

DESCRIPTION

COVER AND MANUFACTURING METHOD OF ROLLED MATERIAL FOR COVER
Field

[0001] The present invention relates to a cover used for
5 a hard disk device and the like and a manufacturing method
of a rolled material for a cover.

Background

[0002] Conventionally, a hard disk device is used in a
precision apparatus such as a computer that performs
10 information processing. In recent years, the hard disk
device is not only used as an external storage device of a
computer, but is also incorporated in household appliances
such as televisions and video recorders and electronic
devices for an automobile.

15 [0003] In conventional hard disk devices, a drive
mechanism is accommodated in a casing main unit that is
covered by a cover. As for conventional covers, at least
on a surface of the outer side thereof, it has been
required that damages and stains are inconspicuous.

20 Therefore, to meet such a requirement, covers with a
characteristic (dull finish) such that damages and stains
are inconspicuous at least on a surface of the outer side
thereof are used. As another required characteristic, it
has been desired that cleanliness is high on a surface of
25 the inner side of the cover facing the drive mechanism.

[0004] As an invention of satisfying the two required
characteristics mentioned above, there is disclosed a
resin-composite type stainless damping steel plate for a
precision apparatus cover in which two stainless steel
30 plates are laminated with a viscoelastic resin put
therebetween (see, for example, Patent Literature 1).
According to the stainless damping steel plate, stainless
steel plates are laminated with dull finish by which

damages and stains on a surface of the outer side are made inconspicuous, and with bright annealing (BA) finish by which cleanliness of a surface of the inner side is high.

Citation List

5 Patent Literature

[0005] Patent Literature 1: Japanese Patent No. 3956346
Summary

Technical Problem

[0006] However, according to the stainless damping steel
10 plate disclosed in Patent Literature 1, because a plurality of steel plates are laminated, there is a problem that there are many work processes and these processes are troublesome.

[0007] The present invention has been achieved to solve
15 the above problem, and an object of the present invention is to provide a cover and a manufacturing method of a rolled material for a cover that are capable of reducing and simplifying work processes.

Solution to Problem

20 [0008] To solve the problem described above and achieve the object, a cover according to the present invention is a cover for being provided in a precision apparatus and covering at least a drive mechanism of the precision apparatus, wherein the cover is formed by using a rolled
25 material in which arithmetic mean roughness of a surface of an outer side thereof and that of a surface of an inner side thereof are different, and the arithmetic mean roughness of the surface of the inner side is less than the arithmetic mean roughness of the surface of the outer side.

30 [0009] Moreover, in the above-described cover according to the present invention, the arithmetic mean roughness of the surface of the inner side is equal to or less than 0.1 micrometer.

[0010] Moreover, in the above-described cover according to the present invention, the arithmetic mean roughness of the surface of the outer side is equal to or larger than 0.2 micrometer.

5 [0011] Moreover, a manufacturing method of a rolled material for a cover according to the present invention is a method of a manufacturing method of a rolled material for a cover used for a cover for being provided in a precision apparatus and covering at least a drive mechanism of the
10 precision apparatus, the method including: a multi-stage mill rolling step of rolling a belt-like material to have a desired plate thickness and applying surface machining so that arithmetic mean roughness of one surface of the belt-like material becomes less than arithmetic mean roughness
15 of the other surface of the belt-like material; and a bright annealing step of, after the multi-stage mill rolling step, applying bright annealing finish on the belt-like material on which the rolling and the surface machining have been applied.

20 [0012] Moreover, in the above-described manufacturing method of a rolled material for a cover according to the present invention, the method further includes a skin pass step of applying a light rolling process with a load smaller than that of the multi-stage mill rolling step on
25 the belt-like material on which the bright annealing finish has been applied by the bright annealing step.

Advantageous Effects of Invention

[0013] In the cover and the manufacturing method of a rolled material for a cover according to the present
30 invention, with a surface of a work roll at the time of rolling, dull finish with arithmetic mean roughness of equal to or larger than 0.2 micrometer is applied on one surface, and gloss finish with arithmetic mean roughness of

equal to or less than 0.1 micrometer is applied on the other surface, and thus work processes can be reduced and simplified.

Brief Description of Drawings

5 [0014] FIG. 1 is a perspective view of a schematic configuration of a hard disk device according to an embodiment of the present invention.

FIG. 2 is an exploded perspective view of a configuration of relevant parts of the hard disk device
10 shown in FIG. 1.

FIG. 3 is a perspective view of a configuration of relevant parts of the hard disk device shown in FIG. 1.

FIG. 4 is a flowchart of an example of a manufacturing method of a rolled material for a cover of a casing main
15 unit according to the embodiment of the present invention.

FIG. 5 is a schematic diagram of an outline of the manufacturing method of a rolled material for a cover of a casing main unit according to the embodiment of the present invention.

20 FIG. 6 is a table of a cleanliness test according to the embodiment of the present invention.

FIG. 7 is a graph of the cleanliness test according to the embodiment of the present invention.

Description of Embodiments

25 [0015] An exemplary embodiment of the present invention will be explained below in detail with reference to the accompanying drawings. The present invention is not limited to the following embodiment. In the following explanations, the drawings to be referred only
30 schematically depict the shape, size, and positional relationships to an extent that the contents of the present invention can be understood. That is, the present invention is not limited only to the shape, size, and

positional relationships exemplified in the respective drawings. In the following explanations, as an example of a cover, configurations of a hard disk device as a precision apparatus are explained.

5 [0016] FIG. 1 is a perspective view of a schematic configuration of a hard disk device according to an embodiment of the present invention. FIG. 2 is an exploded perspective view of a schematic configuration of the hard disk device according to the embodiment of the present invention. In a hard disk device 1, a drive mechanism is accommodated in a casing main unit 2. The casing main unit 2 includes an accommodating part 2a that accommodates therein the drive mechanism and has a substantially rectangular shape, and a cover 2b that has a substantially rectangular shape matching an opening of the accommodating part 2a and covers the opening of the accommodating part 2a. The drive mechanism includes a hard disk 3 that is a recording media, a spindle 4 that rotates and drives the hard disk 3, a carriage 5 that supports a magnetic head 50, which performs information recording and information reading to and from the hard disk 3, and turns on a surface of the hard disk 3, a VCM 6 that drives the carriage 5 by a force generated by a current that flows into a coil and by a magnetic field, turns the carriage 5 with precision, and controls scanning of the magnetic head 50, and a pivot shaft 7 that is coupled to the carriage 5 while being fixed to the casing main unit 2 and is a substantially columnar shape having a configuration of a bearing.

[0017] The accommodating part 2a is formed by using a material with a high radiation characteristic such as aluminum, and has an opening on its top part so as to form a substantially rectangular space that can accommodate the drive mechanism.

[0018] The cover 2b is formed by using plate-shaped stainless steel that is a rolled material, and is provided with holes 20 that penetrate in a thickness direction along with the outer edge of the cover 2b so that the holes 20 are coupled to holes 21 that are provided in the accommodating part 2a. The accommodating part 2a and the cover 2b are fixed by inserting a screw 22 through the holes 20 and 21 so as to screw them. In this case, an outer-side surface S1, which becomes an outer side of the cover 2b shown in FIG. 2 when the cover 2b is coupled to the accommodating part 2a, is applied with dull (2D) finish of, for example, arithmetic mean roughness (Ra) of 0.2 to 0.3 micrometer on a surface. It suffices that the arithmetic mean roughness on the surface of the outer-side surface S1 is equal to or larger than 0.2 micrometer.

[0019] FIG. 3 is a perspective view of a cover of the hard disk device according to the present embodiment. FIG. 3 is an upside down view of the cover 2b, where an inner-side surface 2S faces the side of the accommodating part 2a, that is, the drive mechanism. The inner-side surface S2 is applied with gloss (2B) finish of, for example, arithmetic mean roughness (Ra) of 0.08 to 0.09 micrometer on a surface. It suffices that the arithmetic mean roughness on the surface of the inner-side surface S2 is equal to or less than 0.1 micrometer.

[0020] The cover 2b formed with plate-shaped stainless steel is constituted by two surfaces (the outer-side surface S1 and the inner-side surface S2) respectively having a roughness different from each other. Therefore, damages and stains can be made inconspicuous on the outer-side surface of the hard disk device 1, and cleanliness can be improved on the inner-side surface thereof.

[0021] The carriage 5 extends on the surface of the hard

disk 3 and includes an arm 51 that holds the magnetic head 50 at the leading end thereof. The magnetic head 50 is provided at an end of a side different from the side continuous to the arm 51 and performs information recording and information reading. The arm 51 has a suspension that is positioned on an end part, which is an end side that is different from the side being coupled to the pivot shaft 7 and that can float with respect to the surface of the hard disk 3 with an airflow generated by rotations of the hard disk 3. This suspension has elasticity that enables the suspension to reciprocate in a vertical direction with respect to the surface of the hard disk 3, and supports the magnetic head 50 at the end part.

[0022] FIG. 4 is a flowchart of an example of a manufacturing method of a rolled material for a cover of a casing main unit according to the embodiment of the present invention. First, a multi-stage mill rolling process with cold rolling is performed on a belt-like material (a hot coil) having hot rolling performed thereon (Step S102). In the multi-stage mill rolling process, the belt-like material wound in a coil-like manner as a hot coil is rolled to have a desired plate thickness in a stepwise manner by using a work roll, and then surface machining is applied on a surface of the plate. With this surface machining, dull finish with arithmetic mean roughness of equal to or larger than 0.2 micrometer is applied on one surface, and gloss finish with arithmetic mean roughness of equal to or less than 0.1 micrometer is applied on the other surface. As a result, in the multi-stage mill rolling process, it is possible to obtain a belt-like material that is processed to have a desired plate thickness and have surfaces respectively having different arithmetic mean roughness.

[0023] FIG. 5 is a schematic diagram of an outline of the multi-stage mill rolling process. As shown in FIG. 5, in the multi-stage mill rolling process, when a belt-like member 100 passes through a first work roll 101a and a second work roll 102a, the belt-like member 100 is rolled to have a plate thickness corresponding to a clearance distance between the first work roll 101a and the second work roll 102a. Furthermore, in the multi-stage mill rolling process, intermediate rolls 101b and 102b and backup rolls 101c and 102c are arranged respectively along with each of the work rolls, and deflections of each of the work rolls in the axial direction of these rolls are suppressed.

[0024] The belt-like member 100 reciprocates between the first work roll 101a and the second work roll 102a. In this case, the clearance distance between the first work roll 101a and the second work roll 102a is narrowed in a stepwise manner with reciprocation of the belt-like member 100, and the clearance distance ultimately becomes equal to a desired plate thickness. As a result, the belt-like member 100 is formed to have a desired plate thickness.

[0025] At this time, the surface of a side on which rolling on the first work roll 101a and the second work roll 102a is performed is processed to have desired arithmetic mean roughness. For example, the surface of the first work roll 101a is applied with dull finish of, for example, arithmetic mean roughness of 0.2 to 0.3 micrometer on the surface. Furthermore, the second work roll 102a is applied with gloss finish of, for example, arithmetic mean roughness of 0.08 to 0.09 micrometer on the surface. As a result, in the multi-stage mill rolling process, it is formed to have surfaces respectively having different arithmetic mean roughness.

[0026] In the multi-stage mill rolling process described above, while it has been explained that a pair of work rolls is used to make the plate thickness smaller in a stepwise manner, it is also possible to employ a technique in which the belt-like member 100 sequentially passes through a plurality of pairs of work rolls to roll the belt-like member 100 in a stepwise manner to form a desired plate thickness of the belt-like member 100. In this case, the clearance distance between each pair of the work rolls becomes smaller along with the advancing direction of the belt-like member 100, and the clearance distance between the work rolls at the final stage becomes equal to a desired plate thickness.

[0027] Subsequently, after the multi-stage mill rolling process, bright annealing (BA) finish is applied (Step S104). In the bright annealing finish, a material having undergone the multi-stage mill rolling process is annealed in a non-oxidation atmosphere.

[0028] Thereafter, skin pass is performed to prevent generation of stretcher strain at the time of performing press drawing (Step S106). The skin pass is a process performed on the material having the bright annealing finish applied thereon, where a load smaller than that of the multi-stage mill rolling process is put on the material to perform a rolling process (light rolling process). As well as removal of deformation, surface machining is applied on the material by using the work rolls described above.

[0029] By the processes of Steps S102 to S106 described above, the rolled material having been rolled to have a desired plate thickness and having the surface machining applied thereon is wound in a coil-like manner as a cold-rolled coil. The cover 2b can be obtained by performing

forming from the cold-rolled coil.

[0030] When the belt-like material used for rolling is a material used for a product that does not require any press drawing, the skin pass does not have to be performed.

5 Furthermore, as the material used for the work rolls, it suffices to use a material in which at least the surface to be rolled has a hardness that is higher than that of the belt-like material.

[0031] In the manufacturing method of a rolled material
10 for a cover described above, surface machining can be applied simultaneously with adjustment of the plate thickness as the belt-like member 100 is rolled. With this configuration, the rolled material for a cover can be manufactured while reducing the number of processes using
15 one apparatus (one production line) and without moving the belt-like member 100 between apparatuses and rearranging it.

[0032] As a method of applying surface machining on the rolled material for a cover, a technique of applying dull finish by polishing after applying gloss finish on both
20 surfaces can be considered. In this case, a polishing device is required and the configuration of the apparatus may be complicated as it is incorporated on one production line. Furthermore, because cut chips are generated by the polishing, a mechanism for removing these chips is also
25 required, and thus reduction of the number of processes in manufacturing is hardly achieved.

[0033] In the present embodiment described above, with a surface of a work roll at the time of rolling, dull finish with arithmetic mean roughness of equal to or larger than
30 0.2 micrometer is applied on one surface, and gloss finish with arithmetic mean roughness of equal to or less than 0.1 micrometer is applied on the other surface, and thus characteristics required for an outer surface and an inner

surface can be satisfied, and cost reduction can be also achieved as the processes for manufacturing the hard disk device is reduced and simplified.

[0034] With reference to FIGS. 6 and 7, cleanliness of
5 the inner-side surface S2 (a gloss finished surface) of the cover 2b according to the present embodiment and of an inner-side surface (a dull finished surface) of a conventional cover is explained next. First, as the cover according to the present embodiment, a cover formed from a
10 rolled material for a cover manufactured by the manufacturing method described above was used for a cleanliness test. As for a gloss finished surface as a target of the cleanliness test, for example, gloss finish with arithmetic mean roughness of 0.081 micrometer is
15 applied on the surface. In the cleanliness test, five covers having the same shape formed by using SUS 430 were used and each of these covers was subjected to the cleanliness test.

[0035] As for the conventional cover having a dull
20 finished surface on the inner-side surface as a target of cleanliness comparison, for example, dull finish with arithmetic mean roughness of 0.273 micrometer is applied on the dull finished surface. Furthermore, in the cleanliness test, five covers having the same shape formed by using SUS
25 430 were used and each of these covers was subjected to the cleanliness test. In this test, the shape of the covers was the same as the shape of the cover according to the present embodiment having the gloss finished surface described above, and the area of the dull finished surface
30 as a test target surface is the same as the area of the gloss finished surface.

[0036] In the cleanliness test, the test target surfaces of the covers are washed with a certain amount of pure

water, the pure water used for the washing is collected, and the amount of dusts in the pure water is measured. For the measurement of the amount of dusts, Liquid Particle Counter (manufactured by PMS Inc., model number CLS-700) was used. The cleanliness test was sequentially conducted on each of the five covers, and a measurement of particles with the particle diameter ϕ of equal to or larger than 0.5 micrometer was performed. In this cleanliness test, the amount of dusts (the number of dusts) is designated as the cleanliness.

[0037] FIG. 6 is a table of results of the cleanliness test. FIG. 7 is a graph indicating mean values (denoted by black squares), maximum values, and minimum values of the cleanliness in the result of the cleanliness test. As a result of the cleanliness test described above, the cleanliness mean value on the gloss finished surface was approximately 1703 and the cleanliness mean value on the dull finished surface was 31020. The maximum value of the cleanliness on the gloss finished surface was 4347 and it is 25500 less than the minimum value of the cleanliness of the dull finished surface. Based on this result, it is confirmed that the gloss finished surface has high cleanliness as compared to the dull finished surface.

[0038] Furthermore, as the cleanliness of an inner side of a cover of a precision apparatus, as the cleanliness is converted to the area of the surface in the cleanliness test described above, it is required that the number of particles with an approximate size of equal to or larger than $\phi=0.5 \mu\text{m}$ is less than a few thousand. The gloss finished surface (the inner-side surface S2) described above satisfies this condition and thus satisfies required performance as a cover used for a precision apparatus.

Industrial Applicability

[0039] As described above, the cover and the manufacturing method of a rolled material for a cover according to the present invention are useful when work processes are reduced and simplified.

5 Reference Signs List

- [0040] 1 hard disk device
- 2 casing main unit
 - 2a accommodating part
 - 2b cover
 - 10 3 hard disk
 - 4 spindle
 - 5 carriage
 - 6 VCM
 - 7 pivot shaft
 - 15 50 magnetic head
 - 51 arm
 - S1 outer-side surface
 - S2 inner-side surface

CLAIMS

1. A cover for being provided in a precision apparatus and covering at least a drive mechanism of the precision apparatus, wherein

5 the cover is formed by using a rolled material in which arithmetic mean roughness of a surface of an outer side thereof and that of a surface of an inner side thereof are different, and the arithmetic mean roughness of the surface of the inner side is less than the arithmetic mean
10 roughness of the surface of the outer side.

2. The cover according to claim 1, wherein the arithmetic mean roughness of the surface of the inner side is equal to or less than 0.1 micrometer.

15

3. The cover according to claim 1 or 2, wherein the arithmetic mean roughness of the surface of the outer side is equal to or larger than 0.2 micrometer.

20 4. A manufacturing method of a rolled material for a cover used for a cover for being provided in a precision apparatus and covering at least a drive mechanism of the precision apparatus, the method comprising:

25 a multi-stage mill rolling step of rolling a belt-like material to have a desired plate thickness and applying surface machining so that arithmetic mean roughness of one surface of the belt-like material becomes less than arithmetic mean roughness of the other surface of the belt-like material; and

30 a bright annealing step of, after the multi-stage mill rolling step, applying bright annealing finish on the belt-like material on which the rolling and the surface machining have been applied.

5. The manufacturing method of a rolled material for a cover according to claim 4, further comprising a skin pass step of applying a light rolling process with a load
- 5 smaller than that of the multi-stage mill rolling step on the belt-like material on which the bright annealing finish has been applied by the bright annealing step.