

Master Disks for a Magnetic Recording Medium, Alignment Device and Method

Technical Field of the Invention

The present invention relates to master disks for a magnetic recording medium and to an alignment device and method.

Prior Art

At present, hard disk drives (abbreviated below as HDD) have become the mainstream of external storage devices of computers. In a HDD, a magnetic recording medium that uses a magnetic film as a recording material is used, and an alignment servo signal of a writing/reading head written to the surface of the magnetic recording medium uses magnetic transfer technology, whereby writing is conducted.

In a HDD, the recording and playback of data is conducted while the magnetic head is levitated, by a levitation mechanism called a slider, over the surface of the rotating magnetic recording medium while maintaining a distance of several tens of nm from the disk surface. Bit information on the magnetic recording medium is stored in concentrically disposed data tracks, and a data

recording/playback head is moved and positioned at a high speed to the target data track on the medium surface to record and play back data.

Alignment signals (servo signals) for detecting the relative position between the head and the data tracks are concentrically written on the magnetic recording medium surface, and the head conducting the recording and playback of data detects its own position at fixed time intervals. After the magnetic recording medium has been loaded into a HDD device, writing signals are written thereto using a dedicated device called a servo writer so that the centers of the writing signals of the servo signals do not become decentered from the center of the medium (or center of locus of the head). At present, recording density has reached 100 Gbits/in² at the development stage, and recording capacity is increasing at an annual rate of 60%. In accompaniment therewith, the density of servo signals for the head to detect its own position is also rising, and the trend is such that the writing time of the servo signals is also increasing year by year. This increase in the writing time of the servo signals is a large cause of the drop in the productivity and an increase in the cost of HDDs.

Recently, with respect to a method where the servo signals are written using the signal writing head of the servo writer, remarkable technological developments have been made that attempt to shorten the writing time of servo information by writing the servo signals at once by magnetic transfer.

Figs. 12 and 13 are diagrams describing this magnetic transfer technology (see Patent JP-A-2001-34939). Fig. 13(a) is a diagram showing a state where a permanent magnet 2 is moved over the surface of a magnetic recording medium 1, while maintaining a fixed interval (1 mm or less), represented from a cross-sectional direction of a substrate. A magnetic film 4 formed on a substrate 3 is initially not in a state where it has been unidirectionally magnetized, but is unidirectionally magnetized by a magnetic field leaking from a gap in the permanent magnet 2 (arrows 5 written in the magnetic film in the drawing represent the direction of magnetization). This process is called an initial demagnetization process. Arrow 6 in Fig. 12(a) represents the movement path of the permanent magnet on the magnetic recording medium, and the magnetic layer is uniformly magnetized in the circumferential direction.

Fig. 12(b) shows a state where a master disk 7 for magnetic transfer (abbreviated below as master disk) is disposed and positioned above the magnetic recording medium 1. Fig. 12(c) shows a state where magnetic transfer is conducted by tightly adhering the master disk to the surface of the magnetic recording medium and moving the permanent magnet for magnetic transfer along the movement path in the drawing (represented by arrow 6).

Fig. 13(b) is a diagram describing magnetic transfer. The master disk 7 has a structure where, as shown in the drawing, soft magnetic films 9 (in the drawing, Co soft magnetic films) are imbedded in the surface of a silicon substrate 8 that contacts the medium surface. When the substrate 8, in which the pattern of the soft magnetic films is embedded, is intervened between the permanent magnet 2 and the magnetic recording medium 1, the magnetic field (the orientation of the transfer signal writing magnetic field is in the direction opposite to that of the demagnetization magnetic field) that has leaked from the permanent magnet 2 and penetrated the silicon substrate 8 is again transmitted through the silicon substrate 8 at positions where there is no soft magnetic film so that the magnetic layer can be magnetized (the direction of magnetization thereof is represented by

arrows 10), but passes through the soft magnetic films 9 at portions where the soft magnetic pattern is present to form magnetic paths of small magnetic resistance. For this reason, the magnetic field leaking from the silicon substrate 8 at positions where the soft magnetic layers are present becomes small and new magnetization writing is not conducted. Magnetic transfer of the servo signals is thus conducted by the above mechanism. It should be noted that technology that conducts center alignment of the master disk for magnetic transfer and the magnetic recording medium has also been proposed (see Patent JP-A-11-175973).

Also, a method of conducting reading and writing of both sides of the magnetic recording medium of the HDD by forming magnetic films on the surface and undersurface in order to increase the recording capacity per single medium has become the mainstream. Of the magnetic patterns recorded on the magnetic recording medium, there are the above-described servo pattern and a data pattern. For this reason, magnetic transfer is being conducted by tightly adhering a master disk to both surface sides of the magnetic recording medium (see Patent JP-A-2000-67433). A transparent base material can also be used as the master disk (see Patent JP-A-2000-197647).

Problems to be solved by the Invention

In a HDD device using a magnetic recording medium where magnetic films are formed on the surface and undersurface, numerous magnetic disks are disposed, magnetic heads are individually disposed at the surface and undersurface thereof, only a HSA (Head Stack Assembly) disposed with a head corresponding to a cylinder having a designated data region is controlled by servo control to be at a predetermined position, and the other HSA is not controlled.

Thus, when the misalignment between the surface and undersurface servo patterns is large in a case where the reading and writing cylinder is changed from the surface to the undersurface, there is the problem that time is required until stabilization of the position by the servo of the HSA at the undersurface and, as a result, settling time corresponding to the reading time of the data after the cylinder switching increases.

For this reason, it becomes extremely important that there is no misalignment between the surface and undersurface magnetic patterns of the magnetic recording medium in order for high-speed data access of the HDD to not be compromised. With respect to conventional magnetic

transfer target patterns, because photoprocessing technology that forms the master disks has been based on a μm rule, there have only been servo patterns having a large pattern width, but when consideration is given to the fact that the utility of magnetic transfer and photoprocessing technology are progressing and have become based on a sub- μm rule, data patterns should also be thought of as transfer targets in addition to the conventional servo patterns and magnetic transfer by high-density master disks to the magnetic recording medium becomes necessary.

Thus, the problems that are to be solved in the present invention are:

- (1) to precisely align the magnetic pattern of a surface-use master disk and the magnetic pattern of an undersurface-use master disk of a magnetic recording medium; and
- (2) to precisely align the center of the magnetic recording medium with the centers of the magnetic patterns of the master disks in a state where alignment of the surface and undersurface master disks has been conducted, and the present invention has been devised in light of the above points.

Means for Solving the Problem

An invention of claim 1 is characterized in that master disks for a magnetic recording medium comprising a pair of master disks having regions of magnetic patterns formed therein and having alignment marks, said magnetic pattern to be magnetically transferred to the magnetic recording medium, and said alignment marks for alignment being disposed on the master disks outside the regions of magnetic patterns.

An invention of claim 2 is characterized in that, in the invention of claim 1, at least two alignment marks are formed on each of the pair of master disks.

An invention of claim 3 is characterized in that, in the invention of claim 2, the at least two alignment marks are symmetrically disposed with respect to reference points of the magnetic patterns.

An invention of claim 4 characterized in that, in the invention of any of claims 1 to 3, the alignment marks of one of the pair of master disks and the alignment marks of the other of the pair of master disks have mutually different shapes.

in the invention of any of claims 1 to 4, the master disks of the pair are optically transparent or semi-transparent excluding the alignment marks.

An invention of claim 6 is characterized in that it is an alignment device comprising: a first stage that retains one of the pair of master disks of any of claims 1 to 5 and includes orthogonal movement and rotational movement functions with respect to the other of the pair of master disks facing that master disk; a second stage that retains the magnetic recording medium between the pair of master disks and includes an orthogonal movement function with respect to the pair of master disks; and observing means for observing the positions of the alignment marks of the pair of master disks and an end surface position of an inner periphery or an outer periphery of the magnetic recording medium.

An invention of claim 7 is characterized in that, in the invention of claim 6, the observing means includes first observing means for observing only the positions of the alignment marks of the pair of master disks and second observing means for observing the positions of the alignment marks of the pair of master disks and the end surface position of the inner periphery or the outer

periphery of the magnetic recording medium.

An invention of claim 8 is characterized in that it is an alignment method comprising: orthogonally moving and rotatingly moving one master disk in a state where the pair of master disks of claim 5 face each other, simultaneously observing the alignment marks of the pair of master disks with first observing means, matching the alignment marks between the pair of master disks, observing, with second observing means, the alignment marks of the pair of master disks and an inner peripheral or outer peripheral end surface of the magnetic recording medium positioned between the pair of master disks and, on the basis of the observation results, orthogonally moving and aligning the magnetic recording medium with respect to the pair of master disks.

An invention of claim 9 is characterized in that it is an alignment method comprising: in a state where the position of one of the pair of master disks of any of claims 1 to 4 is fixed, observing the alignment marks of the one master disk with observing means, observing, with observing means, an inner peripheral or outer peripheral end surface of the magnetic recording medium positioned above the one master disk, referencing the observation

results and observation results of the alignment marks of the one master disk, orthogonally moving and aligning the magnetic recording medium with respect to the one master disk, observing, with observing means, the alignment marks of the other of the pair of magnetic disks positioned above the magnetic recording medium, referencing the observation results and observation results of the alignment marks of the one master disk, orthogonally moving or rotatingly moving the other master disk with respect to the one master disk, and matching the positions of the alignment marks between the pair of master disks.

Brief Description of the Drawings

Fig. 1(a) is a front view showing the configuration of a master disk in the invention, and 1(b) is a cross-sectional view.

Figs. 2(a) to (d) are diagrams showing a master disk manufacturing procedure in the invention.

Figs. 3(a) and (b) are diagrams showing master disks disposed with alignment marks in the invention.

Figs. 4(a) to (d) are diagrams describing alignment conditions of the alignment marks of surface/undersurface-use master disks in the invention.

Fig. 5 is a diagram showing the positional relationship of a magnetic recording medium and the master

disks in the invention.

Fig. 6 is a diagram describing an alignment device of a two-side magnetic transfer device in the invention.

Figs. 7(a) and (b) are diagrams showing another example of master disks disposed with alignment marks in the invention.

Figs. 8(a) to (d) are diagrams showing another master disk manufacturing procedure in the invention.

Figs. 9(a) and (b) are diagrams showing an example of patterning-use photomasks of the surface-use master disk in the invention.

Fig. 10 is a diagram showing the positional relationship of the magnetic recording medium and other master disks in the invention.

Fig. 11 is a diagram describing another alignment device of the two-side magnetic transfer device in the invention.

Fig. 12(a) to (c) are explanatory diagrams of a magnetic transfer process in a magnetic recording medium.

Fig. 13(a) and (b) are explanatory diagrams of the principle of magnetic transfer in the magnetic recording medium.

Modes for Carrying Out the Invention

Example 1

Fig. 1 are diagrams showing the configuration of a master disk used in the present example. Although the configuration is the same as that of a conventional master disk resulting from an Si substrate, it is largely different in that it also includes an optically transparent material such as quartz. Fig. 1(a) shows a front view (surface) and (b) shows a cross section. 11 is a transparent substrate including quartz and 12 is a magnetic pattern disposed on the substrate 11. Also, during the manufacture of the master disk, similar to the Si substrate, after a photoprocess in which a photoresist 13 is coated with a uniform thickness on the quartz substrate 11, patterned and developed as shown in Fig. 2(a), groove manufacturing is conducted by etching as shown in Fig. 2(b), a soft magnetic film 14 is formed as shown in Fig. 2(c), and removal of the photoresist is conducted by lift-off as shown in Fig. 2(d) to complete the master disk where the magnetic pattern comprising soft magnetic films and alignment marks (non transparent) described later are formed on the quartz substrate 11.

Figs. 3(a) and (b) show the patterns of a surface-use master disk 15 and an undersurface-use master disk 16 of a magnetic recording medium, seen from the sides of the master disks that face the magnetic recording medium, with

two alignment marks 17 and 18 each that conduct alignment between the master disks being disposed outside of the magnetic patterns 12 resulting from the soft magnetic films for which transfer to the magnetic recording medium is conducted. As for the number of alignment marks, two each are sufficient, but there may also be more than that.

The shapes of the alignment marks are such that they are mutually aligned as shown, for example, in Figs. 4, in order to raise alignment precision. That is, the alignment marks 17 of the surface-use master disk 15 have cross shapes and the alignment marks 18 of the undersurface-use master disk 16 have center-removed cross shapes so that the crosses of the alignment marks 17 can fit thereinside. It should be noted that the alignment marks are not limited thereto. For example, they may also be configured from dot patterns (in this case, the marks of the two disks 15 and 16 are the same) where plural dots are irregularly arranged. In this case, the dot patterns between the two disks 15 and 16 are matched.

The positional relationship between the alignment marks and the magnetic patterns resulting from the soft magnetic films in the master disks is such that both of the surface-use master disk and the undersurface-use

master disk are in a symmetrical relationship. When the magnetic pattern surfaces resulting from the soft magnetic films of the surface-use master disk and the undersurface-use master disk are made to face each other, the superposition of these is observable from the outside because the master disks are transparent. When the position (X, Y, θ) of one master disk with respect to the other master disk is adjusted so that the alignment marks match (are aligned), as shown in Fig. 4(c) (X and Y are orthogonal coordinate axes on a plane and θ is a rotation angle on the plane), the positions of the magnetic patterns resulting from the soft magnetic films match. Fig. 4(d) is a diagram showing a state where the alignment marks are not aligned.

Fig. 5 is a diagram showing the positional relationship between the magnetic recording medium 1 and the master disks 15 and 16. The magnetic recording medium 1 is sandwiched between the magnetic patterns 12 resulting from the soft magnetic films so that the magnetic pattern 12 resulting from the soft magnetic films of the undersurface-use master disk 16 faces the undersurface of the magnetic recording medium 1 and the magnetic pattern 12 resulting from the soft magnetic films of the surface-use master disk 15 faces the surface of the magnetic

recording medium 1. For the recording of the magnetic patterns of the magnetic recording medium 1, it is checked that center misalignment of the magnetic patterns 12 with the shape of the magnetic recording medium 1 is within an acceptable value and that misalignment of the surface and undersurface magnetic patterns is within an acceptable value. In order for the misalignment to be equal to or less than the acceptable value, alignment is conducted using an alignment device, such as shown in Fig. 6, disposed in a two-side magnetic transfer device. In this alignment device, movement control of respective stages, processing of signals from a television camera and control of respective positions are conducted by a signal processing device 43 disposed with a computer.

As shown in Fig. 6, the undersurface-use master disk 16 is fixed and a first stage 19 is disposed thereabove. The first stage 19 is disposed with a rotating stage 20, which retains the peripheral portion thereof so that the surface-use master disk 15 is parallel to the undersurface-use master disk 16, and an X, Y stage 21, on which is disposed the rotating stage 20 so that the rotating stage 20 is rotatable on a plane and which is movable in X and Y (orthogonal) directions with respect to the undersurface-use master disk 16. The superposition of

the alignment marks of the two master disks can be observed from below the undersurface-use master disk 16 with microscopes 22 serving as observing means. While observing this superposition, the rotating stage 20 and the X, Y stage 21 are driven, orthogonal movement (X, Y) and rotational movement (θ) of the master disk 15 with respect to the undersurface-use master disk 16 are conducted, and alignment (Fig. 4(c)) of the alignment marks is conducted.

23 is a second stage that includes the function of being orthogonally movable on a plane with respect to the two master disks in a state where the periphery of the magnetic recording medium 1, to which the magnetic patterns are to be transferred, is retained by a retention mechanism such as a knife edge, moved between the two master disks 15 and 16 and positioned parallel to these disks.

A TV camera 24 serving as observing means is fixed above the surface-use master disk 15, and a third stage 25 that is orthogonally (X, Y) movable on a plane parallel to the magnetic recording medium 1 is disposed.

Thus, in a state where the magnetic recording

medium 1 is positioned between the two master disks 15 and 16 whose alignment marks have been aligned, the third stage 25 is driven in orthogonal directions, the position of the inner periphery or the outer periphery of the magnetic recording medium 1 is viewed full circle along the periphery by the TV camera 24 serving as the observing means from above the surface-use master disk 15, the inner peripheral end shape or the outer peripheral end shape of the magnetic recording medium 1 is measured from the movement position information of the third stage 25 at that time and from the position information of pixels corresponding to the periphery of the magnetic recording medium 1 in imaging pixels of the TV camera 24, and the center position of the magnetic recording medium 1 is estimated from the measurement data. Next, the positions of the two master disks 15 and 16 whose alignment marks have been aligned are measured by the TV camera 24 to determine the center positions of the master disks. Next, the second stage 23 retaining the magnetic recording medium 1 is driven in the X and Y directions and controlled so as to eliminate misalignment between the estimated center position of the magnetic recording medium 1 and the center positions of the master disks.

After alignment of the master disks and the

magnetic recording medium has been conducted in this manner, the master disks are tightly adhered to the magnetic recording medium by a method such as vacuum adsorption or electrostatic adsorption. Next, permanent magnets are rotated and brought into proximity with the master disks from above the surface-use master disk and from below the undersurface-use master disk to conduct magnetic transfer. After magnetic transfer, the magnets are rotated and separated from the master disks, and rotation is stopped at the point in time when a magnetic flux density that does not lead to a magnetization reversal at the position of the magnetic recording medium is reached.

Example 2

Fig. 7 show the configuration of master disks used in the present example, which are greatly different in that, whereas only a magnetic pattern has been embedded in conventional master disks, alignment marks for alignment between the master disks and between the master disks and the magnetic recording medium are disposed. Because the master disks resulting from the Si substrate cannot transmit light, it is necessary to consider disposing, on the master disks, alignment marks for alignment between the two master disks so that observation can always be

made from one side with a TV camera described later.

Figs. 7 are diagrams where surface/undersurface-use master disks are seen from magnetic pattern sides thereof. Fig. 7(a) shows a master disk (surface-use master disk) 30 for the surface of the magnetic recording medium 1. Alignment marks 33 for alignment the two master disks are disposed at symmetrical positions, away from the center of the disk 30 as much as possible, at a region outside of the magnetic pattern, at the side opposite to the side in which a magnetic pattern 32 comprising magnetic films is embedded, in order to raise alignment precision. It should be noted that alignment marks for aligning the master disks may also be formed on both sides of the master disk. Fig. 7b) shows a master disk (undersurface-use master disk) 31 for the undersurface of the magnetic recording medium. Alignment marks 34 for aligning the two master disks are disposed at a region outside of the magnetic pattern of the same side as the side in which the magnetic pattern 32 comprising magnetic films is embedded. It should be noted that, in the above description, although the alignment marks in the surface-use master disk are disposed at the side opposite to the side in which the magnetic pattern is embedded and the alignment marks in the undersurface-use master disk are disposed in

the side in which the magnetic pattern is embedded, there is no problem at all if the reverse is done. Also, the number of alignment marks may exceed two each.

Fig. 8 shows the manufacturing method of the above-described surface-use master disk. The patterns shown in Figs. 9 are formed on two photomasks necessary for patterning the upper surface side and the lower surface side of the surface-use master disk. That is,

1) Upper surface side-use photomask 35 (Fig. 9a)

- Alignment marks 36 (set outside the region of the master disk) for alignment between the upper/lower surface side photomasks

- Alignment marks 37 (set outside the region of the master disk) for alignment between the surface/undersurface-use master disks

2) Undersurface side-use photomask 38 (Fig. 9b)

- Alignment marks 39 (set outside the region of the master disk) for alignment between the upper/lower surface side-use photomasks

- Magnetic transfer-use pattern 40 (set inside the region of the master disk)

That is, the alignment marks for alignment between the upper/lower surface side-use photomasks are marks used to conduct alignment of the upper surface side-use

photomask and the lower surface side-use photomask. As a result, alignment of the magnetic pattern of the surface-use master disk and the magnetic pattern of the undersurface-use master disk is effected by the alignment marks for alignment between the upper/lower surface side-use photomasks and the alignment marks for alignment between the surface/undersurface side-use master disks.

In a state where the Si substrate is sandwiched with the patterned sides of the upper/lower surface side-use photomasks facing the Si substrate side forming the master disks, positional adjustment (orthogonal movement, rotational movement) of one photomask is conducted so that the alignment marks for alignment between the upper/lower surface side-use photomasks are aligned.

After positional adjustment is conducted in this manner, as shown in Figs. 8, first, patterning is conducted on both sides of the Si substrate 41 (a), then both sides are etched (b), a soft magnetic film 42 is formed by sputtering only on the surface on which the magnetic transfer-use patterning is formed (c), lift-off is conducted (d), and the manufacture of the surface-use master disk 32 of the magnetic recording medium is concluded. The photomask used in the manufacture of the

undersurface-use master disk 31 magnetic recording medium is one and created by same manufacturing method as in Example 1 (see Figs. 2).

The shape of the alignment marks described above are such that they are mutually aligned as shown, for example, in Figs. 4, in order to raise alignment precision.

The positional relationship between the alignment marks and the magnetic patterns in the photomasks is such that the surface-use master disk and the undersurface-use master disk are in a symmetrical relationship. When the magnetic pattern surfaces of the surface-use master disk and the undersurface-use master disk are made to face each other and the position (X, Y, θ) of one master disk is adjusted with respect to the other fixed master disk so that the positions of the alignment marks match on the axial direction of the disks as will be described later, the positions of the magnetic patterns match.

Fig. 10 is a diagram showing the positional relationship between the magnetic recording medium 1 and the master disks 30 and 31. The magnetic recording medium 1 is sandwiched between the magnetic patterns 32 so that the magnetic pattern 32 of the undersurface-use master

disk 31 faces the undersurface of the magnetic recording medium 1 and the magnetic pattern 32 of the surface-use master disk 30 faces the surface of the magnetic recording medium 1. For the recording of the magnetic patterns of the magnetic recording medium 1, it is checked that center misalignment of the magnetic patterns with the shape of the magnetic recording medium is within an acceptable value and that misalignment of the top and bottom magnetic patterns is within an acceptable value. In order for the misalignment to be equal to or less than the acceptable value, an alignment device of a two-side magnetic transfer device is configured as shown in Fig. 11 and alignment is conducted in the following manner. This alignment device is the same as the device of Fig. 6 except that it is not disposed with microscopes.

(1) The positions and shapes of the two alignment marks for master disk alignment in the undersurface-use master disk 31 whose position is fixed are observed, with the television camera 24 that is disposed above the undersurface-use master disk and placed on the third stage 25, in accompaniment with the movement of the same stage 25, and stored in a memory of the signal processing device 43. The center position of the undersurface-use master disk 31 is determined from the positions and shapes of the

alignment marks of the undersurface-use master disk 31.

(2) The magnetic recording medium 1 is placed on the second stage 23 disposed above the undersurface-use master disk, the third stage 25 on which the television camera 24 is placed is controlled so that the end surface of the inner periphery of the magnetic recording medium 1 appears in the center of the screen of the television camera 24, the inner periphery is observed full circle, the shape of the inner peripheral end of the magnetic recording medium 1 is measured from the movement amount of the stage and the positions of pixels corresponding to the inner peripheral end in the television screen, and the center position of the magnetic recording medium 1 is estimated from the shape of the inner peripheral end. The amount of misalignment between the center position of the magnetic recording medium 1 and the center position of the undersurface-use master disk 31 is calculated, the second stage 23 on which the magnetic recording medium 1 is placed is moved so as to eliminate this misalignment amount, and the center of the undersurface-use master disk 31 and the center of the magnetic recording medium 1 are matched.

(3) The surface-use master disk 30 is placed on the

first stage 19 disposed above the magnetic recording medium 1, the positions and shapes of the two alignment marks for master disk alignment disposed on the upper surface of the surface-use master disk 30 are observed, with the television camera 24, in accompaniment with the movement of the X, Y stage 21 or the movement of the third stage 25, and the signals are stored in the signal processing device. The amount of orthogonal movement and the amount of rotational movement of the surface-use master disk 30 are determined from the misalignment between the positions and shapes of the two alignment marks in the surface-use master disk 30 and the positions and shapes of the two alignment marks in the undersurface-use master disk 31 stored in the memory of the signal processing device 43, the movement of the rotating stage 20 on which the surface-use master disk 30 is placed and the X, Y stage 21 is controlled, alignment of the two pairs of alignment marks is conducted (state of Fig. 4c), and alignment is concluded.

After alignment of the master disks and the magnetic recording medium has been conducted in this manner, magnetic transfer is conducted in the same manner as in Example 1.

Advantageous Effects of the Invention

As described above, in the present invention, alignment of the magnetic pattern of the surface-use master disk of the magnetic recording medium and the magnetic pattern of the undersurface-use master disk becomes possible. Thus, for example, even if the reading and writing cylinders are changed from surface to undersurface or from undersurface to surface, even data reading and writing time is enabled without the time until position stabilization of the HSA being greatly changed.

Claims

1. Master disks for a magnetic recording medium comprising a pair of master disks having regions of magnetic patterns formed therein and having alignment marks, said magnetic patterns to be magnetically transferred to the magnetic recording medium,

said alignment marks for alignment being disposed on the master disks outside the regions of the magnetic patterns;

the magnetic pattern of a surface-use master disk and the magnetic pattern of an undersurface-use master disk of a magnetic recording medium being perfectly aligned; and

wherein the center of the magnetic recording medium are perfectly aligned with the centers of the magnetic patterns of the master disks in a state where alignment of the surface and undersurface master disks has been conducted.

2. The master disks for a magnetic recording medium of claim 1, wherein at least two alignment marks are formed on each of the pair of master disks.

3. The master disks for a magnetic recording medium of claim 2, wherein the at least two alignment marks are symmetrically disposed with respect to reference points of the magnetic patterns.

4. The master disks for a magnetic recording medium of any of claims 1 to 3, wherein the alignment marks of one of the pair of master disks and the alignment marks of the other of the pair of master disks have mutually different shapes.

5. The master disks for a magnetic recording medium of any of claims 1 to 4, wherein the master disks of the pair are optically transparent or semi-transparent excluding the alignment marks.

6. An alignment device comprising:

a first stage that retains one of the pair of master disks of any of claims 1 to 5 and includes orthogonal movement and rotational movement functions with respect to the other of the pair of master disks facing that master disk;

a second stage that retains the magnetic recording medium between the pair of master disks and includes an orthogonal movement function with respect to the pair of master disks; and

observing means for observing the positions of the alignment marks of the pair of master disks and an end surface position of an inner periphery or an outer periphery of the magnetic recording medium.

7. The alignment device of claim 6, wherein the observing means includes

first observing means for observing only the positions of the alignment marks of the pair of master disks, and

second observing means for observing the positions

of the alignment marks of the pair of master disks and the end surface position of the inner periphery or the outer periphery of the magnetic recording medium.

8. An alignment method comprising:

orthogonally moving and rotatingly moving one master disk in a state where the pair of master disks of claim 5 face each other, simultaneously observing the alignment marks of the pair of master disks with first observing means, matching the alignment marks between the pair of master disks,

observing, with second observing means, the alignment marks of the pair of master disks and an inner peripheral or outer peripheral end surface of the magnetic recording medium positioned between the pair of master disks and, on the basis of the observation results, orthogonally moving and aligning the magnetic recording medium with respect to the pair of master disks.

9. An alignment method comprising:

in a state where the position of one of the pair of master disks of any of claims 1 to 4 is fixed, observing the alignment marks of the one master disk with observing means,

observing, with observing means, an inner

peripheral or outer peripheral end surface of the magnetic recording medium positioned above the one master disk, referencing the observation results and observation results of the alignment marks of the one master disk, orthogonally moving and aligning the magnetic recording medium with respect to the one master disk,

observing, with observing means, the alignment marks of the other of the pair of magnetic disks positioned above the magnetic recording medium, referencing the observation results and observation results of the alignment marks of the one master disk, orthogonally moving or rotatingly moving the other master disk with respect to the one master disk, and matching the positions of the alignment marks between the pair of master disks.