

DESCRIPTION

MAGNETIC DISK CASE

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TECHNICAL FIELD

The present invention relates to a case for magnetic disks. Priority is claimed on Japanese Patent Application No.2004-222810, filed July 30, 2004, the content of which is incorporated herein by reference.

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BACKGROUND ART

In the prior art, Patent Reference 1 (Japanese Unexamined Patent Application, First Publication No. S60-90172) discloses a constitution of a magnetic disk case in which a box having a pair of opposing side walls along their length, and grooves in the side walls for storing magnetic disks, and of which an upper part and a bottom part are
15 open is combined with an upper lid and a bottom lid placed upon the box.

Upon the inner surfaces of the pair of long side walls of this magnetic disk case, a plurality of grooves for storing magnetic disks are formed in parallel along the length direction of the walls. Specifically, the grooves of this magnetic disk case are made by forming a plurality of long thin band shaped projections extending in the upwards and
20 downwards direction from the inner surfaces of the pair of long side walls, spaced in a parallel array at intervals along their length; and a plurality of magnetic disks can be stored on these left and right pairs of grooves.

When storing and transporting magnetic disks in the magnetic disk case, lids are put upon the top and bottom of this case so that, along with preventing the ingress of
25 dust, the magnetic disks are lightly pressed by the upper lid so that they do not move, in

order that dust should not be generated by abrasion between the case and the magnetic disks due to movement of magnetic disks within the case during transportation.

With regard to magnetic disks, it is disclosed to prevent the generation of dust by interposing curved surfaces between the side surfaces of external circumferential end surfaces and chamfers, and between the glass substrate main surfaces and chamfers of the magnetic disks (for example in Patent Reference 2: Japanese Unexamined Patent Application, First Publication No. 2002-100031).

As described above, when storing and transporting magnetic disks within a magnetic disk case, the magnetic disks are lightly pressed by the upper lid, so that the magnetic disks do not move easily due to vibration during transportation. Furthermore, a chamfering or the like is performed upon the end surfaces of the magnetic disks, so that it becomes difficult for dust to be created.

However, there is a problem that, even if this type of countermeasure is taken, when opening and closing the upper lid, or when taking a disk out from the case and putting it back in, the disk and the inner surface of the case may rub together, and a small amount of dust may be thereby created, and this dust may adhere to the magnetic recording surface, so as to cause damage to a head of a hard disk device, or to the magnetic recording medium. Furthermore, the increasing recording densities of magnetic recording mediums, now require elimination of dust particles of a level which did not constitute a problem in the prior art.

In order to solve these problems, the objective of the present invention is to provide a magnetic disk case which reduces the generation of dust.

DISCLOSURE OF INVENTION

The present invention relates to the following:

(1) A magnetic disk case which comprises:

a case main body having a pair of opposing side walls, an open upper part, and an open bottom part;

an upper lid detachably fitted to the upper part of the case main body; and

5 a bottom lid detachably fitted to the bottom part of the case main body.

A plurality of band shaped projections (ribs) are formed in parallel on the interior surfaces of the side walls in a length direction of the side walls so that grooves for holding magnetic disks are formed in spaces between the band shaped projections.

Each of the grooves has bottom surface A, a pair of side surfaces B, and
10 inclined surfaces C formed between each side surface B and the bottom surfaces A.

The grooves satisfies relations given by:

$$d \leq a,$$

$$w > t, \text{ and}$$

$$2\alpha \leq \beta,$$

15 where t is a thickness of a magnetic disk to be stored in the magnetic disk case, d is a width of a circumferential surface of the magnetic disk subjected to chamfering, α is a chamfer angle, a is a width of the surfaces A, β is an angle between the surfaces C on either side of each groove, γ is an angle between the surfaces B on either side of each groove, and w is a shortest distance between the surfaces B on either side of each
20 groove.

(2) A magnetic disk case as described in (1), wherein $(2\alpha + 10^\circ) \leq \beta \leq (2\alpha + 30^\circ)$ is satisfied.

(3) A magnetic disk case as described in (1) or (2), wherein $100^\circ \leq \beta \leq 120^\circ$ is satisfied.

25 (4) A magnetic disk case as described in any one of (1) to (3), wherein $20^\circ \leq \gamma \leq 40^\circ$ is

satisfied.

(5) A magnetic disk case as described in any one of (1) to (4), wherein $(d \times 1.05) \leq a \leq (d \times 1.5)$ is satisfied.

By the use of the magnetic disk case of the present invention, it is possible to
5 reduce the adhesion of dust generated by abrasion between the magnetic disk and the
magnetic disk case to the magnetic disk. In particular, since it becomes difficult for
the dust to adhere to the magnetic recording surface, it is possible to reduce damage to
the head of a hard disk device or to the magnetic recording medium due to dust
adhering to the magnetic recording surface, and, furthermore, it becomes possible to
10 provide a magnetic recording medium to which can be applied an increase in recording
density.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic figure showing the magnetic disk case of the present
15 invention.

FIG. 2 is a schematic figure of the magnetic disk case of the present invention
with the upper lid and the bottom lid removed.

FIG. 3 is a sectional view of the magnetic disk case of the present invention
with a magnetic disk inserted into it.

20 FIG. 4A is a sectional view showing the positional relationship between the
grooves of the magnetic disk case of the present invention, and a substrate or a magnetic
disk.

FIG. 4B is a sectional view showing the shape of the substrate or the magnetic
disk.

BEST MODE FOR CARRYING OUT THE INVENTION

In the following, appropriate embodiments of the present invention will be explained with reference to the drawings.

FIGS. 1 through 3 are figures showing the magnetic disk case. The magnetic disk case 4 is comprised of a case main body 1 having a pair of side walls, an open upper part, and an open bottom part; a removable upper lid 2 fitted to the upper part of the main body 1, and a removable bottom lid 3 fitted to the bottom part of the main body.

In Fig. 2, grooves 5 are formed by a plurality of band shaped projections 6 which are formed in parallel along the length of the inner surfaces of a pair of opposing side walls of a case main body 1 of which the upper part and the bottom part are left open. It should be understood that although, in FIG. 2, two of the band shaped projections 6 and the one of the grooves 5 defined by them are shown, in actual practice, a plurality of these band shaped projections and grooves is formed in the direction of 7.

The positional relationship between the grooves of the magnetic disk case of the present invention and the substrates or magnetic disks will be explained using FIGS. 4A and 4B. In FIGS. 4A and 4B, 10 denotes the cross sectional shape of a magnetic disk, while 11 is the cross sectional shape of a groove. Each of the grooves has bottom surface A, a pair of side surfaces B, and inclined surfaces C formed between each side surface B and the bottom surfaces A.

With the magnetic disk case of the invention, the grooves satisfies, $d \leq a$; $w > t$; and $2\alpha \leq \beta$, where t is a thickness of a magnetic disk 10 to be stored in the magnetic disk case, d is a width of a circumferential surface of the magnetic disk subjected to chamfering, α is a chamfer angle, a is a width of the surfaces A, β is an angle between the surfaces C on either side of each groove, γ is an angle between the surfaces B on

either side of each groove, and w is a shortest distance between the surfaces B on either side of each groove.

In the present invention, where the edge created by the chamfer process on the side closer to the magnetic recording surface is taken as X , the edge on the side remote
5 from the magnetic recording surface is taken as Y , by ensuring that X does not come into contact with the side surface of the magnetic disk case, it is made difficult for dust generated by abrasion between magnetic disks and the magnetic disk case to adhere to the magnetic recording surface.

In other words, by setting the positional relationship between the magnetic disk
10 and the magnetic disk case to a relationship given by the above described equations, only Y is allowed to come into contact with the magnetic disk case, while X does not come into contact with the magnetic disk case, and it accordingly becomes difficult for dust generated by abrasion between the magnetic disk and the magnetic disk case to adhere to the magnetic recording surface. The reason for this is that, by contrast to the
15 edge X contacting with the magnetic recording surface, the edge Y does not contact with the magnetic recording surface, so that the probability is lowered that dust generated by abrasion between the edge and the magnetic disk case should adhere to the magnetic recording surface.

Preferably, the magnetic disk case may satisfy $2\alpha + 10^\circ \leq \beta \leq 2\alpha + 30^\circ$.

20 This is because, by making α and β be within the above described range, it is possible to prevent contact between the side surfaces of the grooves and the edge close to the data surface of the disk caused by opening and closing of the upper lid, taking disks out from the case and putting them in, or by vibration generated by shifting of the case without the upper lid on it, thus obtaining the beneficial effect of preventing dust
25 generated by abrasion between the disk and the case from adhering to the magnetic

recording surface.

More preferably, the magnetic disk case may satisfy $100^\circ \leq \beta \leq 120^\circ$.

Although a chamfer angle of the magnetic disk or magnetic disk substrate may be determined freely, a chamfer angle of 45° is generally employed. Therefore, when
5 the case satisfies the above equation, a case of the same shape can be widely used for many different types of magnetic disks or magnetic disk substrates, and common use of the case is enabled.

Preferably the magnetic disk case may satisfy $20^\circ \leq \gamma \leq 40^\circ$.

By setting γ within the above described range, disks may be smoothly taken out
10 of or put in the case, large movement of disks in the length direction of the case is reduced, and contact of directly adjoining disks is prevented. If γ is smaller than the above described range, it is undesirable, since the width of the uppermost portion of the groove becomes small, and, when taking out or putting in a disk, the disk easily contacts the band shaped projection of the case side walls, and the possibility of generation of
15 dust is increased. On the other hand, if γ is greater than the above described range, it is undesirable, because the height of the band shaped projection of the case side walls becomes small, and when taking out or putting in a disk, it becomes easy to put it into a neighboring groove, and it becomes easy, when shock has been applied to the case, for a disk which has been inserted into the groove to undergo positional displacement, and for
20 neighboring disks to come into contact with one another.

Preferably the magnetic disk case may satisfy $d \times 1.05 \leq a \leq d \times 1.5$.

By setting a and b within the above described range, vibration of the disk in the stored state is minimized, and the edge close to the disk data surface is protected from contact with the side surface of the groove.

25 Preferably, the magnetic disk case described above may be made of an

antistatic synthetic resin composed of thermoplastic resin elements. For example, polycarbonate resin which has been endowed with electrical conductivity by the admixture of carbon powder, ABS resin, propylene type resin, PEEK resin, or the like may be used in an appropriate manner; and, among these, the use of a polycarbonate resin is particularly preferable.

(Example 1)

Magnetic disk cases were manufactured in which magnetic disks of diameter 48 mm (1.89 inch) were to be stored. The cases were made of polycarbonate resin endowed with electrical conductivity by the admixture of carbon powder. The thickness (t) of the magnetic disks was made to be 0.508 mm, the chamfer angle (α) was made to be 45°, and the width (d) after the chamfering process was made to be 0.268 mm. With regard to the shape of the grooves of the magnetic disk cases, the width (a) of the surface A was made to be 0.30 mm, the angle (β) between the surface surfaces C on either side of each groove was made to be 110°, the angle (γ) between the surfaces B on either side of the groove was made to be 30°, and the minimum distance (w) between the surfaces B of either side of the groove was made to be 1.2 mm.

Fifty magnetic disks were inserted into two of these magnetic disk cases (25 magnetic disks per case), and, after having opened and closed the upper lid five times, the number of dust particles adhering to the magnetic recording surfaces of the fifty magnetic disks was counted. No dust was observed in an observation using an optical microscope at one hundred times magnification.

(Comparative Example 1)

The same experiment was performed using magnetic disk cases of conventional type. The cases were made of the same polycarbonate resin as that of example 1. The grooves of these conventional magnetic disk cases had surfaces

corresponding to the surfaces A and B of the present invention, but not the surfaces C. Furthermore, the surface A was plane, and the width of the surface A was 0.74 mm, while the angle between the surfaces B on either side of each groove was 30°.

Using two magnetic disk cases of this type, the same experiment as for
5 example 1 was performed, and as a result, a total of ten dust particles was observed upon the magnetic recording surfaces.

(Example 2)

A magnetic disk case was manufactured in which magnetic disks of diameter 48 mm (1.89 inch) were to be stored. The cases were made of polycarbonate resin
10 endowed with electrical conductivity by the admixture of carbon powder. The thickness (t) of the magnetic disks was made to be 0.508 mm, the chamfer angle (α) was made to be 45°, and the width (d) after the chamfering process was made to be 0.268 mm. Furthermore, with regard to the shape of the grooves of the magnetic disk case, the width (a) of the surface A was made to be 0.30 mm, the angle (β) between the
15 surfaces C on either side of each groove was made to be 100°, the angle (γ) between the surfaces B on either side of the groove was made to be 30°, and the minimum distance (w) between the surfaces B of either side of the groove was made to be 1.0 mm.

Twenty-five magnetic disks were inserted into one of these magnetic disk cases (25 magnetic disks per case), and, after taking the disks out and putting them in twenty
20 times, the number of dust particles adhering to the magnetic recording surfaces of the twenty-five magnetic disks was counted. No dust was observed in an observation using an optical microscope at one hundred times magnification.

(Comparative Example 2)

The same experiment was performed using a magnetic disk case of
25 conventional type. The case was made of the same polycarbonate resin as that of

example 2. The grooves of this magnetic disk case used in the past had surfaces corresponding to the surfaces A and B of the present invention, but not the surfaces C. Furthermore, the surface A was a plane, and the width of the surface A was 0.74 mm, while the angle between the surfaces B on either side of each groove was 30°.

5 Using one magnetic disk case of this type, the same experiment as for example 2 was performed, and as a result, a total of twenty dust particles was observed upon the magnetic recording surfaces.

(Example 3)

A magnetic disk case was manufactured in which magnetic disks of diameter
10 48 mm (1.89 inch) were to be stored. The case was made of polycarbonate resin endowed with electrical conductivity by the admixture of carbon powder. The thickness (t) of the magnetic disks was made to be 0.508 mm, the chamfer angle (α) was made to be 45°, and the width (d) after the chamfering process was made to be 0.268 mm. With regard to the shape of the grooves of the magnetic disk case, the
15 width (a) of the surface A was made to be 0.30 mm, the angle (β) between the surfaces C on either side of each groove was made to be 100°, the angle (γ) between the surfaces B on either side of each groove was made to be 30°, and the minimum distance (w) between the surfaces B of either side of the groove was made to be 1.0 mm.

Using one of these magnetic disk cases, and one magnetic disk, and after
20 having taken the latter out and put it back in once so that it was forcibly contacted against the groove, the number of dust particles adhering to the magnetic recording surface of this magnetic disk was counted. This operation was performed in the same manner with three magnetic disks. No dust was observed in an observation using an optical microscope at one hundred times magnification.

25 (Comparative Example 3)

The same experiment was performed using a magnetic disk case of conventional type. The case was made of the same polycarbonate resin as that of example 3. The grooves of this conventional magnetic disk case had surfaces corresponding to the surfaces A and B of the present invention, but not the surfaces C.

- 5 Furthermore, the surface A was a plane, and the width of the surface A was 0.74 mm, while the angle between the surfaces B on either side of each groove was 30°.

Using one magnetic disk case of this type, the same experiment as for example 3 was performed, and as a result, a total of thirty-two dust particles was observed upon the magnetic recording surface.

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INDUSTRIAL APPLICABILITY

- By the use of the magnetic disk case of the present invention, it is possible to reduce the adhesion of dust generated by abrasion between the magnetic disk and the magnetic disk case to the magnetic disk. In particular, since it becomes difficult for
- 15 dust to adhere to the magnetic recording surfaces, it is possible to reduce damage to the head of a hard disk device or to a magnetic recording medium caused by dust adhering to the magnetic recording surface, and it becomes possible to provide a magnetic recording medium to which can be applied an increase in recording density.

CLAIMS

1. A magnetic disk case comprising:

a case main body having a pair of opposing side walls, an open upper part, and an open bottom part;

5 an upper lid detachably fitted to the upper part of the case main body; and

a bottom lid detachably fitted to the bottom part of the case main body,

wherein a plurality of band shaped projections are formed in parallel on the interior surfaces of the side walls in a length direction of the side walls so that grooves for holding magnetic disks are formed in spaces between the band shaped projections,

10 each of the grooves has bottom surface A, a pair of side surfaces B, and inclined surfaces C formed between each side surface B and the bottom surfaces A, and the grooves satisfies relations given by:

$$d \leq a,$$

$$w > t, \text{ and}$$

15 $2\alpha \leq \beta,$

where t is a thickness of a magnetic disk to be stored in the magnetic disk case, d is a width of a circumferential surface of the magnetic disk subjected to chamfering, α is a chamfer angle, a is a width of the surfaces A, β is an angle between the surfaces C on either side of each groove, γ is an angle between the surfaces B on either side of each
20 groove, and w is a shortest distance between the surfaces B on either side of each groove.

2. A magnetic disk case according to claim 1, wherein $(2\alpha + 10^\circ) \leq \beta \leq (2\alpha + 30^\circ)$ is satisfied.

3. A magnetic disk case according to claim 1, wherein $100^\circ \leq \beta \leq 120^\circ$ is satisfied.
4. A magnetic disk case according to claim 1, wherein $20^\circ \leq \gamma \leq 40^\circ$ is satisfied.
- 5 5. A magnetic disk case according to claim 1, wherein $(d \times 1.05) \leq a \leq (d \times 1.5)$ is satisfied.