becomes 0.3, if a material of the SA 16, as well as that of the WW 19 are SUS. When these values are substituted in the formula (2),

$$\text{a compression force } P = 5 \text{ (kg)}$$

is now known to be necessary. According to the formula (1), it is sufficient to use a WW 19 having a spring constant of 5 (kg/mm) and L1 of 1.5 (mm), and to

insert it into the groove 18 by compressing it by 1 (mm) to L2 of 0.5 (mm), for instance, to gain the compression force *P* of 5 (kg). This is quite feasible. It is therefore possible to make the magnetic head 7 not to slip in position, even if an impact of 500G is impressed.

Fig. 2A is a perspective view depicting an assembling process of the magnetic head supporting mechanism according to the exemplary embodiment of this invention. As has been described, the second end of the SA 16 has a semi-annular shape. The WW 19 is formed into such a shape as to press the second end having the semi-annular shape of the SA 16 against the rotary body 17 with at least three points (refer to hatched portions shown in Fig. 2B). In this way, the shape of the second end of the SA 16 fits to a shape of a surface of the groove 18 after the SA 16 is mounted. Fig. 2C diagrammatically depicts a view in which the SA's 16 are mounted to the rotary body 17. Accordingly, the invention can prevent a variation in gram load, and tilting, warpage and the like of the SA's 16 from occurring, if fabrication accurately of the grooves is precisely maintained. As a result, the supporting device of the present invention obviates the problems associated with mounting of the magnetic heads 7 such as a failure in positioning and the like.

Industrial applicability

As has been described, the magnetic head supporting mechanism according to the present invention realizes mounting and removing of the SA to the rotary body with a simple structure and a simple work. The WW that presses the SA against the rotary body aligns a shape of tilting, warpage, and so on of the SA along the surface of the groove. Thus, it prevents a variation in gram load, and tilting,

warpage and so on of the SA from occurring, so long as an accuracy of the groove is attained properly. Consequently, it obviates problems associated with mounting of the magnetic heads 7 such as a failure in positioning and the like. Moreover, the present invention can provide the magnetic head supporting mechanism of high reliability, since it avoid evolution of gasses because it does not use adhesive.

CLAIMS

1. A magnetic head supporting mechanism comprising:

a. a rotary body having a groove formed therein;

b. a suspension arm carrying a magnetic head attached to a first end thereof; and

c. a waveform washer press-fit in said groove of said rotary body together with a second end of said suspension arm.

2. The magnetic head supporting mechanism according to claim 1, wherein said rotary body has a plurality of said grooves formed therein, and said waveform washer is formed into a semi-annular shape.

3. The magnetic head supporting mechanism according to claim 2, wherein the second end of said suspension arm and said waveform washer are inserted in each of said plurality of grooves, thereby securing said suspension arm to said rotary body by a compression force in an axial direction of said waveform washer.

4. The magnetic head supporting mechanism according to claim 1, wherein a bottom surface of said groove is formed in a circular shape, and said suspension arm has a cutout formed in the second end thereof in a shape of circular arc fitting to the bottom surface of said groove.

5. The magnetic head supporting mechanism according to claim 4,

wherein said waveform washer is provided with three or more points for pressing said cutout of the circular arc shape at the second end of said suspension arm.

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