

DESCRIPTION

MAGNETIC STORAGE DEVICE

TECHNICAL FIELD

[0001] An embodiment of the present invention relates to a magnetic storage device.

BACKGROUND ART

[0002] Conventionally, magnetic storage devices (for example, a hard disk drive (HDD)) have been often used as means for storing data. The magnetic storage device includes a magnetic disk to store data, and a magnetic head to read and write data from and into the magnetic disk, the magnetic head being moved above the magnetic disk by an actuator.

[0003] With regard to the magnetic storage devices, occurrence of failures due to floating at a fixed point for a long time has been reported. The floating at a fixed point refers to a phenomenon that the magnetic head hardly moves (including a case where the magnetic head does not move at all, the same applies hereinafter) above the magnetic disk when the magnetic head gets access to only specific data in the magnetic disk. If the floating at a fixed point continues for a long time, lubricant is non-uniformly distributed on the magnetic disk or the magnetic head is sucked to the magnetic disk. As a result, a failure may occur in sometimes.

CITATION LIST

Patent Literature

[0004] Patent Document 1: Japanese Patent Application Laid-open No. H7-281966

SUMMARY OF INVENTION

Problem to be Solved by Invention

[0005] However, conventional techniques cannot easily prevent the floating at a fixed point for a long time in the magnetic storage devices.

[0006] An embodiment of the invention aims to provide a magnetic storage device that can easily prevent the floating at a fixed point for a long time.

Means for Solving Problem

[0007] A magnetic storage device according to an embodiment includes: a magnetic disk to store data; a magnetic head to read and write data from and into the magnetic disk, the magnetic head being moved above the magnetic disk by an actuator; a check processing unit to perform, at a given timing, check processing of checking normality of data of a given size out of the data stored in the magnetic disk; and a setting unit to, when the check processing is finished, set a first addition value given in advance on a high-order address of a starting address from which the next check processing is to be started, the starting address being composed of the high-order address and a low-order address.

BRIEF DESCRIPTION OF DRAWINGS

[0008] FIG. 1 is a diagram illustrating a schematic overall structure of a computer in an embodiment;

FIG. 2 is a table illustrating information used for calculating a starting address for patrol processing in the embodiment;

FIG. 3 is a flowchart illustrating the patrol processing and the like in the computer in the embodiment;

FIG. 4 is a flowchart illustrating the processing of setting the starting address for the next patrol processing in the computer in the embodiment; and

FIG. 5 is a diagram illustrating relations between the addresses of an HDD and target regions of the patrol processing in the embodiment.

DESCRIPTION OF EMBODIMENT

[0009] The following describes an embodiment of a magnetic storage device of the invention with reference to attached drawings. The following embodiment does not limit the invention.

[0010] FIG. 1 is a diagram illustrating a schematic overall structure of a computer 1 in the embodiment. The computer 1 (magnetic storage device) includes a main board 10, a RAID card 3, and hard disk drives (HDDs) 2. The computer 1 further includes, for example, a display device such as a display, and input devices such as a key board and a mouse, which are not illustrated.

[0011] The main board 10 is a control board on which a central processing unit (CPU) 11, a read only memory (ROM), a random access memory (RAM), and so on, which are not illustrated, are mounted.

[0012] Although operation speed of the HDD 2 is relatively low in recent auxiliary storage devices for computers, the HDD 2 is often used because it can store large capacity data. The HDD 2 comprises many components, for example, a magnetic disk to stores data, and a magnetic head to read and write data from and into the magnetic disk. The magnetic head is moved above the magnetic disk by an actuator.

[0013] The recent HDD 2 includes a hardware interface such as a serial attached SCSI (SAS) interface or a serial ATA (SATA) interface. A logical interface for connection in the recent HDD 2 is an SCSI or an ATA. Those logical interfaces manage spaces for data storage on a sector basis or an address basis.

[0014] The HDD 2 is a device capable of storing large capacity of data at a low cost, while the HDD 2 is a device to store data by utilizing magnetism and an actuator (such as a motor). Thus, the HDD 2 cannot fully guarantee data storage due to physical factors. One of the countermeasure techniques is the use of a redundant arrays of inexpensive disks (RAID) technique.

[0015] The RAID uses the multiple HDDs 2 to perform redundant data storage. Even when a failure occurs in the HDD 2, data stored in the failed HDD 2 can be restored on

the basis of redundant data after replacement of the failed HDD 2. The RAID card 3 (hardware RAID board) implements this RAID function by hardware.

[0016] The RAID card 3 is an expansion card installed in the computer 1. The RAID card 3 implements not only the RAID function but also a function of patrol processing that the RAID card 3 periodically accesses the HDD 2 to check normality of data in the HDD 2.

[0017] As to the HDD 2, as described above, there is a problem that the occurrence of a failure due to the floating at a fixed point for a long time. The following describes a technique that can easily prevent the floating at a fixed point for a long time by utilizing the patrol processing function of the RAID card 3, setting a range of the patrol processing so as to forcibly move the magnetic head periodically, and performing the patrol processing.

[0018] The RAID card 3 includes a RAID controller 31. The RAID controller 31 has a hardware structure including a control device such as a processor and a storage device such as a flash memory, for example. The function of the RAID controller 31 may be implemented by the hardware structure as described above or implemented by a software program or firmware.

[0019] The RAID controller 31 includes a processing unit 32, a setting unit 33, and a transmission reception unit 34.

[0020] The processing unit 32 performs various types of processing relating to the RAID. The processing unit 32 has a function as a patrol processing unit (check processing unit) that performs, at a given timing, the patrol processing (check processing) to check normality of data of a given size out of data stored in the HDD 2.

[0021] Additionally, the processing unit 32 determines a timing of the patrol processing for each data of the given size such that the patrol processing is performed on all data in the multiple HDDs 2 within a given period (for example, several weeks).

[0022] When the patrol processing is finished, the setting unit 33 sets a starting address (an example of a target address) of the next patrol processing by adding a first addition

value to a starting address of the finished patrol processing. The first addition value is set in advance such that the magnetic head moves above the magnetic disk in a radius direction of the magnetic disk equally to or more than a given amount every time the patrol processing is executed.

[0023] When the range of the patrol processing is set with, for example, the logical address of the HDD 2, the first addition value may be set to be a value enabling the magnetic head to move above the magnetic disk in the radius direction equally to or more than a given amount every time the patrol processing is executed and enabling the floating at a fixed point to be reliably prevented for a long time while taking into consideration of a correspondence relation between the logical address and a physical address of the HDD 2, a physical structure of the HDD 2, and the like.

[0024] When the patrol processing is finished, the setting unit 33 adds the first addition value to the starting address of the finished patrol processing. Then, if the address after the addition is beyond an address range of the magnetic disk, the setting unit 33 sets the starting address for the next patrol processing by resetting, to zero, a high-order address of a first predetermined number of digits in the address after the addition and by adding a second addition value to a low-order address of a second predetermined number of digits in the address after the addition. In this case, the second addition value indicates the given size.

[0025] In a case where the starting address for the next patrol processing is set and the size from the starting address to a final address in the address range is smaller than the given size, the setting unit 33 sets the range of the next patrol processing to be a range from the starting address to the final address. The details of the processing by the setting unit 33 will be described later.

[0026] The transmission reception unit 34 performs transmission and reception of data with the main board 10 and the HDD 2.

[0027] FIG. 2 is a table illustrating information used for calculating the starting address for the patrol processing in the embodiment. The setting unit 33 stores the following

pieces of information numbered (1) to (6) in a nonvolatile storage unit and manages them for performing the patrol processing.

[0028] (1) HDD capacity (Capacity)

The Capacity is information about the total storage capacity of the HDD 2, which serves as the auxiliary storage device. The Capacity is treated on a sector basis, for example. The final address in the address range is described as "Last LBA". For example, when the Capacity is "0x80000000" and the address range is from "0x00000000" to "0x7FFFFFFF", the Last LBA is "0x7FFFFFFF".

[0029] (2) Starting address for the next patrol processing (LBA)

The LBA is information about the starting address for the next patrol processing, the starting address being set after the patrol processing is finished. The LBA is treated on a sector basis, for example. The LBA is obtained by adding (3) LBA-L and (4) LBA-H, which will be described later. In the following explanation, the LBA is mainly represented by 32 bits in binary or 8 bits in hexadecimal (hereinafter, also described as "0x"). The LBA-L is low-order 12 bits (the second predetermined number of digits) out of the 32 bits representing the LBA in binary or low-order 3 bits (the second predetermined number of digits) out of the 8 bits representing the LBA in hexadecimal. The LBA-H is high-order 20 bits (the first predetermined number of digits) out of the 32 bits representing the LBA in binary or high-order 5 bits (the first predetermined number of digits) out of the 8 bits representing the LBA in hexadecimal.

[0030] (3) Low-order address (LBA-L)

The LBA-L is information about the low-order address of the second predetermined number of digits, which is used for calculating the (2) LBA (details will be described later). The LBA-L is treated on a sector basis, for example.

[0031] (4) High-order address (LBA-H)

The LBA-H is information about the high-order address of the first predetermined number of digits, which is used for calculating the (2) LBA (details will be described later). The LBA-H is treated on a sector basis, for example.

[0032] (5) High-order/Low-order management division shift (Shift)

The Shift is information about a shift value of bit in binary (in the example described above, the shift value is "12"), which indicates a boundary for dividing the LBA into the LBA-H and the LBA-L. In the following explanation, the "first addition value" refers to the binary value obtained by shifting "1" to the high-order position by the shift value. Specifically, when the Shift is "12", the first addition value is "1000000000000" in binary and is "1000 (0x1000)" in hexadecimal.

[0033] (6) Patrol range (Size)

The Size is information about the size of data to be read out for the patrol processing. The Size is treated on a sector basis, for example.

[0034] For example, when the Shift is "12", the LBA-L is the low-order 12 bits of the LBA in binary while the LBA-H is the high-order 20 bits which are the remaining bits of the LBA in binary. More specifically, for example, when the LBA is "0x12345678", the LBA-L is "0x678" while the LBA-H is "0x12345000".

[0035] When the Shift is "16", the LBA-L is the low-order 16 bits of the LBA in binary while the LBA-H is the high-order 16 bits being the remaining bits of the LBA in binary. More specifically, for example, when the LBA is "0x12345678", the LBA-L is "0x5678" while the LBA-H is "0x12340000".

[0036] In a case where the function of the RAID controller 31 is implemented by firmware, the processing unit 32 performs the patrol processing at a given timing after the firmware is in a normal state.

[0037] When performing the patrol processing, the processing unit 32 performs the patrol processing on data, whose size is the (6) Size (for example, "0x100"), from the (2) LBA in the address range of the HDD 2.

[0038] The setting unit 33 sets the starting address for the patrol processing such that the starting address is sequentially changed from the left to the right in the "LBA" row in FIG. 2. The processing in this case will be described with reference to FIGS. 3 and 4.

[0039] FIG. 3 is a flowchart illustrating the patrol processing and the like in the

computer 1 in the embodiment.

[0040] At step S1, the processing unit 32 determines whether a start timing of the patrol processing has come. When the determination results in Yes, the processing proceeds to step S2. When the determination results in No, the processing returns to step S1.

[0041] At step S2, the processing unit 32 performs the patrol processing on data of the given size (Size) from the LBA of the starting address in data stored in the HDD 2.

[0042] At step S3, the processing unit 32 determines whether the result of the patrol processing at step S2 is normal. When the determination results in Yes, the processing proceeds to step S4. When the determination results in No, the processing proceeds to step S5.

[0043] At step S5, the processing unit 32 stores data indicating that the result of the patrol processing at step S2 is abnormal (error). The error may be notified to a user of the computer 1 by sounds or displays.

[0044] At step S4, the setting unit 33 performs the processing of setting the starting address for the next patrol processing. Step S4 will be described with reference to FIG. 4. FIG. 4 is a flowchart illustrating the processing (the processing at step S4 in FIG. 3) of setting the starting address for the next patrol processing in the computer in the embodiment.

[0045] At step S41, the setting unit 33 calculates a new LBA-H by adding the first addition value (for example, "0x1000") to the LBA-H.

[0046] At step S42, the setting unit 33 calculates a new LBA by adding the LBA-H to the LBA-L.

[0047] At step S43, the setting unit 33 determines whether the LBA is beyond the Last LBA. When the determination results in Yes, the processing proceeds to step S44. When the determination results in No, the processing proceeds to step S47.

[0048] At step S44, the setting unit 33 resets the LBA-H to zero ("0x00000000").

[0049] At step S45, the setting unit 33 calculates a new LBA-L by adding the second addition value (for example, "0x100") to the LBA-L.

[0050] At step S46, the setting unit 33 calculates a new LBA by adding the LBA-H and the LBA-L. Then, the processing proceeds to step S47.

[0051] At step S47, the setting unit 33 determines whether an address away from the LBA by the Size (that is, an address obtained by "LBA + Size - 1") is beyond the Last LBA. When the determination results in Yes, the processing proceeds to step S49. When the determination results in No, the processing proceeds to step S48.

[0052] At step S48, the setting unit 33 sets the patrol processing range to be a range from the LBA to the address of (LBA + Size - 1).

[0053] At step S49, the setting unit 33 sets the patrol processing range to be a range from the LBA to the Last LBA.

[0054] The following describes specific calculation examples with reference to FIGS. 2 and 5. FIG. 5 is a diagram illustrating relations between the addresses of the HDD 2 and the target regions of the patrol processing in the embodiment. In the following explanation, all results of the patrol processing are assumed to be normal.

[0055] Values in a column C1 in FIG. 2 are initial values. In a case that the starting address for the next patrol processing is to be set after the patrol processing starting from the LBA "0x00000000" in the column C1 as the starting address is performed on data of the Size (for example, "0x100"), the first addition value "0x1000" is added to the LBA-H "0x00000000" in the column C1, and thereby a new LBA-H "0x00001000" is calculated (step S41 in FIG. 4).

[0056] Subsequently, a new LBA "0x00001000" is calculated by adding the LBA-H "0x00001000" to the LBA-L "0x000" in the column C1 (step S42).

[0057] At this time, the new LBA "0x00001000" is not beyond the Last LBA "0x7FFFFFFF" (No at step S43).

[0058] Additionally, an address away from the new LBA "0x00001000" by the Size "0x100" (that is, an address expressed by "LBA + Size - 1": "0x000010FF") is not beyond the Last LBA "0x7FFFFFFF" (No at step S47).

[0059] Therefore, the patrol processing range is set as a range from the LBA

"0x00001000" to (LBA + Size - 1), namely, "0x000010FF" (step S48). Likewise, as described above, each value in a column C2 is set. Note that the values of the LBA-L and the Size in the column C1 are copied to the column C2.

[0060] In this way, the starting address for the patrol processing is updated each time
5 when the patrol processing is finished. Then, it is assumed that the values in a column C3 become a state illustrated in FIG. 2. When the starting address for the next patrol processing is to be set after the patrol processing is performed on data of the Size "0x100" in a range from the LBA "0x7FFFE000" in the column C3 as the starting address, a new LBA-H "0x7FFFF000" is calculated by adding the first addition value
10 "0x1000" to the LBA-H "0x7FFFE000" in the column C3 (step S41).

[0061] A new LBA "0x7FFFF000" is calculated by adding the new LBA-H "0x7FFFF000" to the LBA-L "0x000" in the column C3 (step S42).

[0062] At this time, the new LBA "0x7FFFF000" is not beyond the Last LBA "0x7FFFFFFF" (No at step S43).

15 [0063] Additionally, an address away from the LBA "0x7FFFF000" by the Size "0x100" (that is, an address expressed by (LBA + Size - 1): "0x7FFFF0FF") is not beyond the Last LBA "0x7FFFFFFF" (No at step S47).

[0064] Therefore, the patrol processing range is set as a range from the LBA "0x7FFFF000" to (LBA + Size - 1), namely, "0x7FFFF0FF" (step S48). Likewise, as
20 described above, each value in a column C4 is set. The values of the LBA-L and the Size in the column C3 are copied to the column C4.

[0065] Subsequently, when the starting address for the next patrol processing is to be set after the patrol processing starting from the LBA "0x7FFFF000" in the column C4 as the starting address is performed on data of the Size "0x100", a new LBA-H
25 "0x80000000" is calculated by adding the first addition value "0x1000" to the LBA-H "0x7FFFF000" in the column C4 (step S41).

[0066] A new LBA "0x80000000" is calculated by adding the new LBA-H "0x80000000" to the LBA-L "0x000" in the column C4 (step S42).

[0067] The new LBA "0x80000000" is beyond the Last LBA "0x7FFFFFFF" (Yes at step S43).

[0068] In this case, the new LBH-H is reset to zero ("0x00000000") (step S44).

[0069] A new LBA-L "0x100" is calculated by adding the second addition value "0x100" to the LBA-L "0x000" in the column C4 (step S45).

[0070] Subsequently, a new LBA "0x00000100" is calculated by adding the reset LBA-H "0x00000000" to the new LBA-L "0x100" (step S46).

[0071] An address away from the new LBA "0x00000100" by the Size "0x100" (that is, an address expressed by $(\text{LBA} + \text{Size} - 1)$: "0x000001FF") is not beyond the Last LBA "0x7FFFFFFF" (No at step S47).

[0072] Therefore, the patrol processing range is set as a range from the LBA "0x00000100" to $(\text{LBA} + \text{Size} - 1)$, namely, "0x000001FF" (step S48). Likewise, as described above, each value in a column C5 is set. The value of the Size in the column C4 is copied to the column C5.

[0073] As described above, the patrol processing range in the HDD 2 proceeds in the longitudinal direction illustrated with an arrow in FIG. 5. Therefore, the magnetic head is forcibly moved every time the patrol processing is executed, thereby making it possible to prevent the floating at a fixed point for a long time.

[0074] Note that, in conventional techniques, the patrol processing range proceeds in the lateral direction in FIG. 5. As a result, the magnetic head is hardly moved every time the patrol processing is executed. Therefore, it is impossible for the patrol processing in conventional techniques to prevent the floating at a fixed point for a long time.

[0075] The computer 1 according to the embodiment sets, when the patrol processing is finished, the starting address for the next patrol processing by adding, to the starting address for the finished patrol processing, the first addition value that is set in advance so as to cause the magnetic head to move above the magnetic disk in the radius direction of the magnetic disk equally to or more than a given amount every time the patrol

processing is executed. This configuration makes it possible to easily prevent the floating at a fixed point for a long time. In this way, by utilizing the patrol processing function originally installed in the RAID card 3 and setting the starting address for the patrol processing in the manner described above, it is possible to move the magnetic head easily and forcibly at short time intervals.

[0076] As a more specific setting procedure of the starting address for the patrol processing, when an address obtained by adding the first addition value to the starting address in the patrol processing is beyond the address range of the magnetic disk, the high-order address of the first predetermined number of digits in the obtained address is reset to zero while the second addition value is added to the low-order address of the second predetermined number of digits in the obtained address. The second addition value indicates the given size. With this configuration, as understood by FIG. 5, the patrol processing can be performed on all data in the address range of the HDD 2 without omission.

[0077] Additionally, when the starting address for the next patrol processing is set and the size from the starting address to the final address in the address range is smaller than the given size, the range of the next patrol processing is reset to be a range from the starting address to the final address. This makes it possible to set the patrol processing range appropriately even when the starting address is near the final address.

[0078] The program executed by the computer 1 in the embodiment is preliminarily embedded and provided in the ROM, for example. The program may be recorded and provided in a computer-readable recording medium such as a CD-ROM, a flexible disk (FD), a CD-R, or a digital versatile disc (DVD), as an installable or executable file.

[0079] Alternatively, the program may be stored in a computer connected to a network such as the Internet and be provided by being downloaded over the network. The program may be provided or distributed via a network such as the Internet.

[0080] The program has a module structure including the units described above (the processing unit 32, the setting unit 33, and the transmission reception unit 34). In the

actual hardware operation, the CPU (processor) executes the program by reading out the program from the ROM, resulting in the above-described units being loaded on a main storage device to be created.

[0081] The embodiments of the invention are exemplified as described above. The embodiments are only examples and not intended to limit the scope of the invention. These novel embodiments can be implemented in various other forms, and various omissions, replacements, and changes can be made without departing from the gist of the invention. These embodiments and modifications thereof are included in the scope and gist of the invention, and are included in the invention described in the claims and the equivalents thereof.

[0082] For example, in the embodiment, a case where the Shift is "12" is mainly described. The Shift is, however, not limited to this value. For example, the Shift is set to "16" or "20" on the basis of a recent tendency in an increase in capacities of the HDDs. The Shift may employ other values in a range satisfying the condition that can prevent the floating at a fixed point for a long time.

EXPLANATIONS OF LETTERS OR NUMERALS

[0083] 1: Computer, 2: HDD, 3: RAID card, 10: Main board, 11: CPU, 31: RAID controller, 32: Processing unit, 33: Setting unit, 34: Transmission reception unit

CLAIMS

1. A magnetic storage device comprising:
 - a magnetic disk configured to store data;
 - a magnetic head configured to read and write data from and into the magnetic disk, the magnetic head being moved above the magnetic disk by an actuator;
 - a check processing unit configured to perform, at a given timing, check processing of checking normality of data of a given size out of the data stored in the magnetic disk; and
 - a setting unit configured to, when the check processing is finished, set a first addition value given in advance on a high-order address of a starting address from which the next check processing is to be started, the starting address being composed of the high-order address and a low-order address.
2. The magnetic storage device according to claim 1, wherein, when the starting address is beyond an address range of the magnetic disk, the setting unit is configured to set the starting address for the next check processing by resetting the high-order address to zero and adding a second addition value to the low-order address.
3. The magnetic storage device according to claim 2, wherein the second addition value indicates the given size.
4. The magnetic storage device according to claim 3, wherein, in a case where the starting address for the next check processing is set and a size from the starting address to a final address in the address range of the magnetic disk is smaller than the given size, the setting unit sets a range of the next check processing to be a range from the starting address to the final address.