(12) STANDARD PATENT (11) Application No. **AU 2004254437 B2**
(19) AUSTRALIAN PATENT OFFICE

(54) Title
Recording medium, method of configuring control information thereof, recording and/or reproducing method using the same, and apparatus thereof

(51) International Patent Classification(s)
G11B 7/24 (2006.01) ***G11B 7/007*** (2006.01)
G11B 7/0045 (2006.01) *G11B 7/00* (2006.01)

(21) Application No: **2004254437** (22) Date of Filing: **2004.07.05**

(87) WIPO No: **WO05/004138**

(30) Priority Data

(31) Number	(32) Date	(33) Country
10-2003-0061785	**2003.09.04**	**KR**
10-2003-0045825	**2003.07.07**	**KR**
10-2003-0056540	**2003.08.14**	**KR**

(43) Publication Date: **2005.01.13**
(44) Accepted Journal Date: **2009.04.23**

(71) Applicant(s)
LG Electronics Inc.

(72) Inventor(s)
Suh, Sang Woon;Kim, Jin Yong

(74) Agent / Attorney
Freehills Patent & Trade Mark Attorneys, Level 43 101 Collins Street, Mebourne, VIC, 3000

(56) Related Art
US 2003/0021201

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 January 2005 (13.01.2005)

PCT

(10) International Publication Number
WO 2005/004138 A1

(51) International Patent Classification[7]: G11B 7/24

(21) International Application Number:
PCT/KR2004/001654

(22) International Filing Date: 5 July 2004 (05.07.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

10-2003-0045825	7 July 2003 (07.07.2003)	KR
10-2003-0056540	14 August 2003 (14.08.2003)	KR
10-2003-0061785	4 September 2003 (04.09.2003)	KR

(71) Applicant *(for all designated States except US)*: **LG ELECTRONICS INC.** [KR/KR]; 20, Yoido-dong, Youngdungpo-gu, Seoul 150-721 (KR).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **SUH, Sang Woon** [KR/KR]; 10-709, Hyundai APT., 1346, Seocho 2(i)-dong, Seocho-gu, Seoul 137-861 (KR). **KIM, Jin Yong** [KR/KR]; 109-602, Sunkyung APT., Topmaeul, Yatap-dong, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-928 (KR).

(74) Agents: **BAHNG, Hae Cheol** et al.; Kims International Patent & Law Office, 15th Floor Yo Sam Building, 648-23, Yeoksam-dong, Kangnam-gu, Seoul 135-080 (KR).

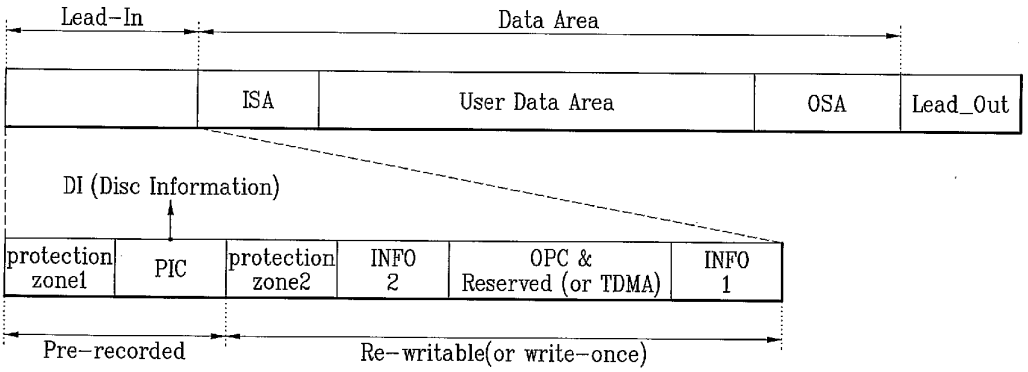
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: RECORDING MEDIUM, METHOD OF CONFIGURING CONTROL INFORMATION THEREOF, RECORDING AND/OR REPRODUCING METHOD USING THE SAME, AND APPARATUS THEREOF



(57) Abstract: The present invention provides a method of recording control information in a recordable optical disc including at least one recording layer. In recording control information within a management area of an optical disc including at least one or more recording layers, the present invention includes providing the control information to each of the at least one or more recording layers per recording velocity, recording an information identifying a type of the corresponding control information within the control information, and recording a write strategy (WS) interworking with the type of the control information. In recording a write strategy (WS) within disc information, CLV and CAV are separately recorded, whereby it is able to efficiently cope with the record/playback of the optical disc.

WO 2005/004138 A1

Recording medium, Method of Configuring Control Information Thereof, Recording and/or Reproducing Method using the Same, and Apparatus Thereof

Technical Field

The present invention relates to a method of recording control information on a recording medium, such as a recordable optical disc, and a method of recording data on a recording medium using the control information.

Background Art

A high-density optical recording medium, known as HD-DVD, is widely used to record and store high-definition video data and high-quality audio data. The Blu-ray disc (hereinafter abbreviated BD) represents next-generation HD-DVD technology. Technological specifications are now being established for the global standardization of the Blu-ray disc, including standards for a write-once Blu-ray disc (BD-WO). Meanwhile, a rewritable Blu-ray disc, known as 1x speed BD-RE and now under discussed should be compatible with BD-RE discs expected to have higher writing speed, i.e., 2x speed BD-RE and beyond. BD-WO specifications for high writing speed are also in progress. Efficient solutions for coping with the high writing speed of a high-density optical disc are urgently needed, and the

2004254437 06 Jun 2006

specifications established should ensure mutual compatibility.

Summary of the Invention

Accordingly, in a first aspect the present invention is directed to a method of recording control information in an optical disc that substantially obviates one or more problems due to limitations and disadvantages of the related art.

An object of an embodiment of the present invention is to provide a new method of recording control information as specified information coping with high writing speed, in which information indicating a kind of control information is recorded within the control information as well as a write strategy interworking with the recorded information.

Another object of an embodiment of the present invention is to define a new data structure configuring control information.

Another object of an embodiment of the present invention is to provide a specified method of recording control information coping with high writing speed in a specific area within a disc, by which reciprocal compatibility is provided between the same based discs.

A further object of an embodiment of the present invention is to provide a recording/reproducing method and apparatus thereof, by which real data is recorded/reproduced on/from an optical disc using the recorded control information.

Additional advantages, objects, and features of embodiments of the invention will be set forth in part in the description

2004254437 07 Jan 2009

which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the illustrative embodiments of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

In a first aspect the present invention provides a method of recording control information on a recording medium, including the steps of: generating a control information associated with at least one recording velocity, the control information including type information identifying a type of the corresponding control information and write strategy information dependent on the type of the control information, the type information indicating whether the control information is usable for CLV (constant linear velocity) mode or CAV(constant angular velocity) mode; and recording the control information on a specific area of the recording medium.

In another aspect of the present invention, there is provided a recording medium having a data structure of a control information recorded on a recording medium, wherein in that the control information is required for recording data and the control information is associated with a specific recording velocity and a specific write strategy typeusable at the specific recording velocity and the control information comprises write strategy information dependent on a type information for indicating whether the control information is associated with CAV mode or CLV mode.

2004254437 07 Jan 2009

In another aspect of the present invention, there is provided a recording medium including at least one recording layer provided with a recordable area and a pre-recorded area, wherein a medium control information is separately provided according to each recording velocity to the pre-recorded area and wherein an identification information identifying a type of the medium control information therein and a write strategy information associated with the identification information therein are provided to the disc information.

In another aspect of the present invention, there is provided an optical disc including at least one or more recording layers, wherein a control information is provided according to each recording layer and/or each recording velocity, wherein an identification information identifying a type of the control information and a write strategy parameters associated with the identification information are recorded within the control information.

In another aspect of the present invention, there is provided a method of recording data on a recording medium including reading a plurality of control information recorded respectively according to each recording velocity within a management area of the recording medium, checking an identification information identifying a control information type recorded within each control information, and performing a recording of data based on a write strategy information associated with a corresponding recording velocity from the identification information.

In another aspect of the present invention, there is provided a method of recording data on a recording medium, including: identifying a specific control information, based on type

2004254437 07 Jan 2009

information for identifying a type of control information, wherein the control information is associated with at least one of a plurality of specific recording velocities to provide a reference information for recording data and associated with a specific write strategy type usable at a corresponding specific recording velocity, and the type information indicates whether the specific control information is used for CLV mode or CAV mode; and recording data by using write strategy parameters included in the control information to be used for CLV mode or CAV mode as a result of identifying step.

In another aspect of the present invention, there is provided an apparatus for recording control information on a recording medium, including: an optical pickup configured to record the control information on the recording medium, the control information unit associated with at least one recording velocity, the control information unit including type information for identifying a type of the corresponding control information unit and a write strategy information dependent on the type of the control information unit, wherein the type information identifies whether the control information unit is usable for CLV (constant linear velocity) mode or CAV(constant angular velocity) mode; and a controller, operatively coupled to the optical pickup, configured to control the optical pickup to record the control information on a specific area of the recording medium.

In another aspect of the present invention, there is provided an apparatus for recording data on an optical recording medium, comprising including: an optical pickup configured to record data on the optical recording medium; and a controller configured to identify control information including type information for identifying a type of the corresponding

2004254437 07 Jan 2009

control information and write strategy information dependent on the type of the control information, wherein the type information indicates whether the control information is usable for CLV (constant linear velocity) mode or CAV (constant angular velocity) mode, and to check the type of the control information based on the type information, and to control the optical pickup to record data by using a write strategy information included in the identified control information.

It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

Brief Description of Drawings

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

FIG. 1 is a diagram of a single-layer disc applicable to the present invention;

FIG. 2 is a diagram of a dual-layer disc applicable to the present invention;

FIG. 3 is a diagram of a management area where control information of the present invention is recorded, in which a format of the disc information in a corresponding area is schematically shown;

FIG. 4 is a diagram of control information recorded according to one embodiment of the present invention;

FIG. 5 is a diagram of a write strategy within control information recorded according to one embodiment of the present invention in FIG. 4;

FIG. 6 is a diagram of control information recorded according to another embodiment of the present invention;

FIG. 7 is a diagram of control information recorded according to a further embodiment of the present invention;

FIG. 8 is a diagram of a write strategy within control information recorded according to the further embodiment of the

present invention in FIG. 7;

FIG. 9 is a diagram of another example of a write strategy within control information recorded according to the further embodiment of the present invention in FIG. 7;

FIG. 10 is a diagram of control information recorded according to another further embodiment of the present invention;

FIG. 11 is a diagram of a write strategy within control information recorded according to the another further embodiment of the present invention in FIG. 10; and

FIG. 12 is a block diagram of an optical disc recording/reproducing apparatus according to the present invention.

Best Mode for Carrying Out the Invention

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

A Blu-ray disc is taken as an example of an optical disc according to the present invention. Yet, the concept of the present invention, characterized in an optical disc having its control information recorded thereon, is applicable to DVD-RAM, DVD-RW, DVD+RW, DVD-R, DVD+R and similar such discs.

, Although the terminology used herein is well known for the most part, some terms have been chosen by the applicant, such that the

present invention should be understood with the intended meanings of the terminology as used by the applicant.

For example, the 'control information' of a disc is recorded in a specified area, i.e., a recordable area of the disc or a prerecorded area, sometimes known as an embossed area, in which manufacturer data is recorded and where no further recording is possible, and includes information necessary for the playback of a recorded disc. Disc control information is called "disc information" or "DI" in relation to Blu-ray disc technology but is typically referred to as 'physical format information' for DVD-RAM, DVD-RW, DVD+RW, DVD-R, DVD+R discs. Hence, it should be apparent that the technical background of the present invention is equally applicable to physical format information.

Moreover, the disc information according to the present invention is recorded as an unspecified unit of information, which may be counted, for example, as a first or second information.

The present invention is characterized in that a write strategy (WS) is recorded by interworking with information that identifies a kind of disc information in recording the write strategy (WS) within disc information, one of a plurality of write strategy types is selectively recorded on manufacturing a disc, and a recording/reproducing apparatus (FIG. 12) performs recording/reproducing by referring to the write strategy (WS) recorded within the disc information. Preferentially, the meaning of 'write strategy (WS)' used in the description of the present invention is explained in detail as follows.

Considering the meaning of 'write strategy (WS)', a medium property of a recording layer is generally modified by applying a laser beam to the recording layer within an optical disc via a pickup ('11' in FIG. 12) to perform a recording thereof. Hence, it should be decided a strength (write power) of the laser beam, a time of applying the write power thereto, and the like. The above decided various kinds of record-associated information are named 'write strategy (WS)' in general and specific contents recorded within a specific 'write strategy (WS)' are named 'write strategy (WS) parameters'.

Write strategy (WS) information used in the present invention means the entire information associated with write strategy (WS). And, 'WS parameters' means items and specific numeric values configuring the WS and is a sort of WS information. Hence, the WS information has an inclusive concept including the above-described 'WS Type', 'WS flag' that will be explained later, and the like as well as the WS parameters.

And, the write strategy (WS) can be recorded in various ways. As a disc tends to be highly densified and to run at higher speed, a writing speed, i.e., disc RPM) as well as the medium property of the recording layer is considerably affected. Hence, a more accurate system is requested. And, the various write strategies (WS) are explained as follows for example.

First of all, there is a system having a recording pulse smaller by 1 than a recording mark size (n) formed on a recording layer medium, which may be called '(n-1) WS'. Secondly, there is a

system having a recording pulse having a size amounting to a half of the recording mark size (n), which may be called 'n/2 WS'. Besides, new write strategies (WS) keep being developed.

Regarding the different types of write strategies (WS), when there exist the various systems of the write strategy (WS) as parameters applied to the write strategies (WS) differ from each other, a disc manufacturer selects a specific WS to test write power according to write strategy parameters and then records a result of the test in 'WS parameters' field in a specific area within the disc information.

Moreover, as a method of recording data on a disc, there are a constant linear velocity (hereinafter abbreviated CLV) method and a constant angular velocity (hereinafter abbreviated CAV) method.

The CLV method applies the same linear velocity to inner and outer circumferential areas of a disc to perform a recording at one recording velocity. The CAV method applies the same RPM to inner and outer circumferences of a disc, whereby linear speed in the outer circumference of the disc having a relatively smaller rotational radius of the disc increases faster than that in the inner circumference of disc having a relatively greater rotational radius. When the radiuses of the inner and outer circumferences are compared to each other, there exists about 2.4 times difference between recording velocities of the inner and outer circumferences of the disc.

Hence, in adopting the CAV system, a recording is performed at about 2.4x speed on the outer circumference and at 1x speed on

the inner circumference. For example, the recording is performed on the inner circumference at 4x speed, whereas performed on the outer circumference at about 9.6x speed. Since there exists a big difference between the recording velocities of the inner and outer circumferences of the disc, it is necessary to select an optimal recording velocity and write strategy (WS) to be applied to each location of the disc to perform a recording thereon. Hence, the CAV method needs definitions for about three kinds of linear velocities (writing speed) such as 1x linear velocity, 1.7x linear velocity, and 2.4x linear velocity, which can be called 'one type recording velocity group'. And, a write strategy (WS) for each of the defined recording velocities should be recorded within disc information.

FIG. 1 and FIG. 2 are structural diagrams of optical discs according to the present invention, in which a recordable optical disc is enough to be the optical disc applicable to the present invention. Moreover, the recordable disc can be any one of a rewritable optical disc, a write-once optical disc, and the like.

FIG. 1 is a structural diagram of a single-layer disc having one recording layer according to the present invention.

Referring to FIG. 1, a lead-in area is provided as a management area on an inner circumference area of an optical disc, whereas a lead-out area is provided as a management area on an outer circumference area of the optical disc. Specifically, a prerecorded area and a rewritable or write-once area are separated from each other within the inner circumference area of

the disc.

The prerecorded area is an area (called 'embossed area') where data was already written in manufacturing the disc, whereby a user or system is unable to perform data writing on the prerecorded area at all. In BD-RE/WO, the prerecorded area is named PIC (permanent information and control data) area. And, the above-described disc information (hereinafter called 'DI') as information required for disc recording is recorded in the PIC area.

In a data area, provided are a user data area where user's real data is recorded and spare areas ISA and OSA to replace a generated defect area. Specifically, TDMA (temporary defect management area) for recording information of defect and general managements is provided to such a write-once optical disc as BD-WO. In case of the re-writable BD (BD-RE), TDMA is unnecessary so that such an area is left as a reserved area.

The present invention intends to provide a method of efficiently recording disc information (DI) as control information required for record playback of a disc in the prerecorded or recordable area. It is apparent that a recording method in the prerecorded area is differently applied to each kind of discs. In case of BD-RE/WO, the PIC area as the prerecorded area is recorded by biphased high frequency modulated signals, the high frequency modulated signals in the corresponding area are played back according to a specific playback method, and information is acquired from the playback.

FIG. 2 is a diagram of a dual-layer disc having dual recording layers, in which a recording layer starting with a lead-in is named a first recording layer Layer0 and a recording layer ending with a lead-out is named a second recording layer Layer1.

In the dual-layer disc, the PIC area is provided to lead-in and lead-out areas of a disc inner circumference area, and disc information (DI) of the same contents is recorded in the PIC area.

FIG. 3 is a structural diagram of a PIC area in the disc shown in FIG. 1 or FIG. 2. As mentioned in the foregoing description, it means that information can be rearranged like the structure of the PIC area in FIG. 3 when the entire information within the high frequency modulated PIC area is acquired.

A method of configuring disc information (DI) in the PIC area is explained in detail as follows.

In BD-RE/WO, 'one cluster' represents a minimum record unit, five hundred forty-four clusters gather to construct one fragment as one upper record unit, and total five fragments gather to form the PIC area. Disc information is recorded in a front head cluster of a first fragment IF0. The disc information is plurally recorded per recording layer and writing speed permitted by the corresponding optical disc, and one disc information includes one hundred twelve bytes. Specifically, disc information constructed with 112-bytes is called disc information (DI) frame. Moreover, the same contents of the disc information are repeatedly recorded in each front head cluster of the rest of the fragments, thereby

enabling to cope with loss of the disc information.

Information representing the corresponding recording layer, information representing writing speed, and write strategy information corresponding to the writing speed are recorded within each disc information. Hence, such information is utilized in the recording or reproducing of the corresponding optical disc, thereby enabling to provide optimal write power per recording layer and per writing speed.

Various embodiments for a method of recording a write strategy (WS) associated with a disc information type within disc information according to the present invention are explained in detail by referring to FIGs. 4 to 12 as follows.

FIG. 4 is a diagram of recording disc information of an optical disc according to one embodiment of the present invention, in which a disc information structure is schematically shown.

Referring to FIG. 4, a plurality of disc information are recorded within a disc, a record sequence of each disc information is decided by a sequence number, and the record sequence is recorded by 1-byte. For instance, the corresponding information is recorded in 5^{th} byte within the disc information, which is named 'DI frame sequence number in DI block' field and is briefly indicated by '00h, 01h, 02h, 03h …'. Namely, if the information of the 5^{th} byte is '00h', it means 1^{st} disc information. And, if the information of the 5^{th} byte is '07h', it means 8^{th} disc information. Moreover, the meaning of 'DI frame sequence number in DI block' of the 5^{th} byte can be defined in a following manner.

First of all, if the information of the 5th byte is '00h', '00h' means 1st disc information as well as disc information of 1x speed of a first recording layer Layer0. '01h' means 2nd disc information as well as disc information of 2x speed of the first recording layer Layer0. '02h' means 3rd disc information as well as disc information of 4x speed of the first recording layer Layer0. And, '03h' means 4th disc information as well as disc information of 8x speed of the first recording layer Layer0. It is a matter of course that the recording layer information and the writing speed information can be separately recorded in a reserved area within disc information.

And, identification information enabling to identify a type or kind of the disc information is recorded in a specific area of Nth byte, which is named 'DI Type' field, within the disc information. Moreover, a write strategy (WS) interoperating with the type of the corresponding disc information is recorded in another specific area, e.g., area named 'Write Strategy parameters' field as Lth~111th bytes, within the disc information. Namely, it is identified whether the corresponding disc information is in 'CLV' mode or 'CAV' mode via 'DI Type' field, and the write strategy (WS) is recorded in a manner fitting the identified mode. For instance, if it is the CLV mode, a WS for one recording velocity is recorded only. If it is CAV mode, it is necessary to record a WS for one type recording velocity group (e.g., three kinds of linear velocities such as 1x, 1.7x, and 2.4x).

And, if the information identifying the disc information type is '0000 0000b' for example, it means to define 'CLV disc information (DI)'. If '0000 0001b', it means to define 'CAV disc information (DI).

FIG. 5 shows an exemplary method of recording disc information in case of recording identification information for identifying a disc information type in Nth byte within the disc information like FIG. 4, in which one recording layer Layer0 is shown for convenience of explanation. And, it is a matter of course that the method can be applied in the same manner even if there exist more recording layers.

The disc information of the present invention, as mentioned in the foregoing description, is information that a disc manufacturer records characteristics of a corresponding disc in a prerecorded area within the disc. A write strategy (WS) the disc has is defined so that a recording/reproducing apparatus (FIG. 12) can utilize it in the practical application of the recording/reproducing. Hence, in recording disc information, a disc manufacturer preferentially decides an applicable writing speed per recording layer and then records identification information indicating whether the decided writing speed corresponds to the CLV or CAV method in the N^{th} byte. Hence, the write strategy (WS) interworking with the identification information is identified according to a CLV or CAV mode to be recorded in L^{th}~111^{th} bytes.

For instance, disc information for 1x speed of 1^{st} recording

layer is recorded in '00h' as a disc information sequence, a disc information type means a CAV mode, and a write strategy (WS) interworks with it so that a CAV WS is selected to be recorded. Disc information for 2x speed of 1st recording layer is recorded in '01h', a disc information type means a CLV mode, and a write strategy (WS) interworks with it so that a CLV WS is selected to be recorded. Disc information for 4x speed of 1st recording layer is recorded in '02h', a disc information type means a CLV mode, and a write strategy (WS) interworks with it so that a CLV WS is selected to be recorded. Disc information for 8x speed of 1st recording layer is recorded in '03h', a disc information type means a CAV mode, and a write strategy (WS) interworks with it so that a CAV WS is selected to be recorded. In this case, the CLV or CAV WS means one write strategy (WS) selected by a disc manufacturer. In case of CLV, the write strategy will be applied to one kind writing speed. In case of CAV, the write strategy will be applied to a plurality of writing speeds for one type writing speed or recording velocity group.

FIG. 6 is a diagram of recording control information according to another embodiment of the present invention. Compared to the embodiment in FIG. 4, FIG. 6 shows that specific identification for CAV mode is subdivided to be applied to 'DI Type' field written in N^{th} byte within disc information.

Namely, in case that corresponding disc information means CAV mode, this is subdivided to identify how many velocities are provided by a write strategy (WS). Hence, 'DI Type' field can be

defined as follows. If 'DI Type' field recorded in N^{th} byte is '0000 0001b', it means CAV mode and a write strategy (WS) recorded in L^{th}~111^{th} bytes is recorded to correspond to one kind of velocity only. If 'DI Type' field recorded in N^{th} byte is '0000 0010b', it means CAV mode and a write strategy (WS) recorded in L^{th}~111^{th} bytes is recorded to correspond to two kinds of velocities. If 'DI Type' field recorded in N^{th} byte is '0000 0011b', it means CAV mode and a write strategy (WS) recorded in L^{th}~111^{th} bytes is recorded to correspond to three kinds of velocities.

Generally, in case of CAV mode, the corresponding disc information has a write strategy relating to three kinds of velocities. Yet, the above-explained definition of 'DI Type' field enables a disc manufacturer to avoid having difficulty in coping with various write strategies. And, the above-explained definition of 'DI Type' field enables a manufacturer of a disc recording/reproducing apparatus to develop an inexpensive product coping with one write strategy (WS) only.

FIG. 7 is a diagram of recording control information according to a further embodiment of the present invention, in which information for identifying a type of disc information is recorded within disc information like the embodiment in FIG. 4 together with another information enabling to identify a type of write strategy (WS) finally used.

Referring to FIG. 7, the information enabling to identify a write strategy (WS) type is to identify which one of a plurality of

specified write strategies (WS) was selected to be used by a disc manufacturer, whereas the information for identifying a disc information type enables to identify whether corresponding disc information is in CLV mode or CAV mode. For instance, as mentioned in the foregoing description, various write strategy types, which can exist such as (n-1) WS, n/2 WS, etc., are defined as 1st WS WS-1, 2nd WS WS-2,... and Kth WS WS-K. And, the information identifying the write strategy type (named 'WS Type') selected by a disc manufacturer is recorded within disc information.

This is explained by being compared to the embodiment in FIG. 4 as follows. First of all, 'Write Strategy (WS) Type' field is added to Pth byte of the embodiment in FIG. 4 so that Lth~111th write strategy (WS) is recorded by interworking with a disc information type in Nth byte and a write strategy (WS) type in Pth byte. Namely, it can be defined as follows. If '0000 0000b' is written in Pth byte, it means 1st WS WS-1. If '0000 0010b' is written in Pth byte, it means 2nd WS WS-2. And, if 'XXXX XXXXb' is written in Pth byte, it means Kth WS WS-K.

FIG. 8 is a diagram of recording a write strategy within control information according to the further embodiment of the present invention in FIG. 7, and FIG. 9 is a diagram of another example of recording a write strategy within control information according to the further embodiment of the present invention in FIG. 7.

FIG. 8 shows that a disc manufacturer optionally records a

specific write strategy (WS) for entire writing speeds in recording one of a plurality of write strategies (WS).

Referring to FIG. 8, N^{th} byte of disc information indicates a disc information type, P^{th} byte of disc information indicates a write strategy (WS) type, and parameters associated with one write strategy (WS) decided by interworking with the N^{th} and P^{th} bytes are recorded in L^{th}~11^{th} bytes.

For instance, disc information for 1x speed of 1^{st} recording layer is recorded in '00h' as a disc information sequence, a disc information type means a CAV mode, a write strategy (WS) type means 1^{st} WS WS-1, and a write strategy (WS) interworks with them so that a CAV WS-1 is selected to be recorded. Disc information for 2x speed of 1^{st} recording layer is recorded in '01h', a disc information type means a CLV mode, a write strategy (WS) type means 1^{st} WS WS-1, and a write strategy (WS) interworks with them so that a CLV WS-1 is selected to be recorded. Disc information for 4x speed of 1^{st} recording layer is recorded in '02h', a disc information type means a CLV mode, a write strategy (WS) type means 2^{nd} WS WS-2, and a write strategy (WS) interworks with them so that a CLV WS-2 is selected to be recorded. Disc information for 8x speed of 1^{st} recording layer is recorded in '03h', a disc information type means a CAV mode, a write strategy (WS) type means 2^{nd} WS WS-2, and a write strategy (WS) interworks with them so that a CAV WS-2 is selected to be recorded.

FIG. 9 shows that one of a plurality of write strategies (WS) is recorded within disc information, in which a mandatory write

strategy (WS) type is recorded for a specific specified writing speed (e.g., 1x speed) but a disc manufacturer optionally records a specific write strategy (WS) for the rest writing speeds.

Hence, the method in FIG. 9 differs from the method in FIG. 8 in that a write strategy (WS) type is decided in a mandatory manner by putting limitation on disc manufacturer's options for a specific writing speed (1x speed). This enables a manufacturer of a disc recording/reproducing apparatus (FIG. 12) to design to manufacture inexpensive products coping with one write strategy (WS) type only.

For instance, disc information for 1x speed of 1st recording layer is recorded in '00h' as a disc information sequence, a disc information type means a CAV mode, a write strategy (WS) type means 1st WS WS-1, and a write strategy (WS) interworks with them so that a CAV WS-1 is selected in a mandatory manner to be recorded. Disc information for 2x speed of 1st recording layer is recorded in '01h', a disc information type means a CLV mode, a write strategy (WS) type means 1st WS WS-1, and a write strategy (WS) interworks with them so that a CLV WS-1 is selected to be recorded. Disc information for 4x speed of 1st recording layer is recorded in '02h', a disc information type means a CLV mode, a write strategy (WS) type means 2nd WS WS-2, and a write strategy (WS) interworks with them so that a CLV WS-2 is selected to be recorded. Disc information for 8x speed of 1st recording layer is recorded in '03h', a disc information type means a CAV mode, a

write strategy (WS) type means 2^{nd} WS WS-2, and a write strategy (WS) interworks with them so that a CAV WS-2 is selected to be recorded.

FIG. 10 is a diagram of recording control information according to another further embodiment of the present invention, in which specific identification for CAV mode is subdivided to be applied to 'DI Type' field written in N^{th} byte within disc information and in which information designating a write strategy (WS) type is recorded as well.

Referring to FIG. 10, in case that corresponding disc information means CAV mode, this is subdivided to identify how many velocities are provided by a write strategy (WS). Hence, 'DI Type' field can be defined as follows. If 'DI Type' field recorded in N^{th} byte is '0000 0001b', it means CAV mode and a write strategy (WS) recorded in L^{th}~111^{th} bytes is recorded to correspond to one kind of velocity only. If 'DI Type' field recorded in N^{th} byte is '0000 0010b', it means CAV mode and a write strategy (WS) recorded in L^{th}~111^{th} bytes is recorded to correspond to two kinds of velocities. If 'DI Type' field recorded in N^{th} byte is '0000 0011b', it means CAV mode and a write strategy (WS) recorded in L^{th}~111^{th} bytes is recorded to correspond to three kinds of velocities.

Moreover, 'Write Strategy (WS) Type' field is added to P^{th} byte within disc information so that L^{th}~111^{th} write strategy (WS) is recorded by interworking with a disc information type in N^{th} byte and a write strategy (WS) type in P^{th} byte. Namely, it can be

defined as follows. If '0000 0000b' is written in P^{th} byte, it means 1^{st} WS WS-1. If '0000 0010b' is written in P^{th} byte, it means 2^{nd} WS WS-2. And, if 'XXXX XXXXb' is written in P^{th} byte, it means K^{th} WS WS-K.

FIG. 11 is a diagram of recording a write strategy within control information according to another further embodiment of the present invention in FIG. 10.

Referring to FIG. 11, '0000 0000b' is written in 'DI Type' field of N^{th} byte to mean CLV mode. '0000 0001b' is written in 'Write Strategy (WS) Type' field of P^{th} byte to mean 1^{st} WS WS-1. 5^{th} byte is '00h' to mean 1x speed disc information of 1^{st} recording layer. And, a specific write strategy (WS) interworking with the N^{th} and P^{th} bytes is written in Lth~111^{th} bytes within a disc.

As it is a CLV mode, a write strategy (WS) for one kind of velocity is recorded. As it is 1^{st} WS WS-1, parameters by '(n-1) WS' type are defined for example. Accordingly, a disc manufacturer records an optimal value in a corresponding disc.

If 'DI Type' field (N^{th} byte) is set to '0000 0001b' to mean a CAV mode, or if 'Write Strategy (WS) Type' field is set to '0000 0010b' to mean 2^{nd} WS WS-2, it is apparent that write strategy (WS) parameters written in L^{th}~111^{th} bytes should be recorded as new contents different from the parameters specified in FIG. 11 or the values of the corresponding parameters.

FIG. 12 is a block diagram of an optical disc recording/reproducing apparatus according to the present invention.

Referring to FIG. 12, a recording/reproducing apparatus according to the present invention includes a recorder/reproducer 10 carrying out recording/reproducing on an optical disc and a control unit 20 controlling the recorder/reproducer 10.

The control unit 20 gives a record or playback command for a specific area, and the recorder/reproducer 10 caries out the recording/reproducing on the specific area according to the command of the control unit 20. Specifically, the recorder/reproducer 10 includes an interface unit 12 performing communications with an external device, a pickup unit 11 directly recording data on the optical disc or reproducing the data, a data processor 13 receiving a playback signal from the pickup unit 11 to restore into a necessary signal value or modulating to deliver a signal to be recorded into a signal to be recorded on the optical disc, a servo unit 14 reading out a signal from the optical disc correctly or controlling the pickup unit 11 to record a signal on the optical disc correctly, a memory 15 temporarily storing management information including control information and data, and a microcomputer 16 responsible for controlling the above-described elements within the recorder/reproducer 10.

Industrial applicability

A disc information recording process of an optical disc according to the present invention is explained in detail as follows.

First of all, once an optical disc is loaded in the recording/reproducing apparatus, the entire disc management information within the disc is read out to be temporarily stored in the memory 15 of the recorder/reproducer 10. And, various kinds of the disc management information are utilized for the recording/reproducing of the optical disc. Specifically, the management information stored in the memory 15 includes disc information of the present invention. Hence, information for identifying a disc information type recorded within disc information, identification information for identifying a write strategy (WS), and write strategy parameter values interworking with them are read out to be temporarily stored in the memory 15. If intending to perform a recording on a specific area within the optical disc, the control unit 20 renders such an intent into a writing command and then delivers it to the recorder/reproducer 10 together with data for writing location information to be recorded. After receiving the writing command, the microcomputer 16 decides the corresponding writing speed applied to an area within the optical disc from the management information (specifically via disc information) stored in the memory 15 and then performs the writing command by finding optimal write power by referring to a write strategy (WS) corresponding to the decided writing speed.

Accordingly, the present invention provides various methods of providing control information coping with higher writing speed in a high-density optical disc. Specifically, in recording a write

strategy (WS) within disc information, CLV and CAV are separately recorded, whereby it is able to efficiently cope with the record/playback of the optical disc.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

2004254437 07 Jan 2009

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of recording control information on a recording medium, including the steps of:

generating a control information associated with at least one recording velocity, the control information including type information identifying a type of the corresponding control information and write strategy information dependent on the type of the control information, the type information indicating whether the control information is usable for CLV (constant linear velocity) mode or CAV(constant angular velocity) mode; and

recording the control information on a specific area of the recording medium.

2. The method of claim 1, wherein the generating step generates the control information further including write strategy parameters associated with CLV (constant linear velocity) mode or CAV (constant angular velocity) mode, the write strategy parameters including at least one of first write pulse duration, first write pulse start time.

3. The method of claim 2, wherein the generating step generates the control information further including information for identifying velocities associated with the write strategy parameters if the type information indicates the control information for CAV (constant angular velocity) mode.

4. The method of claim 2 or 3, wherein respective write strategy parameters associated with the respective velocities are included in the control information.

2004254437 07 Jan 2009

5. The method of any one of claims 2 to 4, wherein the control information includes the write strategy parameters associated with at least one recording velocity if the type information identifies the control information for CLV (constant linear velocity) mode.

6. A recording medium having a data structure of a control information recorded on a recording medium, wherein in that the control information is required for recording data and the control information is associated with a specific recording velocity and a specific write strategy typeusable at the specific recording velocity and the control information comprises write strategy information dependent on a type information for indicating whether the control information is associated with CAV mode or CLV mode.

7. The recording medium of claim 6, wherein the control information further includes write strategy parameters associated with CLV (constant linear velocity) mode or CAV (constant angular velocity) mode.

8. The recording medium of claim 7, wherein the control information further includes an identification information for identifying recording velocities associated with the write strategy parameters if the type information identifies the control information for CAV (constant angular velocity) mode.

9. The recording medium of claim 7 or 8, wherein respective write strategy parameters sets associated with the respective velocities are included in the control information.

2004254437 07 Jan 2009

10. The recording medium of any one of claims 7 to 9, wherein the control information includes the write strategy parameters associated with at least one recording velocity if the type information identifies the control information for CLV (constant linear velocity) mode.

11. A method of recording data on a recording medium, including:
identifying a specific control information, based on type information for identifying a type of control information, wherein the control information is associated with at least one of a plurality of specific recording velocities to provide a reference information for recording data and associated with a specific write strategy type usable at a corresponding specific recording velocity, and the type information indicates whether the specific control information is used for CLV mode or CAV mode; and
recording data by using write strategy parameters included in the control information to be used for CLV mode or CAV mode as a result of identifying step.

12. The method of claim 11, wherein the identifying step further identifies write strategy type information for indicating a specific write strategy type, wherein the write strategy parameters are associated with the type information and the write strategy type information.

13. The method of claim 11 or 12, wherein the recording step records data by using write strategy parameters.

2004254437 31 Mar 2009

14. An apparatus for recording control information on a recording medium, including:

an optical pickup configured to record the control information on the recording medium, the control information unit associated with at least one recording velocity, the control information unit including type information for identifying a type of the corresponding control information unit and a write strategy information dependent on the type of the control information unit, wherein the type information identifies whether the control information unit is usable for CLV (constant linear velocity) mode or CAV(constant angular velocity) mode; and

a controller, operatively coupled to the optical pickup, configured to control the optical pickup to record the control information on a specific area of the recording medium.

15. The apparatus of claim 14, wherein the controller is configured to control the pickup unit to record the control information in a writable area of the specific area of the recording medium..

16. The apparatus of claim 14 or 15, further including a storage configured to store the control information and a servo unit configured to perform a servo operation,

wherein the controller is configured to control the storage to store the control information and to identify the control information in the storage, and

wherein the controller is further configured to control a servo unit to perform the servo operation based on the control information for CLV (constant linear velocity) mode or CAV (constant angular velocity) mode.

17. An apparatus for recording data on an optical recording medium, including:

2004254437 07 Jan 2009

an optical pickup configured to record data on the optical recording medium; and

a controller configured to identify control information including type information for identifying a type of the corresponding control information and write strategy information dependent on the type of the control information, wherein the type information indicates whether the control information is usable for CLV (constant linear velocity) mode or CAV (constant angular velocity) mode, and to check the type of the control information based on the type information, and to control the optical pickup to record data by using a write strategy information included in the identified control information.

18. The apparatus of claim 17, further including a memory configured to store at least one control information associated with at least a specific recording velocity and a specific write strategy type usable at the specific recording velocity,

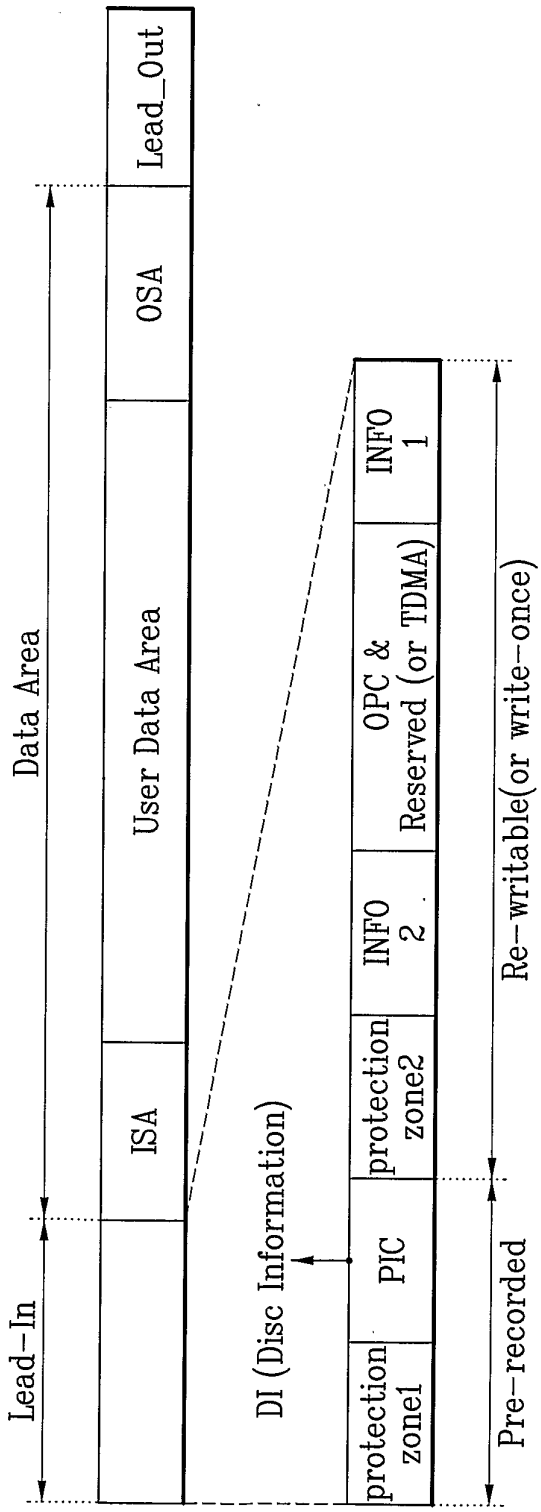
wherein the controller is configured to read the control information from the memory to identify the control information.

19. The apparatus of claim 17, wherein the optical pickup is configured to read the control information associated with at least a specific recording velocity and a specific write strategy type usable at the specific recording velocity from a specific area of the recording medium.

20. The apparatus of any one of claims 17 to 19, further including a servo configured to perform a servo operation,

wherein the controller is configured to control the servo to perform a servo operation.

FIG. 1



- PIC : Permanent Information & Control data
- ISA : Inner Spare Area
- OSA : Outer Spare Area
- TDMA : Temporary Defect Management Area

FIG. 2

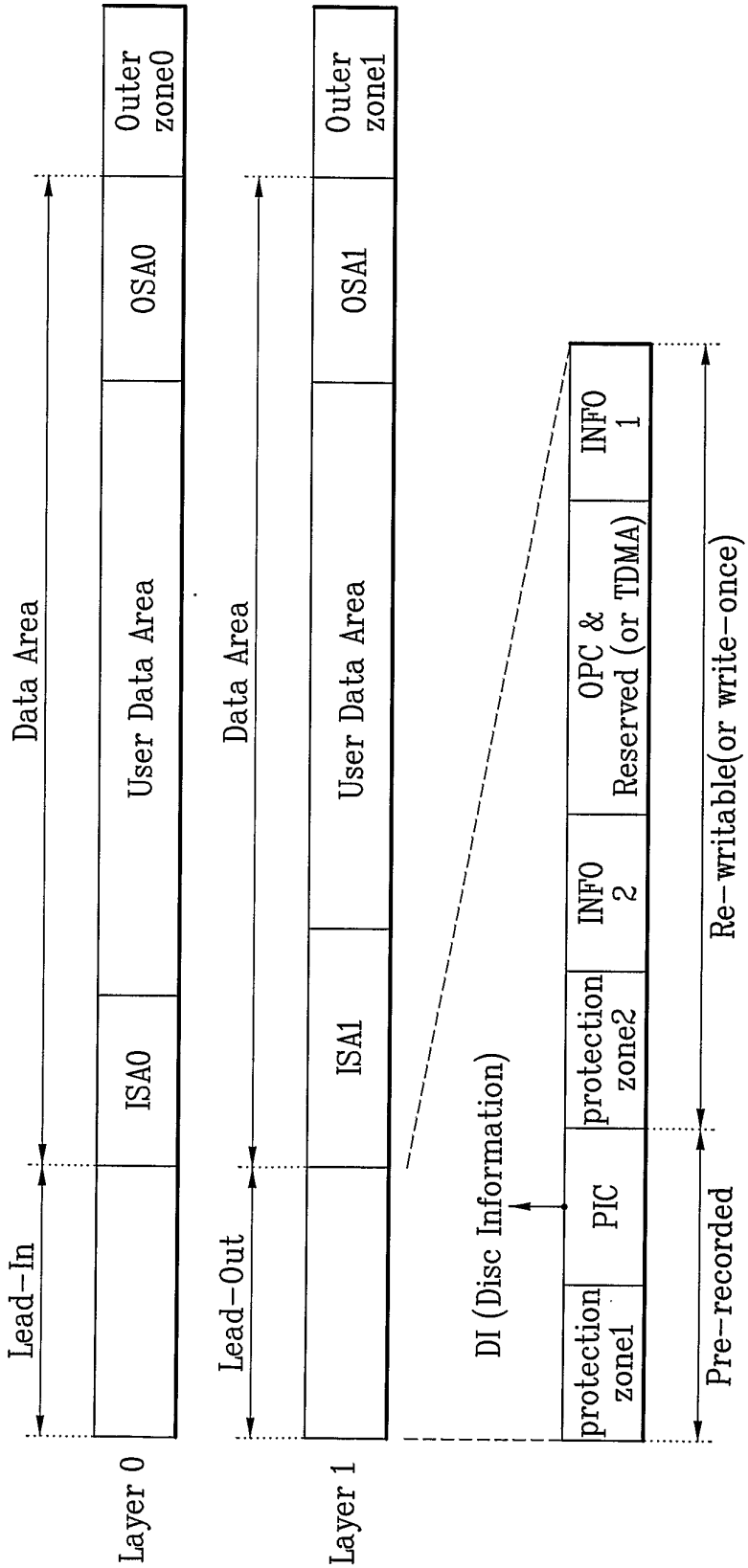

Layer 0
Layer 1
Lead-In
Lead-Out
Data Area
Data Area
ISA0
User Data Area
OSA0
Outer zone0
ISA1
User Data Area
OSA1
Outer zone1
DI (Disc Information)
protection zone1
PIC
protection zone2
INFO 2
OPC & Reserved (or TDMA)
INFO 1
Pre-recorded
Re-writable(or write-once)

FIG. 3

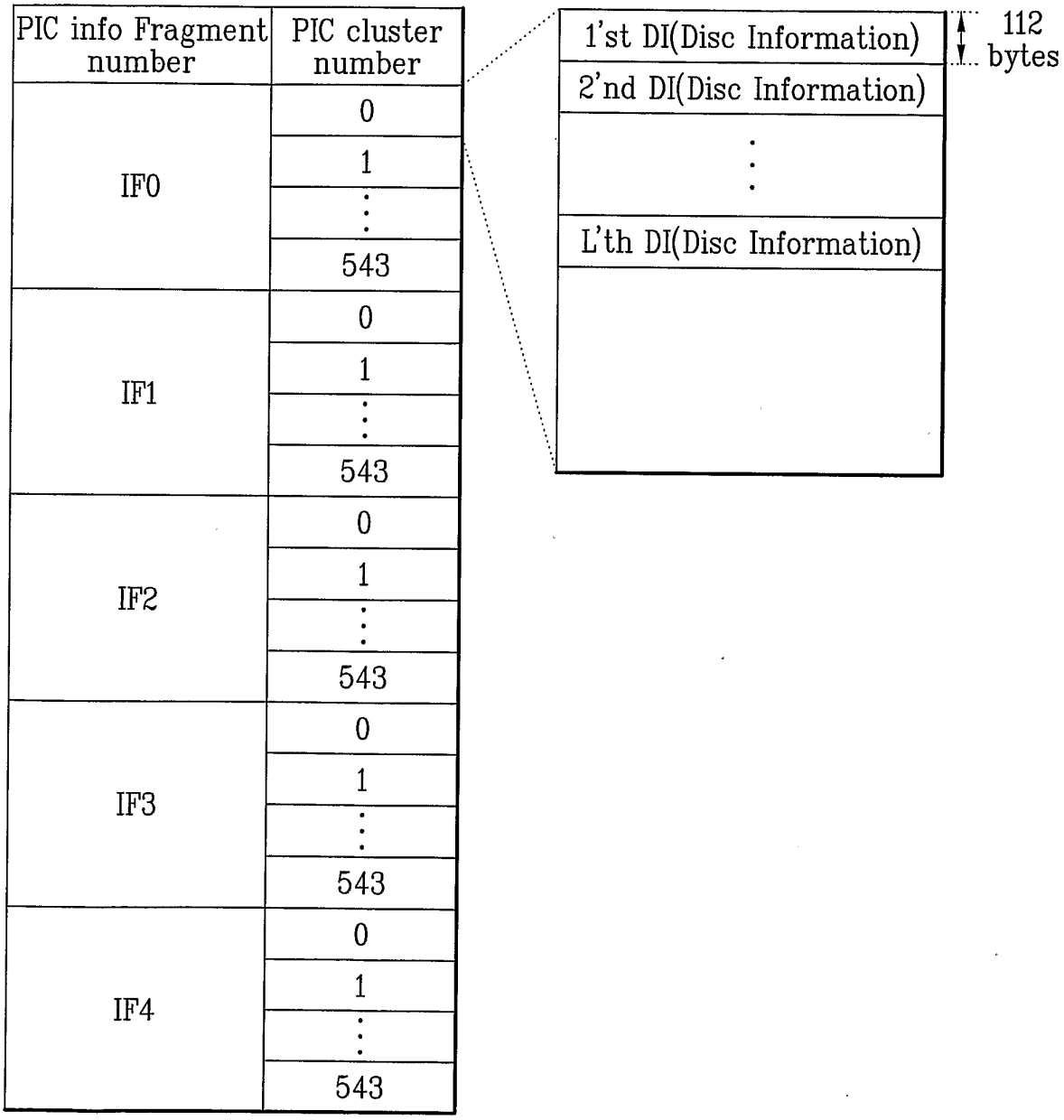

PIC info Fragment number
PIC cluster number
IF0
IF1
IF2
IF3
IF4
0
1
543
1'st DI(Disc Information)
2'nd DI(Disc Information)
L'th DI(Disc Information)
112 bytes

FIG. 4

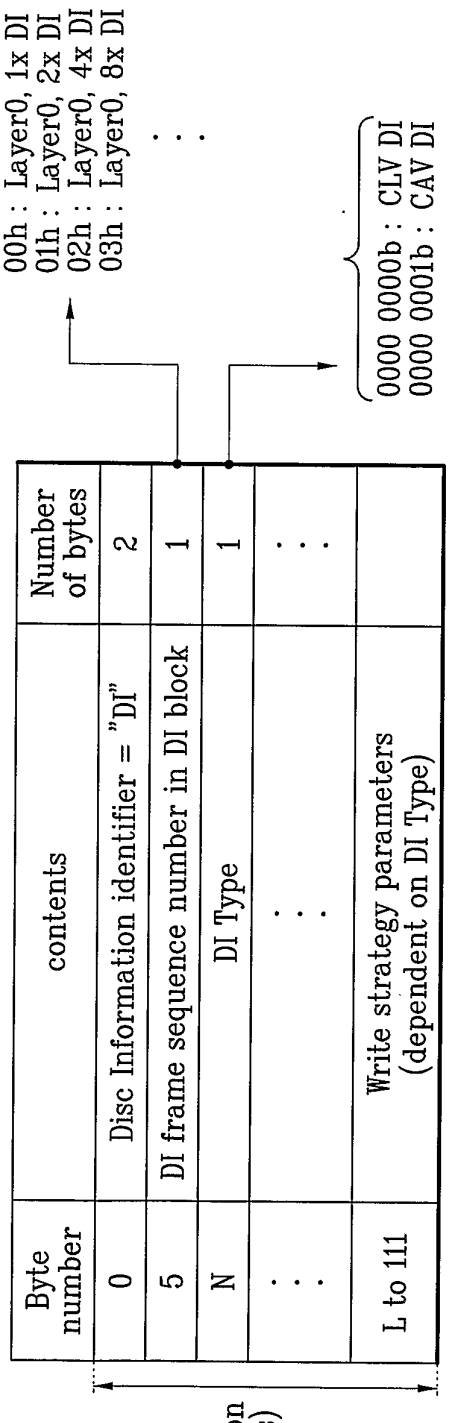

Disc Information (112 bytes)
Byte number
contents
Number of bytes
0
Disc Information identifier = "DI"
2
5
DI frame sequence number in DI block
1
N
DI Type
1
L to 111
Write strategy parameters (dependent on DI Type)
00h : Layer0, 1x DI
01h : Layer0, 2x DI
02h : Layer0, 4x DI
03h : Layer0, 8x DI
0000 0000b : CLV DI
0000 0001b : CAV DI
* CLV : Constant Linear Velocity
CAV : Constant Angular Velocity

FIG. 5

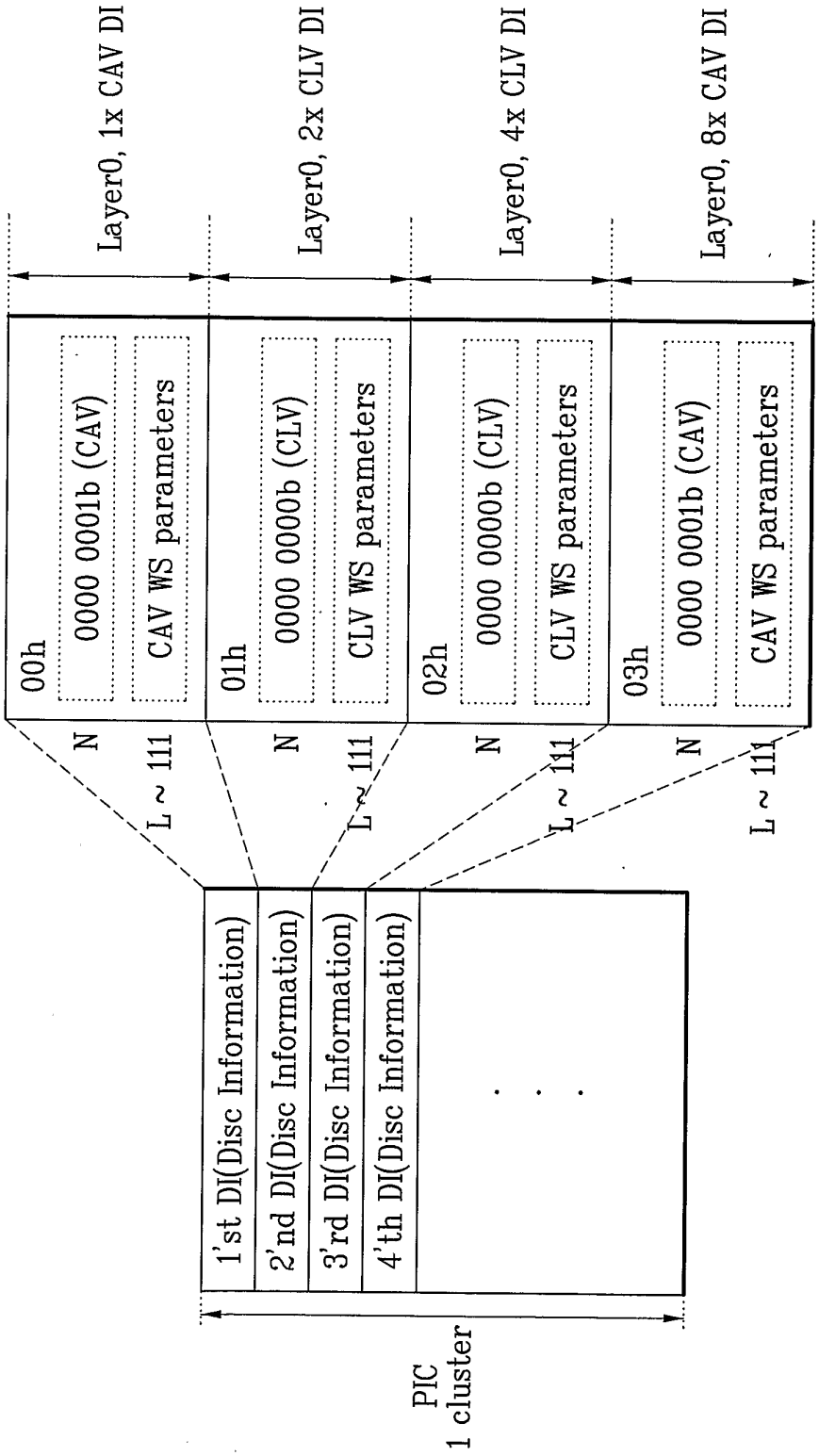

Layer0, 1x CAV DI
Layer0, 2x CLV DI
Layer0, 4x CLV DI
Layer0, 8x CAV DI
00h
0000 0001b (CAV)
CAV WS parameters
01h
0000 0000b (CLV)
CLV WS parameters
02h
0000 0000b (CLV)
CLV WS parameters
03h
0000 0001b (CAV)
CAV WS parameters
N
L ~ 111
1'st DI(Disc Information)
2'nd DI(Disc Information)
3'rd DI(Disc Information)
4'th DI(Disc Information)
PIC
1 cluster

FIG. 6

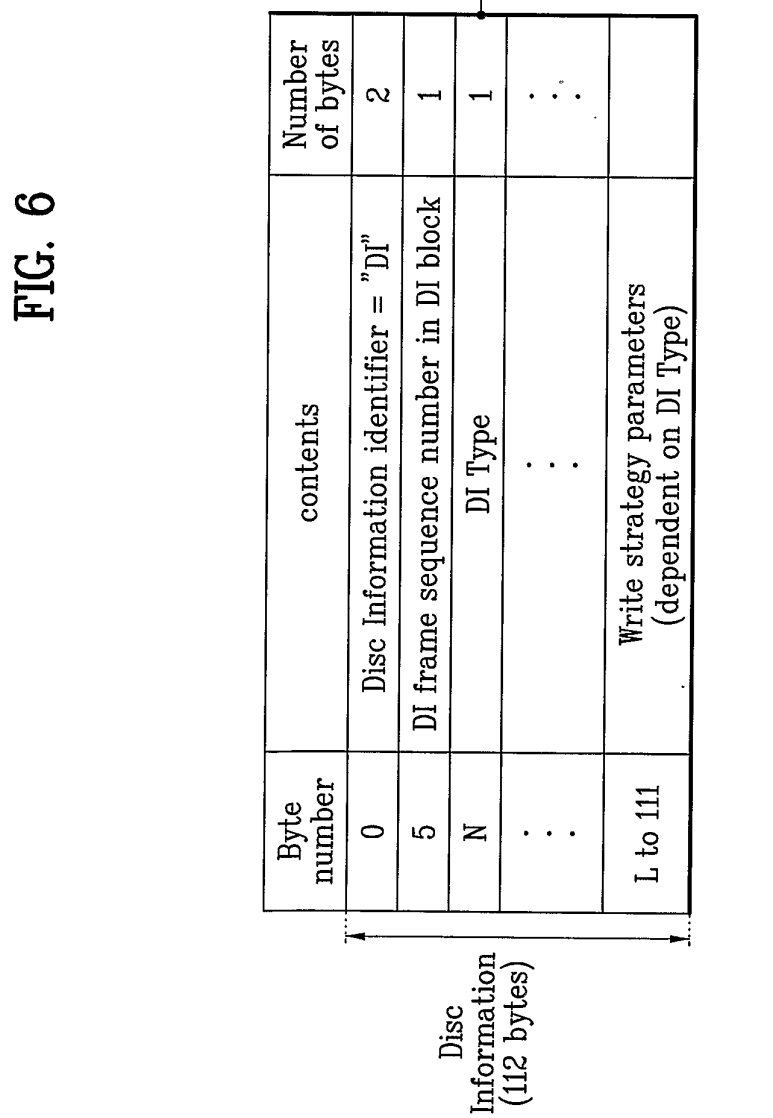

Disc Information (112 bytes)
Byte number
contents
Number of bytes
0
Disc Information identifier = "DI"
2
5
DI frame sequence number in DI block
1
N
DI Type
1
L to 111
Write strategy parameters (dependent on DI Type)
0000 0000b : CLV DI
0000 0001b : CAV DI (WS for 1 velocity)
0000 0010b : CAV DI (WS for 2 velocities)
0000 0011b : CAV DI (WS for 3 velocities)

FIG. 7

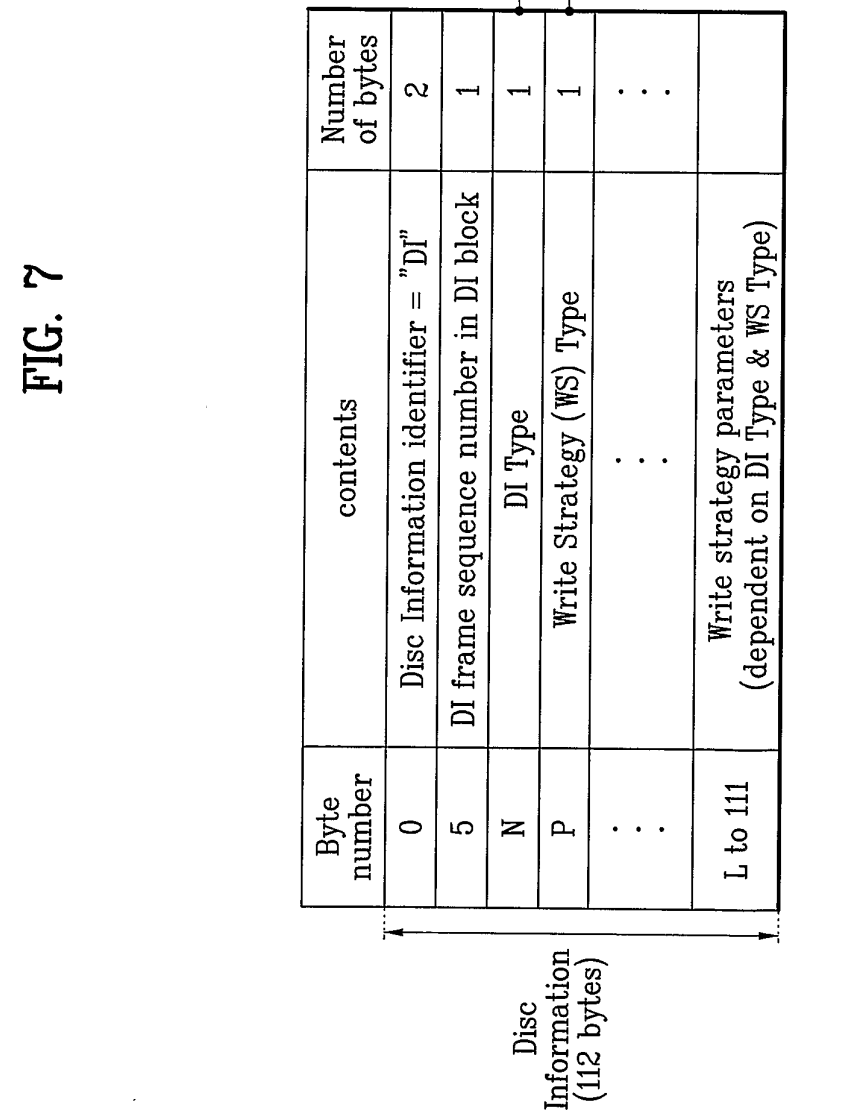

Disc Information (112 bytes)
Byte number
contents
Number of bytes
0
Disc Information identifier = "DI"
2
5
DI frame sequence number in DI block
1
N
DI Type
1
P
Write Strategy (WS) Type
1
L to 111
Write strategy parameters (dependent on DI Type & WS Type)
0000 0000b : CLV DI
0000 0001b : CAV DI
0000 0001b : Write Strategy-1
0000 0010b : Write Strategy-2
XXXX XXXXb : Write Strategy-K

FIG. 8

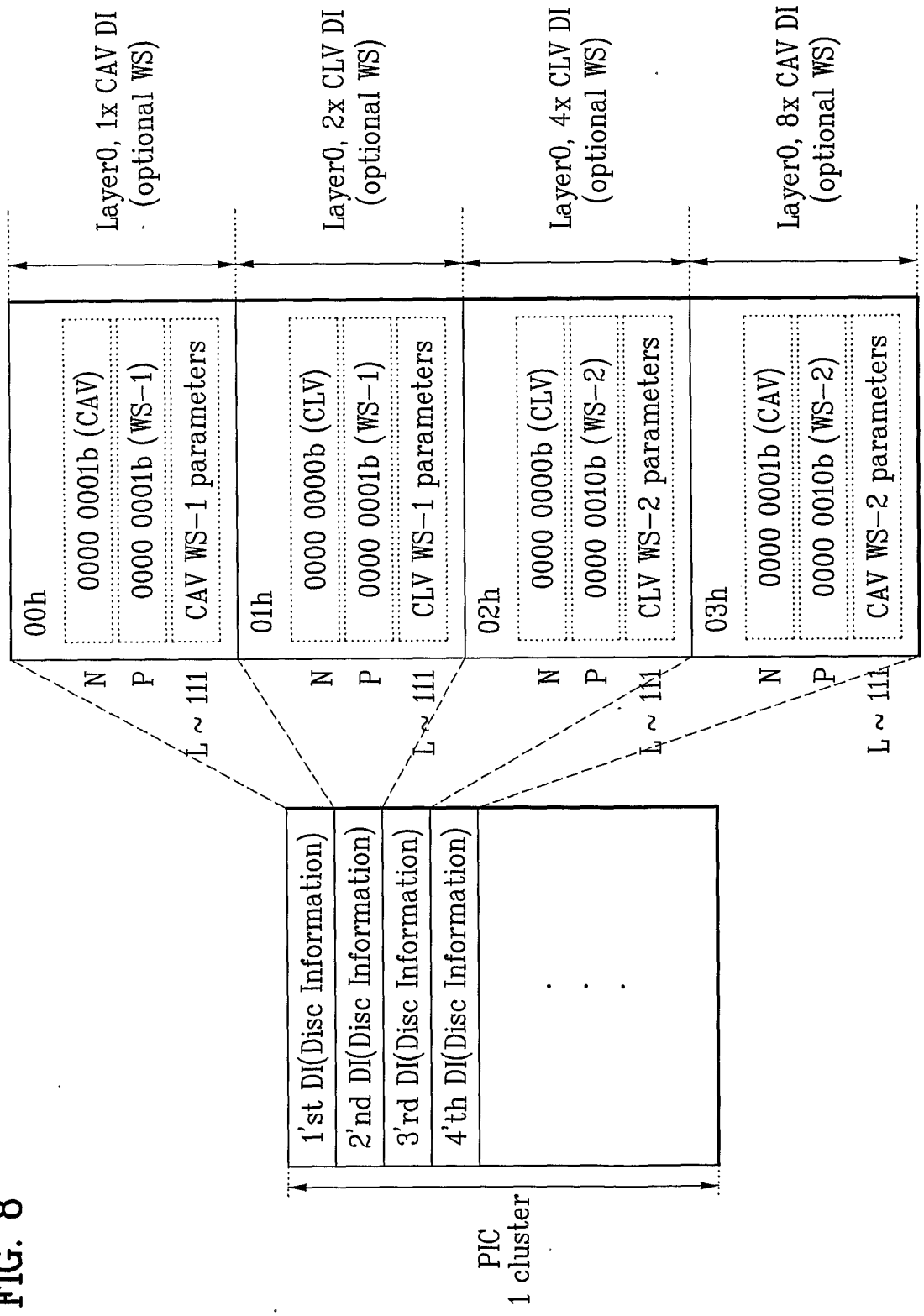

PIC
1 cluster
1'st DI(Disc Information)
2'nd DI(Disc Information)
3'rd DI(Disc Information)
4'th DI(Disc Information)
N
P
L ~ 111
00h
0000 0001b (CAV)
0000 0001b (WS-1)
CAV WS-1 parameters
Layer0, 1x CAV DI
(optional WS)
01h
0000 0000b (CLV)
0000 0001b (WS-1)
CLV WS-1 parameters
Layer0, 2x CLV DI
(optional WS)
02h
0000 0000b (CLV)
0000 0010b (WS-2)
CLV WS-2 parameters
Layer0, 4x CLV DI
(optional WS)
03h
0000 0001b (CAV)
0000 0010b (WS-2)
CAV WS-2 parameters
Layer0, 8x CAV DI
(optional WS)

FIG. 9

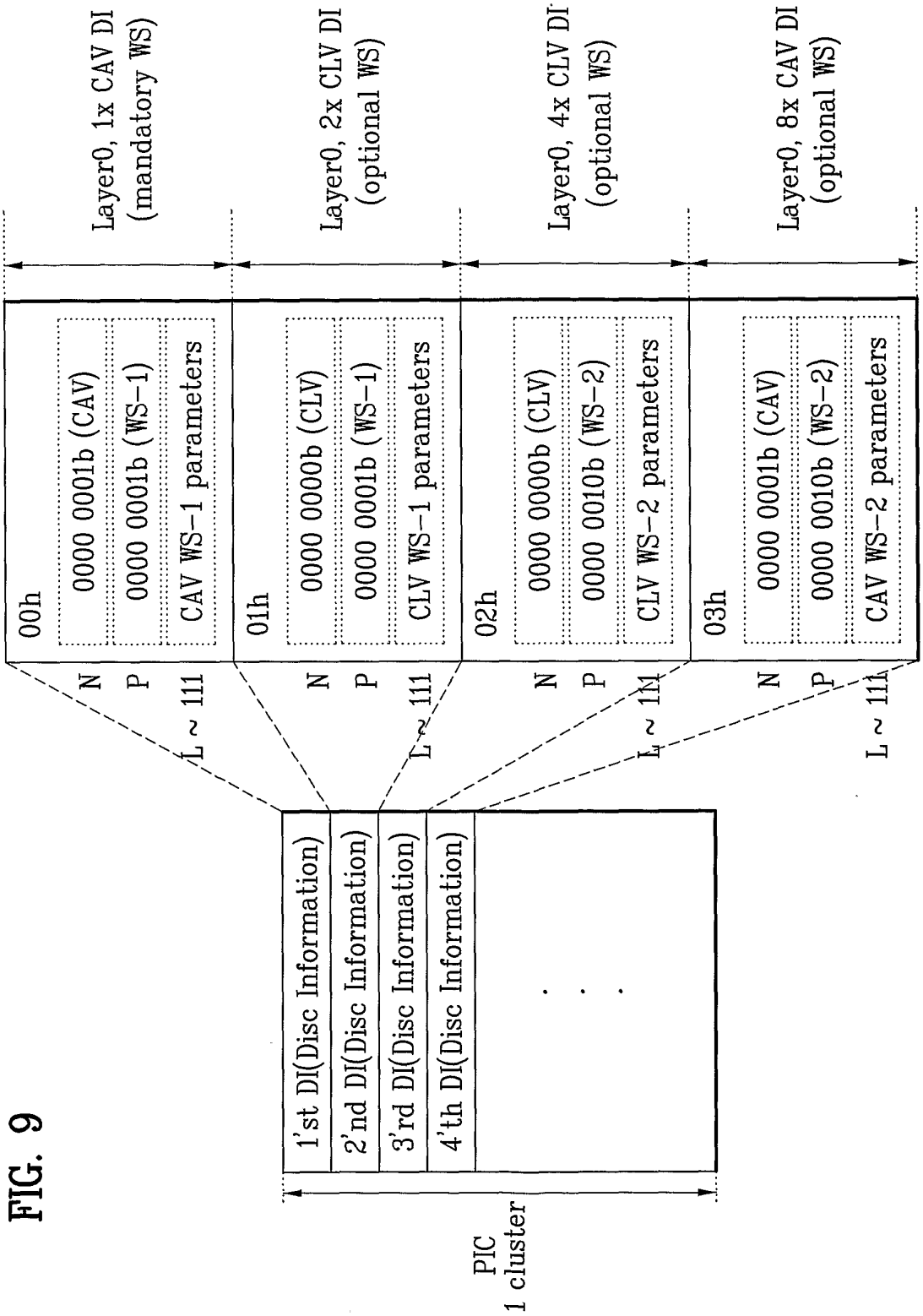

PIC
1 cluster
1'st DI(Disc Information)
2'nd DI(Disc Information)
3'rd DI(Disc Information)
4'th DI(Disc Information)
N
P
L ~ 111
00h
0000 0001b (CAV)
0000 0001b (WS-1)
CAV WS-1 parameters
Layer0, 1x CAV DI
(mandatory WS)
01h
0000 0000b (CLV)
0000 0001b (WS-1)
CLV WS-1 parameters
Layer0, 2x CLV DI
(optional WS)
02h
0000 0000b (CLV)
0000 0010b (WS-2)
CLV WS-2 parameters
Layer0, 4x CLV DI
(optional WS)
03h
0000 0001b (CAV)
0000 0010b (WS-2)
CAV WS-2 parameters
Layer0, 8x CAV DI
(optional WS)

FIG. 10

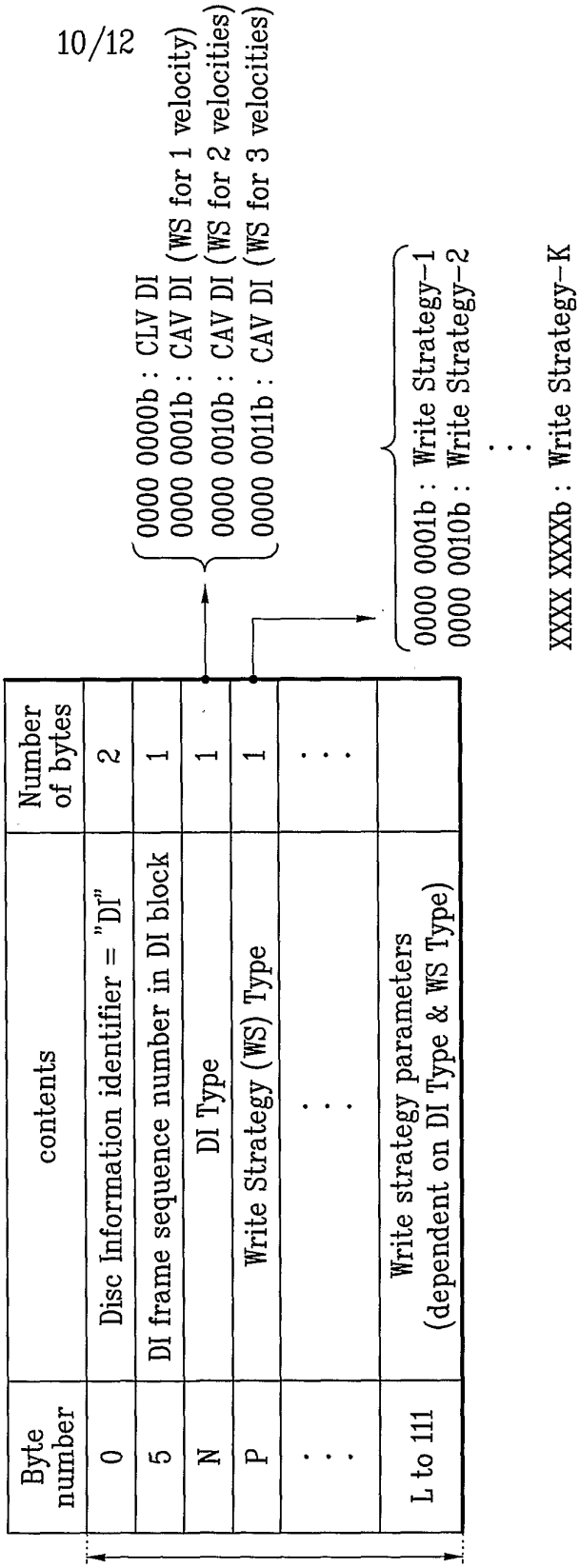

Disc Information (112 bytes)
Byte number
contents
Number of bytes
0
Disc Information identifier = "DI"
2
5
DI frame sequence number in DI block
1
N
DI Type
1
P
Write Strategy (WS) Type
1
L to 111
Write strategy parameters (dependent on DI Type & WS Type)
0000 0000b : CLV DI
0000 0001b : CAV DI (WS for 1 velocity)
0000 0010b : CAV DI (WS for 2 velocities)
0000 0011b : CAV DI (WS for 3 velocities)
0000 0001b : Write Strategy-1
0000 0010b : Write Strategy-2
XXXX XXXXb : Write Strategy-K

FIG. 11

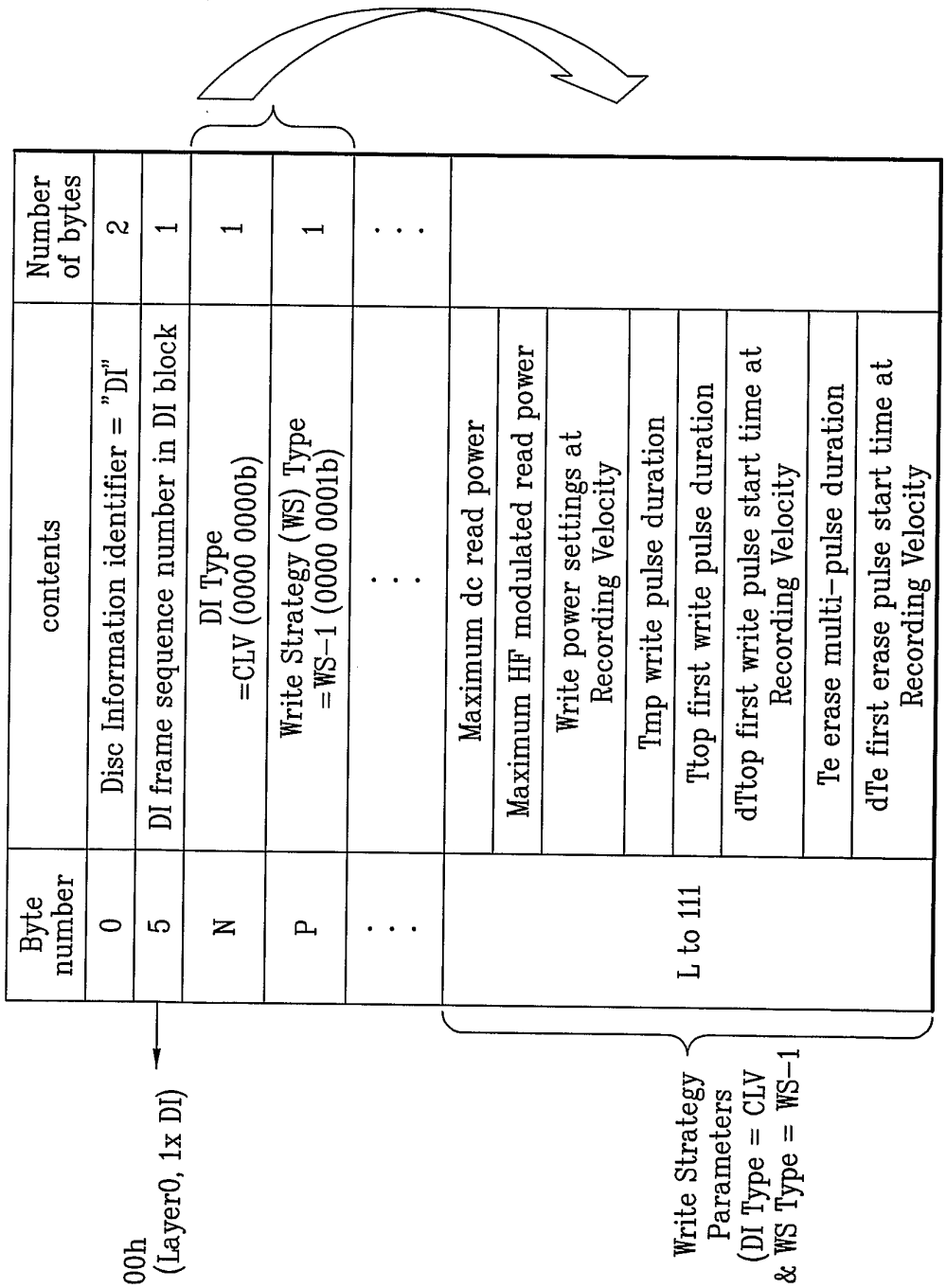
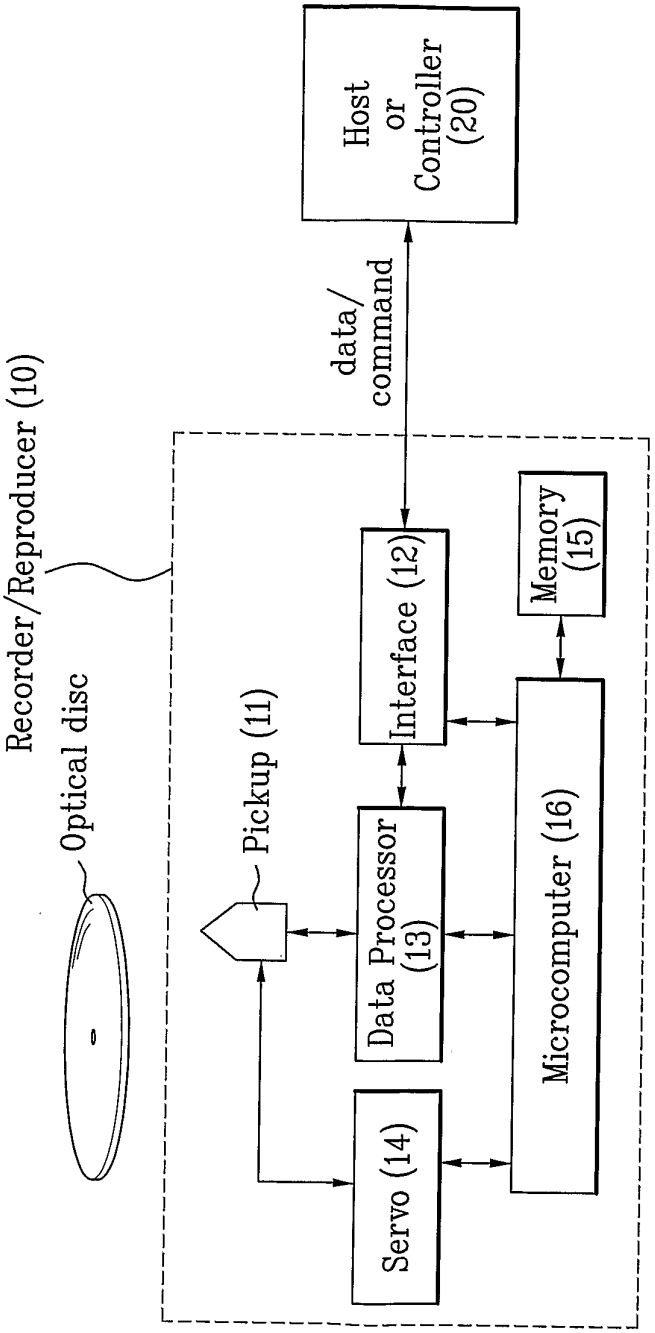

Byte number
contents
Number of bytes
0
Disc Information identifier = "DI"
2
5
DI frame sequence number in DI block
1
N
DI Type =CLV (0000 0000b)
1
P
Write Strategy (WS) Type =WS-1 (0000 0001b)
1
Maximum dc read power
Maximum HF modulated read power
Write power settings at Recording Velocity
Tmp write pulse duration
Ttop first write pulse duration
dTtop first write pulse start time at Recording Velocity
Te erase multi-pulse duration
dTe first erase pulse start time at Recording Velocity
L to 111
00h (Layer0, 1x DI)
Write Strategy Parameters (DI Type = CLV & WS Type = WS-1

FIG. 12


Host or Controller (20)
data/ command
Recorder/Reproducer (10)
Optical disc
Pickup (11)
Interface (12)
Memory (15)
Data Processor (13)
Microcomputer (16)
Servo (14)