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(54) Titre : SUPPORT OPTIQUE DE STOCKAGE D'INFORMATIONS ET PROCEDE D'ENREGISTREMENT SUR CE DERNIER

(54) Title: OPTICAL INFORMATION STORAGE MEDIUM AND METHOD OF RECORDING THEREON

35

b7 b6	b5 b4 b3 b2 b1 b0
MAXIMUM WRITING SPEED	RESERVED

(57) Abrégé/Abstract:
Provided are an optical information storage medium and a method of recording thereon. The optical information storage medium has a lead-in area, a user data area and a lead-out area, and data indicating a maximum and/or a minimum writing speed, maximum and minimum writing speeds, or compatible writing speeds is recorded in a rewritable region of at least one of the lead-in area and the lead-out area. The optical information storage medium and the method of recording on the media enable a disc drive to reliably record data on a disc which cannot achieve a prescribed recording speed due to manufacturing conditions, at an optimal speed considering the pre-recorded writing speed data.

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(54) Title: OPTICAL INFORMATION STORAGE MEDIUM AND METHOD OF RECORDING THEREON

35

b7	b6	b5	b4	b3	b2	b1	b0
MAXIMUM WRITING SPEED		RESERVED					

(57) Abstract: Provided are an optical information storage medium and a method of recording thereon. The optical information storage medium has a lead-in area, a user data area and a lead-out area, and data indicating a maximum and/or a minimum writing speed, maximum and minimum writing speeds, or compatible writing speeds is recorded in a rewritable region of at least one of the lead-in area and the lead-out area. The optical information storage medium and the method of recording on the media enable a disc drive to reliably record data on a disc which cannot achieve a prescribed recording speed due to manufacturing conditions, at an optimal speed considering the pre-recorded writing speed data.

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OPTICAL INFORMATION STORAGE MEDIUM AND METHOD OF RECORDING THEREON

Technical Field

The present invention relates to an optical information storage medium and a method of recording thereon, and more particularly, to an optical information storage medium in which data indicating a maximum writing speed, maximum and/or minimum wiring speeds, or compatible writing speeds is recorded in a rewritable region other than a user data area so that a disc drive can recognize the data and record information on the medium at an optimal speed, and a method of recording the data on the medium.

Background Art

An optical information storage medium, e.g. an optical disc, is generally employed as an information storage medium of an optical pick-up device that records and plays information without touching the disc. Optical discs include compact discs (CDs) and digital versatile discs (DVDs), which have different storage capacities. In addition, various sub-categories of optical discs include CD-Recordables (CD-Rs), CD-Rewritables (CD-RWs), Digital Versatile Disc-rewritables (DVD-RWs), Digital Versatile Disc-Random Access Memories (DVD-RAMs), and Digital Versatile Disc Rewritables (DVD+RWs).

As recording speed of optical discs increases, the performance of disc drives has been improved to accommodate recording at increased speeds. In order to perform reliable recording, disc drives operate such that they can satisfy recording characteristics accompanying the recording speed of the disc. However, while general disc drives reliably record data on low-speed discs, they do not satisfy the recording characteristics of high-speed discs, and thus they frequently cause damage to user data. Likewise, disc drives for high-speed discs can

cause damage to user data when recording on low-speed discs.

Accordingly, information on the recording speed of a disc is necessary for reliably recording data. Such information is recorded in a predetermined region of the disc, and the disc drive recognizes the prescribed recording speed of the disc and records data on the disc at an optimal speed. For example, in the case of a 2X-speed disc, the recording speed of the disc is recorded on a predetermined region of the disc when the disc is manufactured, and thus a disc drive can refer to the prescribed recording speed and accompanying recording characteristics and record data on the disc at a speed of 2x.

However, the prescribed recording speed of a disc is not sometimes satisfied in a disc test. For example, a 4X-speed disc is manufactured, and the recording speed of the disc, i.e., 4X, is recorded on a predetermined region of the disc, but due to various factors during manufacture, the recording speed of the disc does not reach the prescribed 4X speed. Such a disc cannot be used as a 4X-speed disc, but it may be appropriate to be used as a 3x-speed disc or a 2x-speed disc. If such a disc is used, the disc drive recognizes the disc as a 4X-speed disc because the recording speed is recorded as the 4X speed, and thus it tries to record the data at the prescribed 4X speed. However, the actual recording speed is not 4X, and thus the recorded data can be damaged. Therefore, such discs which are manufactured to be 4X- speed discs but come out as 3X-speed discs or 2X-speed discs cannot be used and are discarded.

It is very wasteful to discard discs which fail to achieve a desired recording speed due to various manufacturing conditions but achieve a lower recording speed.

Disclosure of the Invention

The present invention provides an optical information storage medium which is capable of reliably recording user data at an optimal speed due to information indicating the medium's maximum writing

speed, maximum and minimum wiring speeds, or compatible writing speeds in a rewritable region other than a user data area, and a method of recording on the medium.

According to one aspect of the present invention, there is provided an optical information storage medium having a lead-in area, a user data area, and a lead-out area, wherein a maximum writing speed is recorded in a rewritable region of at least one of the lead-in area and the lead-out area.

The maximum writing speed is recorded in rewritable regions of both the lead-in area and the lead-out area.

The rewritable region includes a disc ID zone in which disc ID information is recorded and which has at least one disc ID information region and a reserved region, and the maximum writing speed is recorded in at least one disc ID information region or the reserved region.

A minimum writing speed is further recorded in the rewritable region of at least one of the lead-in area and the lead-out area.

According to another aspect of the present invention, there is provided an optical information storage medium having a lead-in area, a user data area and a lead-out area, wherein information indicating compatible writing speeds is recorded in a rewritable region of at least one of the lead-in area and the lead-out area.

Information on each of the compatible writing speeds is recorded by a corresponding bit of a predetermined byte of the rewritable region.

According to yet another aspect of the present invention, there is provided a method of recording on an optical information storage medium having a lead-in area, a user data area, and a lead-out area, the method comprising recording a maximum writing speed in a rewritable region of at least one of the lead-in area and the lead-out area; and recording data on the optical information storage medium at an optimal speed determined based on the maximum wiring speed.

According to yet another aspect of the present invention, there is

provided a method of recording on an optical information storage medium having a lead-in area, a user data area and a lead-out area, the method comprising recording information indicating compatible writing speeds in a rewritable region of at least one of the lead-in area and the lead-out area; and recording data on the optical information storage medium at an optimal speed determined based on the maximum writing speed.

Brief Description of the Drawings

FIG. 1 is a diagram of the structure of a lead-in area of an optical information storage medium according to the present invention;

FIG. 2 is a diagram of the structure of a part of an optical information storage medium according to the present invention;

FIG. 3A is a diagram for explaining an optical information storage medium and a method of recording thereon according to a first embodiment of the present invention;

FIG. 3B is a diagram for explaining an optical information storage medium and a method of recording thereon according to a second embodiment of the present invention; and

FIG. 4 is a diagram for explaining an optical information storage medium and a method of recording thereon according to a third embodiment of the present invention.

Best mode for carrying out the Invention

The present invention now will be described more fully with reference to the accompanying drawings, in which preferred embodiments of the invention are shown.

FIG. 1 shows a lead-in area of an optical information storage medium according to the present invention, which includes the lead-in area, a user data area and a lead-out area. The lead-in area includes an embossed data zone 10 in which basic disc information is recorded in an innermost area of the disc in the form of pits, a mirror zone 20, and a rewritable data zone 30.

The embossed data zone 10 includes a control data zone 10a in which a prescribed recording speed of the disc is recorded. The prescribed recording speed means a recording speed such as 2X speed, 3X speed or 4X speed which is predetermined when the disc is designed, and it is one piece of the basic disc information recorded in the control data zone 10a. A disc drive recognizes the prescribed recording speed when it records data in the disc, and it records the data at an optimal speed considering the prescribed recording speed recorded on the disc.

The mirror zone 20 may be a connection zone which connects the embossed data zone 10 with the rewritable data zone 30.

The rewritable data zone 30 may include a disc test zone 30a, a drive test zone 30b, a disc ID zone 30c and a defect managing zone 30d. The disc ID zone 30c includes at least one disc ID information region in which disc ID information is recorded. In the present embodiment, first through fourth disc ID information regions 30c-1, 30c-2, 30c-3 and 30c-4 are included in the disc ID zone 30c. Also, reserved regions 30c-5 and 30c-6 can be further included as regions in which other information can be recorded.

The lead-out area has a similar structure to the lead-in area, and thus a detailed description of the lead-out area will be omitted.

It is desirable that optical information storage media satisfy the prescribed recording speed recorded in the control data zone 10a. However, the actual recording speed may be lower than the prescribed recording speed due to disc manufacturing conditions. In this case, it is desirable for information on the actual recording speed to be recorded on a disc and referred to instead of the prescribed recording speed. This is accomplished by the present invention.

A method of recording on an optical information storage medium according to a first embodiment of the present invention includes recording a maximum writing speed of the medium in at least one rewritable region of the lead-in area and the lead-out area. For

example, the maximum writing speed can be recorded in a predetermined region of the rewritable data zone 30.

Referring to FIG. 2, the predetermined region of the writable data zone 30 is comprised of a plurality of bytes, and the maximum writing speed can be recorded in one of the plurality of bytes. For example, a speed flag for the writing speed can be recorded in a 0 byte position BP 35 of the predetermined region of the writable data zone 30. Alternatively, the writing speed can be recorded in a desired byte position such as a 1-byte position BP of FIG. 2.

The 0 byte position BP 35 is comprised of 8 bits from bit 0 through bit 7, i.e., b0 through b7 as shown in FIG. 3A, and a speed flag for the maximum writing speed can be recorded in b7 and b6. Other bits are left as reserved regions. More specifically, the following speed flags for the maximum writing speed can be recorded in b7 and b6.

In the case of a 5X-speed disc, if the speed flag is 00b, it is possible to record data at 5X speed. If the speed flag is 01b, the maximum writing speed of the disc is 2X speed. If the speed flag is 10b, the maximum writing speed of the disc is 3X speed. Finally, if the speed flag is 11b, the maximum writing speed of the disc is 4X speed.

In a 3X-speed disc, if the speed flag is 00b, it is possible to record data at 3X speed. If the speed flag is 01b, the maximum recording speed is 2X-speed.

In addition, the speed flag can be comprised of 3 bits for the discs having a disc speed of more than 6X speed. For example, in a 6X-speed disc, if the speed flag is 000b, it is possible to record data at 6X speed. If the speed flag is 001b, the maximum writing speed is 2X speed. If the speed flag is 010b, the maximum writing speed is 3X speed.

In the above examples, a speed flag of 2 or 3 bits is used to record the maximum writing speed. However, in some cases, a speed flag of 4-8 bits can be used. Also, it is sometimes possible to record the

maximum writing speed using at least one bit of one byte of the rewritable region.

The maximum writing speed is recorded in the predetermined region of the writable data zone 30 of the lead-in area, and disc drives record data on the disc at an optimal recording speed considering the maximum writing speed of the disc.

Preferably, the maximum writable speed is recorded in one of the disc ID information regions 30c-1, 30c-2, 30c-3, and 30c-4 of the disc ID zone 30c, or one of the reserved regions 30c-5 or 30c-6 of the disc ID zone 30c. In the above description, the maximum writing speed is recorded in the rewritable region of the lead-in area. However, it can alternatively be recorded in a rewritable region of the lead-out area at an outer portion of the storage media, or in the rewritable regions of both the lead-in area and the lead-out area.

In the optical information storage medium and method of recording on the same according to the first embodiment of the present invention, the maximum writing speed is recorded in a predetermined region of a rewritable region of at least one of the lead-in area and/or the lead-out area. Here, the maximum writing speed can be recorded as a speed flag by using at least one bit of predetermined bytes.

In the above description, the maximum writing speed is recorded in the 0 byte position BP. However, the maximum writing speed may be recorded in another byte position BP.

A method of recording on an the optical information storage media according to a second embodiment of the present invention includes recording the maximum writing speed and minimum writing speed of the medium in a rewritable region of at least one of the lead-in area and the lead-out area. For example, the maximum writing speed and minimum writing speed can be recorded in a predetermined region of the rewritable data zone 30. Here, the rewritable data zone 30 is included in the lead-out area as well as in the lead-in area.

The maximum writing speed and minimum writing speed can be recorded in a predetermined region of the rewritable data zone 30, e.g., the disc ID information regions 30c-1, 30c-2, 30c-3, 30c-4 or reserved regions 30c-5 or 30c-6. The disc ID information regions 30c-1, 30c-2, 30c-3, 30c-4 or reserved regions 30c-5 or 30c-6 are composed of a plurality of bytes, and the maximum writing speed and minimum writing speed are recorded in one byte position BP of the plurality of bytes, as shown in FIG. 3B.

In addition, it is desirable that the maximum writing speed and minimum writing speed are recorded in rewritable regions of both the lead-in area and the lead-out area, in order to reliably record the data.

For example, when an 8X-speed disc is found to actually be capable of recording at only 5X-7X speed in a test of its recording characteristics, the maximum writing speed is 7X and the minimum writing speed is 5X. FIG. 3B shows a case where the maximum writing speed is recorded in b7, b6, b5 and b4 and the minimum writing speed is recorded in b3, b2, b1 and b0. Such a case in which the maximum writing speed and the minimum writing speed are recorded by using 4 bits can be expressed as follows:

[Table 1]

Bite	Recording speed
0000b	2X speed
0001b	3X speed
0010b	4X speed
0011b	5X speed
0100b	6X speed
0101b	7X speed
0110b	8X speed
0111b	9X speed

Referring to table 1, the 5X-7X speeds can be expressed by 01010011b. Here, the maximum writing speed and the minimum writing

speed are each indicated by using 4 bits. However, they can be indicated by using 3 bits each or 2 bits each.

In the optical information storage medium and the method of recording thereon according to the second embodiment of the present invention, the maximum writing speed and the minimum writing speed are recorded in a rewritable region of at least one of the lead-in area and the lead-out area. And, the maximum writing speed and the minimum writing speed can be recorded by using 2 through 4 bits each.

Hereinafter, a method of recording on the optical information storage medium according to a third embodiment of the present invention will be described.

According to the third embodiment of the present invention, the method includes recording information on writing speeds in a predetermined region of the rewritable region of at least one of the lead-in area and the lead-out area by using one bit per writing speed.

For example, the writing speed can be recorded by using one bit of a predetermined region of the rewritable data zone of FIG. 1. The writing speed is recorded in the disc ID information regions 30c-1, 30c-2, 30c-3, 30c-4 or the reserved regions 30c-5 or 30c-6 of the rewritable data zone 30. The disc ID information regions 30c-1, 30c-2, 30c-3, 30c-4 or the reserved regions 30c-5 or 30c-6 are comprised of a plurality of bytes, and the writing speed is recorded by using one of 8 bits of one byte of the plurality of bytes.

Specifically, each bit of a predetermined bite position corresponds to a different writing speed, and any given writing speed is recorded by a corresponding bit. For example, each bit can correspond to a writing speed as follows:

[Table 2]

Bit Position (BP)	Writing speed
7 b	9X speed
6 b	8X speed

5 b	7X speed
4 b	6X speed
3 b	5X speed
2 b	4X speed
1 b	3X speed
0 b	2X speed

Referring to table 2, if 0b is recorded in 7b, it is impossible to record data at 9X speed. If 1b is recorded in 7b, it is possible to record data at 9X speed. If 0b is recorded in 6b, it is impossible to record data at 8X speed. If 1b is recorded in 6b, it is possible to record data at 8X speed. This same goes for 5b, 4b, 3b, 2b, 1b, 0b, and thus each bit records information on a different writing speed.

According to the third embodiment of the present invention, when the 9X-speed disc is found to actually capable of recording at only 5X-7X speed in a test of its recording characteristics, the writing speed can be recorded as 00111000b.

Here, the writing speed information can be recorded in a rewritable region of both the lead-in area and the lead-out area in order to reliably record the data.

According to the second and the third embodiments, all writing speeds can be expressed, and by recording information on all writing speeds, a high-speed disc can be compatible with a disc drive for a low-speed disc.

It is important that the writing speed information is recorded only by disc manufacturers and cannot be changed or deleted after shipment of the disc.

While this invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims and equivalents.

Industrial Applicability

As described above, the optical information storage medium and the method of recording thereon according to the present invention enable a disc drive to record data on a disc which cannot achieve its prescribed recording speed due to manufacturing conditions, at an optimal speed considering information on the maximum, the minimum or compatible writing speeds of the disc. The present invention may be very important considering the current trend toward higher and higher speed discs.

In addition, according to the optical information storage medium and the method of recording thereon of the present invention, it is possible to reduce the number of discs that are discarded as being defective and to prevent damage to user data due to recoding at an unsuitable recording speed.

What is claimed is:

1. An optical information storage medium having a lead-in area, a user data area, and a lead-out area, wherein a maximum writing speed is recorded in a rewritable region of at least one of the lead-in area and the lead-out area, wherein the maximum writing speed represents an actual maximum recording speed obtained by a manufacturer after testing actual recording characteristics of the optical information storage medium during the manufacture of the optical information storage medium and is different from a prescribed writing speed assigned to the optical information storage medium by the manufacturer during the manufacture of the optical information storage medium.

2. The medium of claim 1, wherein the maximum writing speed is recorded in rewritable regions of both the lead-in area and the lead-out area.

3. The medium of claim 1, wherein the rewritable region includes a disc ID zone in which disc ID information is recorded and which has at least one disc ID information region and a reserved region, and the maximum writing speed is recorded in at least one disc ID information region or the reserved region.

4. The medium of claim 3, wherein the maximum writing speed is recorded as a speed flag by using at least one bit of a predetermined byte of the rewritable region.

5. The medium of claim 1, wherein the maximum writing speed is recorded as a speed flag by using at least one bit of a predetermined byte of the rewritable region.

6. The medium of claim 1, wherein a minimum writing speed is further recorded in the rewritable region of at least one of the lead-in area and the lead-out area.

7. The medium of claim 6, wherein the rewritable region includes a disc ID zone in which disc ID information is recorded and which has at least one disc ID information region and a reserved region, and the maximum writing speed and the minimum writing speed are recorded in at least one disc ID information region or the reserved region.

8. The medium of claim 6, wherein the maximum writing speed and the minimum writing speed are each recorded as a speed flag by using at least one bit of a predetermined byte of the rewritable region.

9. The medium of claim 6, wherein the maximum writing speed and the minimum writing speed are recorded in rewritable regions of both the lead-in area and the lead-out area.

10. An optical information storage medium having a lead-in area, a user data area and a lead-out area, wherein information indicating compatible writing speeds is recorded in a rewritable region of at least one of the lead-in area and the lead-out area, wherein the compatible writing speeds represent actual compatible recording speeds obtained by a manufacturer after testing actual recording characteristics of the optical information storage medium during the manufacture of the optical information storage medium and are different from prescribed writing speeds assigned to the optical information storage medium by the manufacturer during the manufacture of the optical information storage medium.

11. The medium of claim 10, wherein information on each of the compatible writing speeds is recorded by a corresponding bit of a predetermined byte of the rewritable region.

12. The medium of claim 11, wherein the rewritable region includes a disc ID zone in which disc ID information is recorded and which has at least one disc ID information region and a reserved region, and the information indicating compatible writing speeds is recorded in at least one disc ID information region or the reserved region.

13. The medium of claim 11, wherein the information indicating compatible writing speeds is recorded in rewritable regions of both the lead-in area and the lead-out area.

14. The medium of claim 10 wherein the rewritable region includes a disc ID zone in which disc ID information is recorded and which has at least one disc ID information region and a reserved region, and the information indicting compatible writing speeds is recorded in at least one disc ID information region or the reserved region.

15. A method of recording on an optical information storage medium having a lead-in area, a user data area, and a lead-out area, the method comprising:

recording a maximum writing speed in a rewritable region of at least one of the lead-in area and the lead-out area; and

recording data on the optical information storage medium at an optimal speed determined based on the maximum writing speed, wherein the maximum writing speed represents an actual maximum recording speed obtained by the manufacturer after testing actual recording characteristics of the optical information storage medium during the manufacture of the optical information storage medium and is different from a prescribed writing speed assigned to the

optical information storage medium by the manufacturer during the manufacture of the optical information storage medium.

16. The method of claim 16, wherein the maximum writing speed is recorded in rewritable regions of both the lead-in area and the lead-out area.

17. The method of claim 15, wherein the rewritable region includes a disc ID zone in which disc ID information is recorded and which has at least one disc ID information region and a reserved region, and the maximum writing speed is recorded in at least one disc ID information region or the reserved region.

18. The method of claim 16, wherein the maximum writing speed is recorded as a speed flag by using at least one bit of a predetermined byte of the rewritable region.

19. The method of claim 15, wherein the maximum writing speed is recorded as a speed flag by using at least one bit of a predetermined byte of the rewritable region.

20. The method of claim 15, wherein a minimum writing speed is further recorded in the rewritable region of at least one of the lead-in area and the lead-out area.

21. The method of claim 20, wherein the maximum writing speed and the minimum writing speed are recorded in rewritable regions of both the lead-in area and the lead-out area.

22. The method of claim 20, wherein the rewritable region includes a disc ID zone in which disc ID information is recorded and which has at least one disc ID information region and a reserved region, and the maximum writing speed and the minimum writing speed are recorded in at least one disc ID information region or the reserved region.

23. The method of claim 20, wherein the maximum writing speed and the minimum writing speed are each recorded as a speed flag by using at least one bit of a predetermined byte of the rewritable region.

24. A method of recording on an optical information storage medium having a lead-in area, a user data area and a lead-out area, the method comprising:

recording information indicating compatible writing speeds in a rewritable region of at least one of the lead-in area and the lead-out area; and

recording data on the optical information storage medium at an optimal speed determined based on the maximum writing speed, wherein the compatible writing speeds represent actual compatible recording speeds obtained by the manufacturer after testing actual recording characteristics of the optical information storage medium during the manufacture of the optical information storage medium and are different from prescribed writing speeds assigned to the optical information storage medium by the manufacturer during the manufacture of the optical information storage medium.

25. The method of claim 24, wherein information indicating each of the writing speeds is recorded by a corresponding bit of a predetermined byte of the rewritable region.

26. The method of claim 24, wherein the rewritable region includes a disc ID zone in which disc ID information is recorded and which has at least one disc ID information region and a reserved region, and the information indicating the compatible writing speeds is recorded in at least one disc ID information region or the reserved region.

FIG. 1

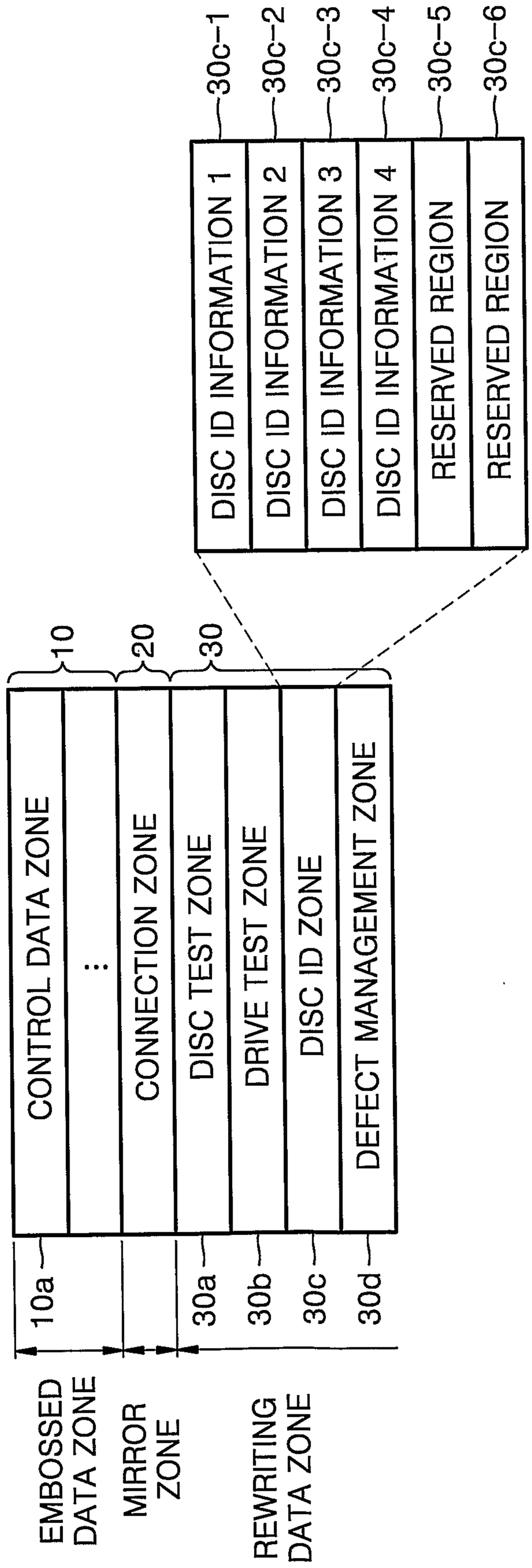
10a
EMBOSSED DATA ZONE
MIRROR ZONE
30a
30b
30c
30d
REWRITING DATA ZONE
CONTROL DATA ZONE
CONNECTION ZONE
DISC TEST ZONE
DRIVE TEST ZONE
DISC ID ZONE
DEFECT MANAGEMENT ZONE
10
20
30
30c-1
30c-2
30c-3
30c-4
30c-5
30c-6
DISC ID INFORMATION 1
DISC ID INFORMATION 2
DISC ID INFORMATION 3
DISC ID INFORMATION 4
RESERVED REGION
RESERVED REGION

FIG. 2

30

BP	DESCRIPTION	NUMBER OF BYTES
35 ~ 0	SPEED FLAG FOR WRITING SPEED	ONE BYTE
1~	RESERVED	RESERVED

FIG. 3A

35

b7 b6	b5 b4 b3 b2 b1 b0
MAXIMUM WRITING SPEED	RESERVED

FIG. 3B

35

b7	b6	b5	b4	b3	b2	b1	b0
MAXIMUM WRITING SPEED				MINIMUM WRITING SPEED			

FIG. 4

35

b7	b6	b5	b4	b3	b2	b1	b0
		SPEED FLAG FOR SPEED					

35

b7 b6	b5 b4 b3 b2 b1 b0
MAXIMUM WRITING SPEED	RESERVED