

DESCRIPTION

Recording Method, Recording Apparatus and Recording Medium

Technical Field

The present invention relates to a recording apparatus and a recording method using a recording medium, and further relates to a recording program for recording a predetermined file on a recording medium such as an optical disk, etc. and a recording medium having the recording program recorded therein. The present invention is applicable to a DVD (digital versatile disk), for example. In particular, according to the present invention, individual management information can be accessed via guide information for an extension file and an identification code indicative of the type of the extension file in consideration and recording format information in the management information are allocated to the extension-file guide information to extend the disk recordability sufficiently for recording also a file of still pictures other than moving pictures.

This application claims the priority of the Japanese Patent Application No. 2002-134045 filed on May 9, 2002, the entirety of which is incorporated by reference herein.

Background Art

Conventionally, there are available DVDs as large-capacity optical disks

including writable DVDs (digital versatile disk) such as a DVD-R (DVD-recordable), which is once rewritable, DVD-RW (DVD-rewritable) and DVD-RAM (DVD-random access memory). Of these DVDs, DVD-R and DVD-RW having video data recorded therein in a format complying with the DVD video format can be played by a reproduce-only DVD player or a computer to reproduce the video data.

FIG. 1 shows a chart explaining the DVD video format-based logical format of an optical disk. As shown in FIG. 1A, the optical disk logically formatted according to the DVD video format has an information recording area thereof divided into a zone called "lead-in" at the innermost circumference thereof, a data zone and a zone called "lead-out" at the outermost circumference. The optical disk will have desired video data or the like recorded to the data zone thereof.

As shown, the data zone consists of a UDF (universal disk format) area (file system area) A1, VMG (video manager) area (DVD management information area) A2 and a real-time data recording area A3 in this order from the lead-in zone. The UDF and VMG areas are provided to record management information used to manage files of video data recorded in this optical disk. Of these UDF and VMG areas, the VMG area A2 is directed to a DVD player and will have recorded thereto TOC information (table of contents) used for management of all video data recorded in the real-time data recording area A3. On the other hand, the UDF area A1 is directed to a file management by a computer, and will have recorded

thereto management information used for management of all the video data recorded in the real-time data recording area A3 in a format compatible with the file management system of the computer.

As shown in FIG. 1B, the real-time data recording area A3 is a program area where real data are to be recorded, and will have video data recorded therein in units of VTS (video title set; will be referred to simply as "title" wherever appropriate hereunder). It is also important to note that as shown in FIG. 1C, the "VTS" is composed of VTSI (video title set information), VTSM VOBS (video object set for the VTSM), VTSTT VOBS (video object set for titles in a VTS), and VTSI BUP (backup of VTSI) in this order. VTSTT VOBS will have recorded thereto MPEG (Moving Pictures Experts Group)-2-formatted video data as real video data, VTSI will have recorded thereto the address information etc. for management of the video data composed of real data, and VTSM VOBS will have a title menu of the video data recorded thereto. It should be noted that VTSM VOBS is an option and VTSI BUP is a backup of VTSI.

When the above optical disk is accessed by a computer, a desired file can be searched based on UDF for reproduction. When the optical disk is accessed by a DVD player, a desired file can be searched based on VMG for reproduction. Namely, UDF is supported by the file management system of the computer to manage video data recorded in the optical disk, while VMG is supported by the DVD player to manage video data recorded in the optical disk.

Video data is written to such an optical disk by either an incremental recording method (will be referred to as “INC method” hereunder) or restricted overwrite method (will be referred to as “ROW method” hereunder). The INC method is intended for sequential recording of video data, while the ROW method is applied to an overwritable optical disk. In the ROW method as well, however, video data which are to be recorded to a fresh (unrecorded) area will sequentially be recorded. In these INC and ROW methods, an RMA (recording management area) formed along the inner circumference of the lead-in zone provides an area management such as padding (will be described in detail later) or the like.

FIG. 2 shows a chart for explaining the ROW-based recording procedure. In the ROW method, a lead-in, UDF and VMG areas, and areas for recording the leading titles VTSI and VTSM VOBS are reserved by padding as shown in FIG. 2A. It should be noted that the “padding” refers to a process for reserving an area by recording there dummy data such as null (zero) or the like.

In the ROW method, when these areas are reserved, video data are sequentially recorded to define a VTSTT VOBS of real data as shown in FIG. 2B. Upon completion of recording the real data under one title, a VTSI BUP area is defined, and padding is done for securing recording areas for subsequent titles VTSI and VTSM VOBS, as shown in FIG. 2B. Then, defining VTSI and VTSM VOBS areas for recording the real data will be repeated again from the beginning as shown in FIG. 2C. Thus, one VTS is recorded in the optical disk by the ROW

method.

In the ROW method, for continuously recording a next title, real data are recorded following a padded area for a preceding VTS to define VTSTT VOBS and VTSI BUP areas, and then padding is done for securing subsequent titles VTSI and VTSM VOBS, as will be known from FIG. 2D. Subsequently, areas are defined for titles VTSI and VTSM VOBS as shown in FIG. 2E to thereby record successive VTSs to the optical disk as shown in FIG. 2F. In the ROW method, for successively recording titles, similar padding is done to record VTSs sequentially.

On the other hand, in an optical disk having such VTSs sequentially recorded therein to define a real-time data recording area, the ROW method defines UDF and VMG areas by finalization, and then lead-in and lead-out as shown in FIG. 2G to thereby establish compatibility with a read-only optical disk. It should be noted that the UDF and VMG areas are defined by producing UDF and VMG data from the VTSI and VTSM VOBS title data and recording the data to an inner-circumferential leading area by padding.

In the Japanese laid-open patent Publication Nos. 2002-063765, 2001-148166 and 2002-56609, it is proposed to record the top address of VTSI corresponding to a management table formed along the inner circumference of an optical disk correspondingly to recording of a title, manage the program area according to the management table to record a file of moving pictures and thus

make each title accessible with reference to the management table even in a step before the finalization.

It is conceivable that such an optical disk is played in place of the magnetic tape in a portable video recorder. In this case, since the conventional video tape recorder can record moving pictures as well as still pictures, such an optical disk for use with the portable video disk recorder should also desirably be capable of recording still pictures other than moving pictures.

A possible approach to the above problem is to record still and moving picture files to an optical disk by recording the moving pictures to DVD video format and management information for the moving pictures to the UDF and VMG areas while recording the other file (still picture file in this case) than the moving pictures to the UDF area alone. Thus, it is considered that the file management system of a computer or the like is based on the UDF so that the computer can all files recorded in a real-time data recording area being a program area. Also, it is considered that the DVD player is based on the VMG so that it can record such files other than the moving pictures without influence of the reading by the DVD player.

Also, it is possible that the management information for each file, required for organizing such a UDF, is provisionally recorded along with a still picture file to an optical disk until the latter is finalized.

In this type of optical disk, however, since it has a large storage capacity, so

it may not only be used in a video recorder in place of a magnetic tape but also may be used in a variety of apparatuses and systems to record other files than moving and still picture files and manage the recorded files according to management information applied in each of such apparatuses and systems.

In this case, on the assumption that a management information format is defined for each type of a file in consideration, each time a recordable file type is added, the management information must be defined, which will lead to increased trouble in procedure for enabling an optical disk drive to additionally record a new file.

Note that in case an optical disk drive is used without definition of such a management information format, the optical disk is finalized so that in a UDF-based file management system, a file of this type will be managed in a directory structure for which the file is not intended.

Disclosure of the Invention

It is therefore an object of the present invention to overcome the above-mentioned drawbacks of a conventional recording apparatus using an optical disk as a recording medium by providing a new recording apparatus and recording method using a recording medium.

It is another object of the present invention to overcome the above-mentioned drawbacks of the related art by providing a recording apparatus

and a recording method using a recording medium, a recording program for recording a file on the recording medium, and a recording medium having the recording program recorded therein, capable of assuring a sufficient extension of the disk recordability for recording also a file of still pictures other than moving pictures.

The above object can be attained by providing a recording apparatus and recording method using recording medium according to the present invention, in which an extension file other than a moving picture file formatted to be readable by a dedicated reproducing apparatus for the recording medium is recorded in combination with individual management information for the extension file to a program area of the recording medium; guide information for the extension file, including at least the address of the individual management information, is recorded to the recording medium; the address of the extension-file guide information is recorded to a management table; and an identification code indicative of an extension file type in the corresponding individual management information and recording format in the management information are allocated to the extension-file guide information.

In a program of a recording method for recording a file on a recording medium according to the present invention, an extension file other than a moving picture file formatted to be readable by a dedicated reproducing apparatus for the recording medium is recorded in combination with individual management

information for the extension file to a program area of the recording medium; guide information for the extension file, including at least the address of the individual management information, is recorded to the recording medium; the address of the extension-file guide information is recorded to a management table; and an identification code indicative of an extension file type in the corresponding individual management information and recording format in the management information are allocated to the extension-file guide information.

The program described above is recorded in a recording method according to the present invention.

In the recording apparatus and the recording method according to the present invention, an extension file other than a moving picture file formatted for reproduction by a dedicated reproducing apparatus for the recording medium is recorded in combination with management information for the extension file to a program area; guide information for the extension file, including at least the address of the individual management information, is recorded to the recording medium; the address of the extension-file guide information is recorded to a management table; and the identification code indicative of an extension file type in the corresponding individual management information and address of the management information are allocated to the extension-file guide information, whereby an extension file other than a moving picture file defined in the DVD video format can be recorded to a DVD video-formatted optical disk so that the

extension file type and recording format of the individual management information for the extension file can be acquired from the extension-file guide information. Thus, when a new extension file is additionally recorded without any modification of the recording formation of the individual management information. For example, only the identification code indicating the type of the extension file has to be changed. Thereby, the disk recordability can be extended sufficiently for recording also still files, etc. other than moving picture files.

These objects and other objects, features and advantages of the present invention will become more apparent from the following detailed description of the preferred embodiments of the present invention when taken in conjunction with the accompanying drawings.

Brief Description of the Drawings

FIGS. 1A to 1C explain the DVD video format;

FIGS. 2A to 2G explain the ROW-based recording;

FIG. 3 is a block diagram of the optical disk drive according to the present invention;

FIG. 4 shows a flow of operations made in the recording and reproducing procedures performed in the optical disk drive according to the present invention;

FIGS. 5A to 5H explain recording of an extension file in the optical disk drive according to the present invention;

FIGS. 6A to 6D explain processing of the management information in the optical disk drive according to the present invention;

FIGS. 7A and 7B explain processing of the management information for additional recording of the extension file;

FIG. 8 shows a flow of operations made in the recording procedure in the optical disk drive according to the present invention;

FIG. 9 shows a flow of operations made in the reproducing procedure in the optical disk drive according to the present invention;

FIGS. 10A and 10B explain guide information employed in the optical disk drive according to the present invention;

FIGS. 11A and 11B explain management information employed in the optical disk drive according to the present invention;

FIGS. 12A and 12B explain management information employed in the optical disk drive according to the present invention;

FIGS. 13A and 13B explain individual information employed in the optical disk drive according to the present invention;

FIGS. 14A to 14D explain processing of the management information in the optical disk drive according to the present invention; and

FIGS. 15A and 15B explain processing of the management information for additional recording of the extension file.

Best Mode for Carrying Out the Invention

The embodiments of the present invention will be described in detail below with reference to the accompanying drawings:

FIG. 3 is a block diagram of the first embodiment of the optical disk drive according to the present invention. The optical disk drive is generally indicated with a reference 1. This optical disk drive 1 is a portable video recorder designed to record picked up pictures to an optical disk 2 which is a DVD.

More particularly, the optical disk drive 1 shown in FIG. 3 includes a video input block 3 which makes analog-digital conversion of video signals captured by picture pickup means (not shown) or video signals supplied from an external apparatus to provide video data. It should be noted that a plurality of pickup means incorporated in the optical disk drive 1 is controlled by a CPU (Central Processing unit) 4 also included in the optical disk drive 1 to provide results of imaging composed of moving pictures and still pictures. Thus, the video input block 3 operates in response to the control by the CPU 4 of the pickup means to selectively receive either video data composed of moving picture or still picture data.

The optical disk drive 1 further includes an audio input block 5 which makes analog-digital conversion of audio signals picked up by a microphone or audio signals supplied from outside to produce audio data.

The optical disk drive 1 also includes a compress/expand block 6 whose

mode of operation is changed under the control of the CPU 4 to process data for recording or reproducing. More specifically, for recording video and audio data supplied from the video input block 3 and audio input block 5, respectively, the compress/expand block 6 will use a random access memory (RAM) 9 to multiplex the video and audio data by compression and supply the data to a head information processor 7. On the contrary, for reproduction of the video and audio data from the optical disk 2, the compress/expand block 6 will also use the RAM 9 to break the data supplied from the header information processor 7 into video and audio data, then expand the video and audio data, respectively, and output the expanded data.

More particularly, for data recording, a video processor 8 included in the compress/expand block 6 is controlled by the CPU 4 to compress video data supplied from the video input block 3, and outputs the compressed data. At this time, in case the video data is moving picture data, the compress/expand block 6 will take the MPEG-2 format for compression of the video data, and in case the video data is composed of still pictures, the compress/expand block 6 will compress the data in the JPEG (Joint Photographic Coding Experts Group) format, and output the compressed data. Also, for data reproduction, the video processor 8 will expand video data output from a multiplexer 10 correspondingly to the format, MPEG-2 or JPEG, in which the data has been compressed, and output the expanded data.

For data recording, an audio processor 11 included in the compress/expand block 6 will compress audio data output from the audio input block 5 in an MPEG format, Dolby audio format or a linear PCM format, and output the compressed data. On the contrary, for data reproduction, the audio processor 11 will expand audio data supplied from the multiplexer 10 and output the expanded data.

For data recording, the multiplexer 10 makes time-division multiplexing of video data output from the video processor 8 and audio data output from the audio processor 11, and outputs the multiplexed data to the header information processor 7. On the contrary, for data reproduction, the multiplexer 10 will break the time-division multiplexed data output from the head information processor 7 into video and audio data, and supply these data to the video processor 8 and audio processor 11, respectively.

The optical disk driver 1 also includes a monitor block 12 constructed of a display mechanism to monitor video data supplied from the video input block 3, audio data supplied from the audio input block 5 or video data and audio data supplied from the compress/expand block 6, and an audio processing mechanism. Thus, the optical disk drive 1 according to the present invention can monitor captured pictures and sounds and results of data reproduction.

The optical disk drive 1 also includes a video/audio encoder 13 which compresses video and audio data supplied from the video and audio input blocks 3 and 5, respectively, or video and audio data supplied from the compress/expand

block 6 in predetermined formats, respectively, and outputs the data to the external apparatus. Thus, the optical disk drive 1 according to the present invention enables to monitor captured pictures and sounds and results of data reproduction on the external apparatus.

For data recording, the header information processor 7 is supplied with time-division multiplexed data supplied from the compress/expand block 6 and adds, to the time-division multiplexed data, header information unique to a DVD, header information or the like on an extension file which will be described in detail later, under the control of the CPU 4, and outputs the data. Also, according to information supplied from the CPU 4, the header information processor 7 will produce data such as UDF, VMG, VTSI, etc. and output these data to a DVD signal processor 14. Also, for data reproduction, the header information processor 7 will separate, from output data from the DVD signal processor 14, head information having been added at the time of recording and output it to the compress/expand block 6, and inform the CPU 4 of the separated header information. It should be noted here that the "extension file" is a file not defined in the DVD video format standardized for the optical disk 2 and in this embodiment, a still picture format is applied as the extension file.

For data recording, the DVD signal processor 14 will use a random access memory 15 to generate an error correction code from data output from the header information processor 7 and add the error correction code to the output data. Also,

the DVD signal processor 14 makes scrambling, 8/16 modulation and the like and outputs a data string composed of the processing results as a serial data string to an analog front end block 16.

On the contrary, for data reproduction, the DVD signal processor 14 will make error correction, descrambling and decoding of the output data from the analog front end block 16, namely, process the output data in an reverse order to the order in the data recording procedure, and output the results of such processes to the header information processor 7. Also, the DVD signal processor 14 make digital-analog conversion of drive information such as spindle control, tracking control, focus control and sled control data supplied from the CPU 4 to provide such drive signals and output the drive signals to a motor amplifier 18.

The analog front end block 16 generates a light amount control signal for a laser bean to be emitted from an optical head 19 to the optical disk 2, and outputs the control signal. For data reproduction, the analog front end block 16 will keep, according to the light amount control signal, the amount of laser beam projected onto the optical disk 2 from the optical head 19 at a constant value for data reading.

On the contrary, for data recording, the analog front end block 16 will change the level of the light amount control signal correspondingly to the output data from the DVD signal processor 14, to thereby elevate the amount of laser beam intermittently from the value for data reproduction to a value for data recording correspondingly to the output data from the DVD signal processor 14.

Also, the analog front end block 16 amplifies and processes a result of detection of a return light supplied from the optical head 19 to generate a reproduced signal whose level varies correspondingly to a train of pits formed on the optical disk 2, and processes the reproduced signal for binary differentiation to yield reproduced data which will be supplied to the DVD signal processor 14. With the above processing of the result of return light detection, the analog front end block 16 will generate a tracking error signal and focus error signal of which the levels vary correspondingly to magnitudes of tracking error and focus error, respectively, and output these signals in the form of digital signal to the CPU 4.

The motor amplifier 18 is supplied with the drive signals from the DVD signal processor 14, and drives mechanisms corresponding to the drive signals. More specifically, the motor amplifier 18 drives to rotate a spindle motor 20 and sled motor 21 with ones, for spindle control and sled control, of these drive signals.

Also, the motor amplifier 18 will drive an actuator installed in the optical head 19 with the drive signals for tracking control and focus control, respectively.

The spindle motor 20 chucks the optical disk 2 and drives to rotate the latter at a predetermined velocity. The sled motor 21 makes the optical head 19 movable radially of the optical disk 2.

Supplied with the light amount control signal from the analog front end block 16, the optical head 19 will emit a laser beam from a semiconductor laser incorporated therein, and focus the laser beam on the information recording area of

the optical disk 2 through an objective lens. Also, a return light, namely, a reflected part of the laser beam projected on the optical disk 2 is guided to a predetermined photodetector element of the optical head 19 through the objective lens, and the result of light detection is supplied to the analog front end block 16. The objective lens of the optical head 19 is movable by the actuator driven with the tracking and focus control drive signals to have the tracking and focus thereof controlled. Also, the amount of laser beam is intermittently elevated according to the light amount control signal, whereby the information recording area of the optical disk 2 is locally elevated in temperature to record desired data there.

The CPU 4 is provided as a system controller for the optical disk drive 1. By executing a processing program pre-installed in the optical disk drive 1, supplied with signals of operations made by the user at a control panel (not shown) or supplied with various signals detected by the analog front end block 16, the CPU 4 controls the operation of each of the component blocks. More specifically, the CPU 4 will be supplied with a tracking error signal and focus error signal detected by the analog front end block 16 to generate tracking and focus control drive information, convert these signals by the DVD signal processor 14 into analog signals and supply the analog signals to the motor amplifier 18 which in turn will control the tracking and focus of the optical head 19. Also, supplied with the header information detected by the header information processor 7, the CPU 4 will detect a laser beam-projected position, generates sled control drive

information from the result of detection and supply the information to the DVD information processor 14, to thereby perform a seek and the like. Similarly, the CPU 4 will make a performance for spindle control.

The basic operations of the CPU 4, directed to the optical disk 2, have been described in the foregoing. Here will be described with reference to the flow chart in FIG. 5 operations that will be made by the CPU 4 for data read or write after the optical disk drive 1 is turned on. In step SP1, the optical disk drive 1 is turned on. Then the CPU 4 goes from step SP1 to SP2 where it will judge based on the result of detection of the optical disk 2 from a detection mechanism (not shown) whether the optical disk 2 is set in place in the optical disk drive 1. If the result of judgment in step SP2 is negative (no optical disk 2 is set in place), the CPU 4 will repeat the operation in step SP2. On the contrary, when the optical disk drive 1 has been turned on with the optical disk 2 loaded therein or when the optical disk 2 has been loaded after the optical disk drive 1 is turned on, namely, when the above result of judgment is affirmative (the optical disk 2 is set in place), the CPU 4 will go from step SP2 to SP3. It should be noted that if the optical disk drive 1 is turned off when the CPU 4 is repeating the operation in step SP2, the CPU 4 will go directly to step SP4 where it will exit this reproducing or recording procedure (power off).

In step SP3, the CPU 4 drives the sled motor 21 to move the optical head 19 to the innermost circumference of the optical disk 2, and is supplied with the result

of reading the innermost-circumferential area from the DVD signal processor 14. In case the optical disk 2 is a finalized one, the CPU 4 will acquire data in the VMG area from the DVD signal processor 14. On the contrary, if the optical disk 2 is not any finalized one, the CPU 4 will acquire information in the RMA area from the DVD information processor 14. When the CPU 4 determines based on the information in the RMA area that data has already been recorded in the real-time data recording area of the optical disk 2, it searches the optical disk 2 for VTSI and VTSTT VOBS data in each VTS. Thus, as in an optical disk drive to record and reproduce an ordinary DVD, the CPU 4 will acquire management information required for data write to, and read from, the optical disk 2.

In this procedure, the CPU 4 acquires the data in the VMG area and data in the UDF area as well. When reading the real-time data recording area, the CPU 4 will also acquire intermediate management information, if any, found recorded in the real-time data recording area. Thus, the CPU 4 acquires also management information for an extension file not defined in the DVD video format to enable reading of the extension file from the optical disk 2. The CPU 4 will record and hold a series of thus acquired management information in a built-in memory.

Next, the CPU 4 goes to step SP5 where it will judge whether it is instructed to eject the optical disk 2. When the result of judgment is affirmative, the CPU 4 will instruct a loading mechanism (not shown) to eject the optical disk 2 and then go back to step SP2.

On the contrary, when supplied with an instruction for other than the ejection of the optical disk 2 from the user, the CPU 4 goes from step SP5 to SP6 where it will judge which the supplied user's instruction is, recording (REC), reproduction (PB) or power off. When the user's instruction is "PB (reproduction)", the CPU 4 goes from step SP6 to SP7 where it will proceed to reproduction of a file from the optical disk 2 and then return to step SP5.

When the user's instruction is "REC (recording)", the CPU 4 goes from step SP6 to SP8 where it will proceed to recording of moving or still pictures to the optical disk 2 and then go back to step SP5. It is important to note that when the optical disk 2 has UDF and VMG areas defined therein through the so-called finalization, the CPU 4 will skip over the recording procedure to step SP5 since the optical disk 2 has been processed against data recording. Also, even in case the optical disk 2 is a DVD-RW which is finalized but erasable, the CPU 4 will erase the data existent in the optical disk 2 with acknowledgment from the user and proceed to data recording.

When the user's instruction is "Power off", the CPU 4 goes from step SP6 to SP9 where it will proceed to turn off the power to the optical disk drive 1 and then return to step SP4 where it will exit this recording or reproducing procedure.

In the recording one of the above procedures, when the optical disk 2 is DVD-R, the CPU 4 will adopt the INC method to record a moving or still picture file to the optical disk 2. On the other hand, when the optical disk is DVD-RW or

DVD-RAM, the CPU 4 will adopt the ROW method to record a moving or still picture file to the optical disk 2.

FIGS. 5A to 5H are chart for explanation of the recording of a moving picture file and a still picture file to an optical disk having no files yet recorded therein, namely, a virgin disk, by the ROW method. Updating RMA information acquired from the optical disk 2 and held in the built-in memory, the CPU 4 performs padding to reserve UDF and VMG areas in the optical disk 2. Also, when an instruction for recording of a moving picture file is given from the user, the CPU 4 will define, by padding, areas for the subsequent titles VTSI and VTSM VOBS in the optical disk 2 as shown in FIG. 5A. Also, with these operations, the CPU 4 will update the RMA data held in the built-in memory thereof.

Given an instruction for starting the recording from the user, the CPU 4 will sequentially record real data in the moving picture file to define a VTSTT VOBS area, then generate management information including the address of a recording start position, file size, recording data, etc., and record the management information to define a VTSI BUP area. Also, to record subsequent titles, the CPU 4 will reserve, by padding, areas for the titles VTSI and VTSM VOBS as shown in FIG. 5B. Further, the CPU 4 will sequentially record the management information starting at a position a predetermined number of areas returned back from a position where recording of VTSTT VOBS has started to define areas for VTSI and VTSM VOBS, thereby completing recording of one title, as shown in

FIG. 5C. In these operations, the CPU 4 will record and hold the management information for the title in the built-in memory thereof.

For recoding a moving picture file next, the CPU 4 will similarly control the operation of each of the component blocks to sequentially record the moving picture files by the ROW method as in the conventional optical disk drive.

Through the above operations, the CPU 4 updates the RMA data held in the memory thereof appropriately, and rewrites the RMA in the optical disk 2 by the RAM data held in the memory at the time of ejection of the optical disk 2, power off, etc. Thus, even the record in the memory is lost, the optical disk drive 1 will be able to access any yet-to-finalize optical disk 2 with reference to the recorded RMA.

Note here that the CPU 4 will perform the above operations through appropriate updating of the management table held in the memory. It should also be noted that the management table is indicated with a reference TV in FIG. 5.

Note here that the management table TV is to manage the program area on the optical disk 2 and can record top and bottom addresses of VTSs recorded in the program area, and an area not accessed by any reproduce-only optical disk drive (DVD player) are assigned to the management table TV.

Thus, the CPU 4 will record, to the optical disk 2, top and bottom addresses corresponding to the management table TV held in the memory thereof through recording of VTSs to the optical disk 2, and update the management table TV in

the optical disk 2 according to the management table TV held in the memory in its free time and during ejection of the optical disk 2 as well.

Given an instruction for recording of still pictures from the user, the CPU 4 will set a recording start position for real data at the top of an area reserved by padding. Also, supplied with a user's instruction for start of the recording, the CPU 4 will sequentially record still picture files being extension files (indicated with a reference EF in FIG. 5) as shown in FIG. 5D. Further, the CPU 4 sequentially generates intermediate management information for provisional management of the still picture files until the finalization correspondingly to the recording of the still picture files and hold the information in the built-in memory thereof.

Furthermore, after having recorded a desired number of still picture files and when given a user's instruction for ending the recording of the still picture files, the CPU 4 will convert the intermediate management information held in the memory into a format of recording to the optical disk 2, and record the intermediate management information to reserve, by padding, areas for recording the subsequent titles VTSI and VTSM VOBS, as shown in FIG. 5D. Thus, the CPU 4 will generate management information for all extension files to successively be recorded. Also, the CPU 4 will select a recording format according to the attribute of a file by recording a moving picture file in combination with corresponding management information in the order of management information,

moving picture file and management information, while recording an extension file in combination with corresponding intermediate management information in the order of the extension file and intermediate management information and recording intermediate management information collectively for a plurality of files.

Thus, for recording a moving picture file next, the CPU 4 will record VTSTT VOBS and VTSI BUP by real data next to an area reserved by padding, and then reserve subsequent areas by padding, and record VTSI and VTSM VOBS back at the beginning, to thereby record one title, as shown in FIGS. 5E to 5G. Also, for recording still picture files, the CPU 4 will similarly record them sequentially back at the top of padding to record the management data, and then reserve areas by padding. Further, given an instruction for finalization from the user, the CPU 4 will define UDF and VMG areas and lead-in and lead-out zones according to the management information, as shown in FIG. 5H.

The CPU 4 will update the management table TV as above with these moving picture files correspondingly to the recording of the titles for the moving picture files. On the other hand, for the extension files, the CPU 4 will generate guide information for the extension files each time intermediate management information DK is recorded to the optical disk 2 and update extended information guide information TE recorded in a fixed area along the inner circumference of the optical disk 2 by the extension-file guide information. It should be noted that the "fixed area" means a predetermined area for recording the extension-file guide

information TE. In this embodiment, of the areas initially reserved by padding, a clearance area where no UDF and VMG are allocated is used as such a "fixed area". Further, the CPU 4 will record top and bottom addresses of the extension-file guide information TE to the management table TV.

Note that the CPU 4 actually performs the above operations by the use of the memory thereof while reading and updating the optical disk 2 at the time of ejecting the optical disk 2, power off and in its free time. Also, the top address of the extension-file guide information is recorded only once to the management table TV at the time of recording the first intermediate management information DK since the extension-file guide information TE is recorded to the fixed area.

Thus, in the optical disk drive 1, the extension-file guide information TE can be detected according to the recorded management table TV and each extension file can be searched according to the extension-file guide information, so that a desired extension file can quickly be searched without having to scan the entire information recording area on the optical disk 2. Also, the extension-file guide information TE can be detected according to the management table TV for the moving picture files, so that the information recording area can effectively be used.

Note that the intermediate management information DK is required for reading of an extension file, and it is composed of attribute information as an extension indicative of the attribute of an extension file, address information indicative of an address where the extension file is recorded, file size information

indicative of the size of the extension file, time information indicative of a date and time when the extension file was recorded to the optical disk 2, etc. As shown in FIGS. 6A to 6D, the intermediate management information DK includes, at the top thereof, management information CI for a collection of still picture files EF1 to EF3 successively recorded following the information CI. It should be noted that the management information CI includes identification information indicative of a category, directory, etc. of files managed according to individual information EXF1 to EXF3 included next to the management information, whereby it is made possible to maintain the compatibility of the files with the file management system of the computer.

The individual information EX is individual management information composed of the name of a file, start address of the file, etc. The extension-file guide information TE is extension-file guide information including the address of the individual management information, and includes an identification code, address as a pointer indicative of a start address of the management information CI, which is also a start address of the intermediate management information DK, etc.

Thus, as shown in FIG. 6A, when a title (VTS #1) for a moving picture file is recorded, the CPU 4 records top and bottom addresses of the title in the management table TV correspondingly to the recording of the title (VTS #1). When three still picture files EF1 to EF3 are recorded in the JPEG format in this condition, the CPU 4 will record the management information CI and individual

information EXF1 to EFX3 for the still picture files EF1 to EF3 to record the intermediate management information DK. Also, the CPU 4 records the extension-file guide information TE and also updates the management table TV correspondingly to the recording of the guide information TE. It should be noted that the CPU 4 effects these operations by updating or otherwise processing information in consideration held in the memory, and actually updates the record in the optical disk 2 at the time of ejecting the optical disk 2 or at any other time. This will also be true in the subsequent steps of operations.

When the second recorded still picture file EF2 is deleted in this condition, the CPU 4 detects the extension-file guide information TE from the record in the management table TV and detects the address of corresponding intermediate management information DK from the guide information TE, as shown in FIG. 6B.

With the detection of the address, the CPU 4 changes the individual information EFX2 with the still picture file EF2 left in the optical disk 2 by actually deleting the individual information EXF2 or setting, for the individual information EXF2, a flag indicating that the individual information EXF2 is a meaningless information, to thereby set the recorded area of the still picture file EF2 as an unrecorded area. It should be noted that in this case, the CPU 4 will update the intermediate management information DK by overwriting the intermediate management information DK as a whole.

When given an instruction for recording a still picture file from the user, if

the previously deleted still picture file EF2 used to be recorded at the top of the unrecorded area, the CPU 4 will similarly detect the extension-file guide information TE from the record in the management table TV, the address of corresponding intermediate management information DK from the guide information TE, and also the address of an area having been set as an unrecorded area from the record of the individual information EXF22 in the intermediate management information DK, as shown in FIG. 6C. Thus, the CPU 4 records the still picture file EF22 related to the user's instruction to the detected unrecorded area and overwrites the management information CI and individual information EXF1, EXF22 and EXF3 related to the still picture files EF1, EF22 and EF3, respectively, thereby updating the record of the intermediate management information DK. Further, when instructed by the user to delete the still picture file EF22, the CPU 4 will set the recorded area of the still picture file EF22 as an unrecorded area as having been described above with reference to FIG. 6B.

The microcomputer records the intermediate management information DK as above. For recording the intermediate management information DK by additionally recording an extension file, however, the CPU 4 will generate intermediate management information DK for all intermediate management information DK for extension files already recorded in the optical disk 2 and record the intermediate management information DK1 to the optical disk 2, as shown in FIGS. 7A and 7B. Also, the CPU 4 updates the extension-file guide

information TE for correspondence to the recording of the intermediate management information DK1.

FIG. 7A shows recording of still picture files EF4, EF5 and EF6 next to one recorded title (VTS #2) after the aforementioned condition shown in FIG. 7A. In this case, the CPU 4 generates management information CI and individual information EXF1 to EXF6 for the management information CI from the intermediate management information DK for the still picture files EF1, EF2 and EF3 held in the memory and information such as addresses of the still picture files EF4, EF5 and EF6, records the thus generated information CI and individual information EXF1 to EXF6 to the optical disk 2, and also updates the extension-file guide information TE.

Thus, the CPU 4 will update the existent record of the still picture files EF1, EF2 and EF3 in the optical disk 2 so that they can be accessed based on the individual information EXF1 to EXF3 corresponding to the above newly recorded intermediate management information DK1. As shown in FIG. 7B, the CPU 4 will update or delete the newly recorded still picture files EF4 to EF6 and also the already recorded still picture files EF1 to EF3 by processing the individual information EXF1 to EXF6 corresponding to the newly recorded intermediate management information DK1.

Thus, when instructed from the user to finalize the optical disk 2 having the extension files recorded therein as above, the CPU 4 will generate UDF data from

the management information (VTSI and VTSTT VOBS) titles having thus been generated with reference to the management table and intermediate management information for all the extension files, and record the UDF data to the optical disk 2, as shown in FIG. 5H. Also, the CPU 4 will generate VMG data from only the management information (VTSI and VTSTT VOBS) for all the titles, and record it to the optical disk 2. It is important to note that the UDF and VMG data are generated according to the intermediate management information held in the memory or the like. Also, having recorded the UDF and VMG in this way, the CPU 4 will define lead-in and lead-out zones. It should also be noted that the CPU 4 will record the UDF and VMG data, define the lead-in and lead-out zones and record the intermediate management information, all by outputting the corresponding data to the DVD signal processor 14.

Therefore, in this embodiment, the UDF data for management of the computer will include management information by which also an extension file can be recognized and accessed but the VMG data for management of DVD reproduction will include no extension file-related information. In this procedure, the CPU 4 will make, invisible from the user, similarly to titles VTSI, VTSM VOBS, etc., a file of provisional intermediate management information which is meaningless in reproduction of the optical disk 2 by the computer, so that the optical disk drive 1 can accordingly be improved in operability.

Thus, the conventional optical disk drive for DVD can only read moving

picture files recorded in the optical disk 2 by recording VMG data to the optical disk 2. On the contrary, in the optical disk drive 1, the CPU 4 acquires UDF and VMG data in step SP3 in FIG. 4 to provide a system control for access to each of extension files based on the UDF data, to thereby reproduce the extension files as well.

FIG. 8 shows a flow of operations in the recording procedure having been described above with reference to FIGS. 4 and 5. When this recording procedure is started, the CPU 4 goes from step SP11 to SP12 where it will judge which the user has instructed to do, recording of a moving picture file, recording of a still picture file or finalization.

When the user's instruction is to record a moving picture file, the CPU 4 goes from step SP12 to SP13 where it will judge whether the user has instructed to start the recording. If the result of judgment in step SP13 is negative, the CPU 4 will repeat the operation in step SP13. If the above result of judgment is affirmative, the CPU 4 goes from step SP13 to SP14 where it will record real data as having been described above with reference to FIG. 4. Further, the CPU 4 goes to step SP15 where it will judge whether the user has instructed to stop the recording. If the result of judgment in step SP15 is negative, the CPU 4 will go back to step SP14. This, the CPU 4 repeats the operations in steps SP14, SP15 and again in SP14, thereby sequentially recording real data. When the above result of judgment is affirmative, the CPU 4 will complete the recording of VTSTT

VOBS data with exiting the recording of real data.

Next, the CPU 4 goes to step SP16 where it will sequentially define VTSI BUP, VTSI and VTSM VOBS areas in the optical disk 2, thereby recording one VTS, and then goes to step SP17 where it will exit this recording procedure.

On the other hand, when the user's instruction is to record a still picture file, the CPU 4 goes from step SP12 to SP18 where it will judge whether the user has instructed to start the recording. If the result of judgment in step SP18 is negative, the CPU 4 will repeat the operation in step SP18. On the contrary, when the above result of judgment is affirmative, the CPU 4 goes from step SP18 to SP19 where it will record an extension file for the still picture file as having been described above with reference to FIGS. 4 and 5. Further, the CPU 4 goes to step SP20 where it will judge whether the user has instructed to stop the recording. If the result of judgment in step SP20 is negative, the CPU 4 will go back to step SP19. Thus, the CPU 4 repeats the operations in steps SP19, SP20 and again in SP19 to sequentially record the still picture files. If the above result of judgment is affirmative, the CPU 4 terminates the recording of still picture files and goes to step SP21 where it will record intermediate management information, and goes to step SP17 where it will exit this recording procedure.

When the user's instruction is to record data related to finalization of the optical disk 2, the CPU 4 goes from step SP12 to SP22 where it will judge whether the user has instructed to start the recording. If the result of judgment in step

SP22 is negative, the CPU 4 will repeat the operation in step SP22. When the above result of judgment is affirmative, the CPU 4 goes from step SP22 to SP23 where it will finalize the optical disk 2 as having been described above with reference to FIGS. 4 and 5, and then goes to step SP17 where it will exit this procedure.

FIG. 9 shows a flow of operations included in the reproducing procedure shown in FIG. 4. When this reproducing procedure is started, the CPU 4 goes from step SP31 to SP32 where it will judge which the user has instructed to read, a moving picture file or a still picture file.

When the user's instruction is for reproduction of a moving picture file, the CPU 4 goes from step SP32 to SP33 where it will judge whether the user has instructed to start the reproduction. If the result of judgment is negative, the CPU 4 will repeat the operation in step SP33. When the above result of judgment is affirmative, the CPU 4 goes from step SP33 to SP 34 where it will provide a system control for reproducing a moving picture file designated by the user with reference to the management information held in the memory.

That is, when the optical disk 2 is a finalized one, the CPU 4 will detect the address of a file in consideration on the basis of the VMG data held in the built-in memory thereof, and instruct each of the components of the optical disk drive 1 to read the file from the address. On the other hand, in case the optical disk 2 is not any finalized one, the CPU 4 will detect the address of the file in consideration on

the basis of record of the management table TV held in the memory and recording of corresponding titles VTSI and VTSTT VOBS, and instruct each of the components of the optical disk drive 1 to read the file from the address.

After instructing the reproduction as above, the CPU 4 goes to step SP35 where it will judge whether the user has instructed to stop the reproduction. If the result of judgment in step SP35 is negative, the CPU 4 will return to step SP34. Thus, the CPU 4 repeats the operations in steps SP34, SP35 and again in SP34 to sequentially read moving picture files designed by the user. On the other hand, when the above result of judgment is affirmative, the CPU 4 will terminate the reproducing operation, and goes to step SP36 where it will exit the reproducing procedure.

On the other hand, in case the user's instruction is to read an extension file, the CPU 4 goes from step SP32 to SP 37 where it will judge whether the user has instructed to start the reproduction. If the result of judgment is negative, the CPU 4 will repeat the operation in step SP37. On the contrary, when the result of judgment is affirmative, the CPU 4 goes from step SP37 to SP38.

In case the optical disk 2 is a finalized one, the CPU 4 will detect the address of a file in consideration on the basis of the UDF data held in the memory thereof, and instruct each of the components of the optical disk drive 1 to read the file from the address. On the other hand, in case the optical disk 2 is not any finalized one, the CPU 4 will detect the address of the file in consideration on the

basis of record of the management table held in the memory, recording of the guide information and corresponding intermediate management information, and instruct each of the components of the optical disk drive 1 to read the file from the address.

After instructing the reproduction as above, the CPU 4 goes to step SP39 where it will judge whether the user has instructed to stop the reproduction. If the result of judgment in step SP 39 is negative, the CPU 4 will go back to step SP38. Thus, the CPU 4 repeats the operations in steps SP38, SP39 and again in SP38 to sequentially read still picture files designated by the user. On the contrary, if the above result of judgment is affirmative, the CPU 4 terminates the reproducing operation, and goes to step SP36 where it will exit the reproducing procedure.

FIG. 10 is a chart showing the extension-file guide information TE and management information CI. The guide information TE is to control an entire area where a corresponding extension file is recorded and has the address defined in the RAM management table as above. It should be noted that it can be judged whether the guide information TE is recorded by EX_STATUS_FLAG stated in the area occupied by the management table TV, and also the top address and size thereof are defined. The guide information TE is composed of a temporary information management table (TMP EXTI MAT) and category information search pointer table (CAT INFO SRPT) recorded in succession.

The above temporary information management table (TMP EXTI MAT) has recorded therein a number of category information search pointer tables (CAT

INFO SRPT) laid following the management table itself. Each of the category information search pointer tables (CAT INFO SRPT) manages the extension files by each category.

According to ISO/IEC646: 1983 (a-character), the temporary information management table (TMP EXTI MAT) has assigned at top 12 bytes thereof an identification code indicating that the table itself is a temporary information management table. A version number of a corresponding management table TV is recorded at next two bytes. Further two bytes are reserved, and the number of category information search pointer tables (CAT INFO SRPT) is recorded at one byte following the reserved two bytes. In this embodiment, the number of tables ranges from 1 to 255. Further three bytes are reserved.

Thus, the guide information TE is such that the temporary information management table (TMP EXTI MAT) can be detected with reference to the management table TV to detect a number of category information search pointer tables (CAT INFO SRPT) included following the management table TMP EXTI MAT.

The category information search pointer table (CAT INFO SRPT) is defined for each extension file category as shown in FIG. 11. In each category information search pointer table (CAT INFO SRPT), identification code CAT ID indicative of an extension file type at top two bytes. At next two bytes, there is stated type information CAT INFO TYPE which is the format of corresponding

management information CI and indicates the recording format of individual information EXF. At further four bytes, there is stated address information CAT INFO SA indicative of a start address of a corresponding management information CI, and at next four bytes, there is stated a size CAT INFO SZ of the corresponding management information CI.

In the category information search pointer table (CAT INFO SRPT) defined as above, the identification code CAT ID indicative of the format of an extension file is assigned to a still picture file. For example, "01" is assigned to a JPEG-formatted still picture file, and "02" is assigned to a GIF-formatted still picture file.

Thus, the recording formats of the management information CI and individual information EXF can be confirmed according to the type information CAT INFO TYPE by detecting the file format on the basis of the identification code CAT ID by sequentially searching through the management table TV. Therefore, when a bit map-based still picture file is newly recorded as an extension file with the identification code CAT ID being defined as "01" or "02" only, the format of a JPEG-formatted still picture file can be appropriated to the management information CI and individual information EXF by changing the statement of only the identification code CAT ID and setting the type information CAT INFO TYPE the same as that of the JPEG-formed still picture file. Thus in this embodiment, the procedure for adding to the formats of recordable files can be

simplified and the recording ability of the optical disk 2 can be assured.

Also, appropriating the formats of the management information CI and individual information EXF as above, the optical disk 2 can be finalized for a file not defined in any way by processing it with the intermediate management information DK similarly to the JPEG-formatted still picture file, whereby an sufficient extension of the recording ability of the optical disk 2 can be assured.

Thus, the management information CI and individual information EXF can be defined in compliance with each category information search pointer table (CAT INFO SRPT) as shown in FIG. 12. It should be noted that the management information CI varies in structure depending upon the type information CAT INFO TYPE in the category information search pointer table (CAT INFO SRPT). A type information CAT INFO TYPE can be set according to the category of an extension file related to the individual information EXF managed by the management information CI.

FIG. 12 shows a case in which the type information CAT INFO TYPE is "01" and a structure of this "01" type is applied to the intermediate management information DK for the aforementioned still image file.

Note that according to ISO/IEC 646: 1983 (a-character), the management information CI has stated at the top 12 bytes thereof an identification code CAT INFO ID indicating that it is management information for an extension file, at next two bytes a version number TV VERN of management information TMP_VMGI.

In the management information CI, next two bytes are reserved, and at next eight bytes, there is stated a directory name in a first hierarchical layer of the extension file according to ISO/IEC 646: 1983 (e-character). Also, at next eight bytes, there is similar stated a directory name in a second layer.

Also, a last updated implement identifier IMP ID is stated at further eight bytes, a time stamp CR TM indicating a date and time when the management information CI was defined is stated at next 12 bytes, and a time stamp MD TM indicating an update date and time when the management information CI was last updated is stated at further 12 bytes. Also, at next two bytes, there is stated a number of individual information EXF1 to EFXn within a range of 1 to 9999, and last two bytes are reserved.

On the other hand, as shown in FIG. 13, the individual information EXF has top 12 bytes thereof allocated to a file name FILE NAME, and a next one byte thereof allocated to copyright protective information CGMS INFO. Further three bytes of the individual information EXF are allocated to a start address EXF SA of a corresponding extension file, next four bytes are allocated to a file size EXF SZ, and further 12 bytes are allocated to a time stamp CR TM indicating the date and time when the individual information EXF was generated.

Thus, the optical disk drive 1 is so designed that the user can be informed of an extension file recorded in the optical disk 2 via the directory structure by sequentially searching through the guide information TE, management information

CI and individual information EXF for the extension file with reference to the management table TV, and that a variety of information necessary for organizing the file management system of a personal computer can be acquired from these guide information TE, management information CI and individual information EXF.

As above, the CPU 4 acquires properties, name size, etc. of each extension file according to the statements in the aforementioned guide information TE, management information CI and individual information EXF at the time of finalization to generate UDF.

The optical disk drive 1 constructed as having been described above with reference to FIG. 3 functions as will be described herebelow:

When the optical disk 2 is loaded by the user into the optical disk drive 1 turned on or when the optical disk drive 1 is turned on with the optical disk 2 loaded in the optical disk drive 1, the CPU 4 controls the DVD signal processor 14 and motor amplifier 18 to drive the sled motor 21 in order to move the optical head 19 toward the inner circumference of the optical disk 2. Further, a laser beam is projected from the optical head 19 to the optical disk 2. A return light reflected from the optical disk 2 is detected by the optical head 19. The detection power detected by the optical head 19 is sequentially processed through the analog front end block 16 and CPU 4. The CPU 4 controls the optical head 19 by controlling the DVD signal processor 14 and motor amplifier 18, which causes the optical

head 19 to undergo tracking control and focus control.

Also, the data recorded on the optical disk 2 is read out by processing the detected detection power of the return light reflected from the optical disk 2 at the DVD signal processor 14. In the optical disk drive 1 according to the present invention, various kinds of information recorded along the inner circumference of the optical disk 2 are acquired by the CPU 4 through the above series of operations and held in the memory built in the CPU 4.

In case the optical disk 2 is a read-only optical disk formed by a stamper precedently having concavity and convexity pattern indicating the data to be recorded on the optical disk 2, or in case it is a finalized one having only moving picture files recorded therein, the CPU 4 will acquire VMG data recorded along the inner circumference of the optical disk 2, which is management information for a DVD player through the above series of operations. Thus in the optical disk drive 1, when it is instructed by the user to reproduce the optical disk 2, the sled motor 21 is driven according to the VMG data by means of the DVD signal processor 14 and motor amplifier 18 to move the optical head 19 to the address of a user-designated title (seek operation), and with the optical head 19 undergoing the tracking control and focus control on the basis of the detected return light, the detected return light is sequentially processed through the DVD signal processor 14, header information processor 7 and compress/expand block 6 to read video data composed of moving pictures. More particularly, a read signal being a result

of return light detection and which varies in level correspondingly to pit trains on the optical disk 2 is processed by the analog front end block 16 to produce read data, and the read data is decoded, deinterleaved and error-corrected by the DVD signal processor 14. Also, the error-corrected read data is supplied to the header information processor 7 where the header is removed from the data and the CPU 4 is informed of the header. Further, the read signal is supplied to the compress/expand block 6 and broken by the multiplexer 10 into video and audio data. The video data is released by the video processor 8 from the MPEG-compressed state and displayed on the monitor 12 or supplied to an external apparatus via the video/audio encoder 13. On the other hand, the audio data is expanded by the audio processor 11 and then supplied to the monitor 12 for monitoring or supplied to the external apparatus via the video/audio encoder 13.

In case the optical disk 2 is a rewritable virgin disk, however, when the optical disk 2 is loaded into the optical disk drive 1 or when the optical disk drive 1 is turned on, the CPU 4 will access the optical disk 2 to acquire RMA data from the latter. In the optical disk drive 1, when the user selects the moving picture capture mode, the CPU 4 will update the RMA data held in the memory thereof (as shown in FIG. 6) and define, by padding, areas for UDF and VMG and also areas for VTSI of VTS.

When the user instructs to start the recording in this condition, video and audio data are sequentially supplied from the video input block 3 and audio input

block 5 and the video data is compressed by the video processor 8 with the MPEG technique while the audio data is compressed by the audio processor 11. Further, the video and audio data thus compressed are multiplexed by the multiplexer 10 and then the multiplexed data has a header added thereto by the header information processor 7. In the DVD signal processor 14 provided downstream, the multiplexed data has an error correction code added thereto, and undergoes interleaving and encoding. According to the result of this data processing, the analog front end block 16 will set an amount of laser beam emitted from the optical head 19 to the optical disk 2. Thus, pits are sequentially formed on the optical disk 2 to sequentially record moving video data composed of moving pictures.

In the optical disk drive 1, when the user instructs to stop the recording, a series of operations in the compress/expand block 6 and the like is stopped by the CPU 4 to cease the recording of the video data and then the management information for the moving picture file thus recorded is recorded to the optical disk 2. Namely, in the optical disk recorder/player 100, the system controller 10 will generate management information from the address, file size, recording date and time, etc. of the moving picture data, and supply the management information to the DVD signal processor 14 and record it to the optical disk 2 so that the management information will be recorded next to the video data, whereby VTSI BUP area is defined. Then, areas for VTSI and VTSM VOBS of a next VTS are defined by padding, and the optical head 19 is caused to seek for the existing VTSI

and VTSM VOBS. Similar management information is supplied to the DVD signal processor 14 and recorded to the optical disk 2 to define the intended VTSI and VTSM VOBS areas.

In the optical disk drive 1, video data composed of moving pictures is recorded for one title. Thus, in the optical disk drive 1, for recording a moving picture file, management information and the file are recorded in the DVD video format in which management information composed of VTSI, management information composed of VTSM VOBS, moving picture file and management information composed of VTSI BUP are laid successively. When the user then instructs to record moving pictures, the optical disk drive 1 will repeat the similar operations to sequentially record titles to the optical disk 2.

Upon completion of recording moving pictures for one title as above, addresses indicative of the top and bottom addresses of the titles are recorded to the management table in the inner-circumferential RMA area of the optical disk 2.

In case an optical disk having such titles sequentially recorded therein as above and not yet finalized is loaded into the optical disk drive 1, the management table is acquired, the management information having been recorded in combination with the titles are sequentially acquired by scanning the optical disk 2 according to the management table, and are held in the memory built in the CPU 4.

Further, a moving picture file the user has instructed to read is read on the basis of the management information thus acquired.

In the optical disk drive 1, when titles are recorded to the optical disk 2 as above and the user instructs to finalize the optical disk 2, UDF and VMG data are generated according to the management information recorded in combination with the titles in the memory of the CPU 4 on the basis of the record in the management table and recorded to the inner-circumferential area defined on the optical disk 2, and also the lead-in and lead-out zones are defined. Thus, this optical disk can be set up for reproduction by a DVD player which supports only the ordinary DVD format.

On the other hand, in case the user has selected the still picture recording mode, UDF and VMG areas will be defined in a virgin disk as in the recording of moving pictures. Also, in the optical disk drive, the mode of operation of the imaging means is switched to the still picture mode and the operation mode of the compress/expand block 6 is switched to the operation mode for a JPEG-based data compression.

When the user instructs to start the recording of still pictures in this condition, video data composed of still pictures supplied from the video input block 3 are compressed by the video processor 8 of the compress/expand block 6 into the JPEG format. Thus, in the optical disk drive 1, the still pictures-composed video data, not any moving pictures-composed video data, are provided for recording and sequentially recorded to the optical disk 2 as in the recording of the moving pictures.

In this optical disk drive 1, for recording moving pictures, areas for VTSI and VTSM VOBS are initially defined for recording real data, but for recording still pictures, real data composed of the still pictures are recorded back at the top of areas reserved by padding. Namely, for recording still pictures, it is not necessary to reserve areas such VTSI and VTSM VOBS. Also, when the user instructs to record still pictures, subsequent still pictures are recorded to the optical disk 2 as above. At each recording, the address of each file is recorded to the memory of the CPU 4.

In the optical disk drive 1, when the recording of still pictures is stopped by the user changing the mode of operation or otherwise with a desired number of still picture files having been recorded to the optical disk, the management information composed of addresses etc. held in the memory is recorded, as provisional intermediate management information intended for use until the finalization, in successive areas for the plurality of still picture files. Thus in the optical disk drive 1, for recording other files than any moving picture file, the files and management information for them will be recorded in the order of a file and management information, and a format for recording the files and management information is selected depending upon the attribute of the files to be recorded.

As above, the optical disk drive 1 can also record still picture files not defined in the DVD video format to the optical disk 2. Also, when the optical disk having the still picture files thus recorded therein is loaded into an optical disk

drive which supports only the DVD video format, the management information having been recorded according to the DVD video format such as VTSI or the like is detected through a search made at the time of disk loading, and VTS is read based on the management information. Thus, the still picture files thus recorded and management information for the files will not possibly influence the reading of any moving pictures. Therefore, any ordinary DVD player can read a moving picture file from the optical disk 2 having the moving picture file thus recorded therein.

In the optical disk drive 1, such intermediate management information DK (as shown in FIG. 6) will collectively be laid for a plurality of files recorded successively and the management information CI providing a total control be recorded. After that, individual information EXF including a top address of each file and a file name will be recorded, and the top address of the intermediate management information DK be recorded as extension-file guide information TE to a fixed area along the inner circumference of the optical disk 2. Further, the address of the extension-file guide information TE will be recorded to the management table TV.

Thus, an optical disk drive which also supports other than the moving picture files can read still picture files. That is, in the optical disk drive 1 having the aforementioned optical disk 2 loaded therein, the optical disk 2 will be searched with reference to the management table to read VTS and VTSM VOBS data as

well as the intermediate management information DK for the still picture files from the optical disk 2, and the management information DK be also held in the memory of the CPU 4.

Thus, the moving and still picture titles recorded in the optical disk 2 under the user's instruction can be provided to the user. Also, when the user instructs to read moving pictures, the optical disk drive 1 can read the moving picture files on the basis of the VTS and VTSM VOBS data as having been described concerning the read-only optical disk.

On the other hand, when the user instructs to read a still picture file, the address etc. of the file will be detected on the basis of the intermediate management information DK held in the memory of the CPU 4, data recorded in the optical disk 2 be sequentially read according to the result of detection, and processed through the operations similar to those in reading the moving pictures. In the optical disk drive 1, to process the read data including the still pictures in processing of the read data, the operation of the video processor 8 is changed by the CPU 4 to expand the video data having been compressed according to the JPEG, and video data including the still pictures is monitored on the monitor 12 and further can be supplied from the video/audio encoder 13 to an external apparatus.

Generally, the still picture file is smaller in size than the moving picture file. In the optical disk drive 1, however, intermediate management information as

such management information is generated and recorded for a plurality of files as shown in FIG. 6. Thus in the optical disk drive 1, since an extension file composed of such still picture files or the like is recorded, it is possible to minimize the reduction of recording areas due to the recording of management files.

Also, the intermediate management information for a plurality of files is collectively recorded for each file type being the attribute of a file, whereby the operations for search and finalization (which will be described in detail later) can be simplified.

Especially, since addresses of such intermediate management information DK vary due to recording of various types of files, it is possible that the intermediate management information will be recorded for each of many files. The variation in addresses of the intermediate management information can be accommodated by recording the management table for them, but in case each extension file is to be recorded with only the management table provided for the extension file as in recording of moving picture files, however, if many extension files are recorded to the optical disk, so many management tables cannot be provided for the extension files. In this embodiment, however, since the guide information TE for extension files are managed by the management table and the management information CI for collectively managing successively recorded extension files is managed by the extension-file guide information TE, such an

irregularity of addresses and recording of many files can be accommodated simultaneously.

Also, since the address (guide information) TE of the intermediate management information DK is recorded in such a management table, an extension file can be accessed simply and quickly by accessing the optical disk 2 with reference to the address information TE. Also, by utilizing the management table TV for moving picture files as above, it is possible to prevent the information recording area from being consumed due to separate generation of such a kind of table for each extension file, and thus to use the information recording area correspondingly more effectively.

In the optical disk drive 1, such extension files are recorded each in combination with intermediate management information DK1 for the file. Thus, in case any new intermediate management information DK is to be recorded, existent intermediate management information DK in the optical disk 2 will be updated in combination with the new one as will be known from FIG. 7. Also, by updating the last intermediate management information DK1 in combination as above, any extension file is updated or deleted. Thus, in the optical disk drive 1, even if multiple extension files are discretely recorded, an extension file in consideration can be accessed by acquiring the intermediate management information in one place, which also enables the optical disk drive 1 to access the optical disk 2 quickly.

With the above operations, the optical disk drive 1 is operated by the user to sequentially record moving and still picture files to a so-called virgin disk, an optical disk having only moving pictures recorded therein but not yet finalized and an optical disk having moving and still picture files recorded therein but not yet finalized.

On the other hand, when the user instructs to finalize any of the above optical disks having moving and still pictures recorded therein as above, UDF data for a computer is generated based on the management information and intermediate management information, acquired from the optical disk with reference to the management table and held in the memory of the CPU 4, as well as on the management information and intermediate management information generated by recording moving and still pictures and held in the memory, and the UDF data is recorded to a pre-defined area on the optical disk 2. Also, VMG data for a DVD player is generated according to only the management information for the moving picture file, and similarly recorded to the optical disk 2.

Thus in the optical disk drive 1, management information for all files recorded on the optical disk 2 will be recorded collectively in combination with the files to the UDF area for recording the first management information, of the management information recording area on the optical disk 2, while management information for only a moving picture file having a specific attribute, recorded in the optical disk 2, will be recorded in combination with the moving picture file to

the VMG area intended for a DVD to record the second management information.

Thus, when the optical disk 2 finalized as above is reproduced by a DVD player, files recorded in the optical disk 2 will be read with reference to the DVD-oriented VMG area, whereby it is possible to positively read the DVD video-formatted moving pictures without being influenced by recording of the files such as still picture files.

When reproducing such a finalized optical disk by a computer, since the UDF is defined in a file management format corresponding to the file management system of the computer and the computer will read each file based on the UDF, it is possible to read the moving picture file as well as the still picture file.

Thus, in the optical disk drive 1 capable of recording, to the optical disk 2, still picture files in addition to moving picture files, the individual information EXF being management information for each extension file is grouped according to the management information CI and the top address of the management information CI is recorded in the extension-file guide information TE. In the optical disk drive 1, there is included in the guide information TE identification codes CAT ID indicating the extension file types collectively managed under the management information CI and also the recording format information CAT INFO TYPE for corresponding individual information EXF separately from the identification codes CAT ID.

Thus, for recording a file formed from GIF, bit map or the like, for example,

other than any JPEG-formatted still picture file to the optical disk 2, the user can record such various types of files to the optical disk 2 by setting individual management information EXF and recording format CAT INFO TYPE the same as for still picture files and changing only the identification code CAT ID indicating the extension file type. Also, by generating UDF by finalization, it is possible for a computer to access a file recorded as above. Thus, in this embodiment, it is possible to record other files than moving picture files to the optical disk 2 with a sufficient extension of the recording ability of the latter.

The optical disk drive 1 constructed as having been described in the foregoing allows to access individual management information via extension tile guide information and record a file of still pictures other than moving pictures to the optical disk with a sufficient extension of the recording ability by allocating an identification code indicating the type of an extension file in consideration and recording format of the management information to the extension-file guide information.

Also, the address of the guide information for an extension file by which the address of the management information for the extension files can be identified is set in an inner-circumferential area on an optical disk where a first file starts being recorded, whereby it is made possible to record also the guide information in a fixed area. Thus, the extension-file guide information can be accessed independently of the management table to identify the address of the management

information as well, which leads to an effective utilization of the information recording area and thus a quick search over the recording area on the optical disk.

For recording management information for an extension file additionally recorded, management information for existing extension files are collectively recorded and the guide information for the extension files are updated correspondingly to the recording of the additional extension file and corresponding management information. Thus, by reading one management information piece, it is possible to identify the addresses of all the extension files recorded in the optical disk, and accordingly, the optical disk 2 can be prevented from being accessed frequently.

By reading files having respective attributes recorded on the optical disk on the basis of thus recorded management information other than that of moving pictures, it is possible to read and utilize the files other than that of moving pictures.

Also, by collectively recording management information in combination with all files recorded in the optical disk to the first management information recording area and management information in combination with only files having a specific attribute to the second management information recording area, it is possible to read the moving picture file by some ordinary DVD players and all the files of moving and still pictures by some computers.

Other embodiments of the optical disk drive according to the present

invention are explained thereafter.

FIGS. 14 and 15 explain together the recording of intermediate management information concerning the aforementioned embodiment with reference to FIGS. 7 and 8. In this embodiment of the optical disk drive, guide information TE for extension files is recorded along with intermediate management information DK for the file at the end of a last recorded extension file. It is important to note that this embodiment of the optical disk drive is constructed identically to the optical disk drive 1 according to the embodiment having been described in the foregoing except for the handling of the extension-file guide information TE. Therefore, the same aspects of this embodiment as those of the optical disk drive 1 will not be described any longer.

As shown in FIG. 14A, the microcomputer in this optical disk drive records extension files EF1, EF2 and EF3, then records guide information TE for the extension files, and further records intermediate management information DK composed of management information CI and individual information EXF1 to EXF3. Also, the microcomputer will record the top address of the guide information TE thus recorded to the management table TV.

Also, to update or delete the extension files EF1, EF2 and EF3 thus recorded, the individual information EXF1 to EXF3 are updated by deleting the corresponding individual information EXF1 to EXF3 themselves, setting invalid flags indicating that the files in consideration have been deleted or by processing

otherwise, as shown in FIGS. 14B to 14D. Also, the individual information EXF1 to EXF3 are updated by overwriting the guide information TE and intermediate management information DK together. It should be noted that for real updating of the record in the optical disk 2, the operations to be done with the use of the memory of the microcomputer and at ejection of the optical disk 2 are the same as those in the first embodiment.

On the other hand, when recording a new intermediate management information DK1 correspondingly to the recording of additional extension files, the existent intermediate management information DK are combined together to generate management information CI and corresponding guide information TE, and they are sequentially recorded next to the extension files, as shown in FIGS. 15A and 15B. Also, the record in the management table TV is updated correspondingly to the above recording. Further, all the extension files recorded in the optical disk 2 are deleted or updated by updating the last recorded intermediate management information DK1.

By setting an address of extension-file guide information in an area next to the last recorded extension file in the optical disk as in this embodiment, the same effect as in the first embodiment can be assured even if the extension-file guide information varies.

The present invention is also applicable as an external storage for a personal computer. In this embodiment, various files other than still picture files, such as

the moving picture file defined in a different format from that of VTS, text file, map data, are applied as the above-mentioned extension files and recorded to the optical disk 2 as in the aforementioned first or second embodiment, and also the optical disk 2 is finalized.

Correspondingly, intermediate management information DK is combined with the management information CI and corresponding individual information EXF for each of the types of files recorded in the optical disk 2, and in the guide information TE, there are provided a plurality of category information search pointer tables (CAT INFO SRPT) next to a temporary information management table (TMP EXTI MAT) correspondingly to the above combinations.

Even in case other files than the still picture images are applied as the extension files as in this third embodiment, the similar effect to that in the embodiments described above can be assured.

Note that in the respective aforementioned embodiments, the guide information for extension files is used as provisional information until finalization of the optical disk, but the present invention is not limited to any of these embodiments aspect. Namely, the optical disk drive may be designed for use the guide information after the finalization as well.

The present invention has been described concerning the respective aforementioned embodiments thereof in which a series of operations is done according to a recording or reproducing program pre-installed to the optical disk

drive, but it is not limited to these embodiments. That is, the present invention can widely be applied to making such a series of operations according to a program downloaded via a network such as the Internet or a program provided via a variety of recording media. Also it should be noted that the recording medium may be an magnetic disk, optical disk, a magnetic tape or the like.

Also the present invention has been described concerning the respective aforementioned embodiments thereof applied to an optical disk drive having an imaging function and an optical disk drive which is an external storage unit of a computer, but it is not limited to these embodiments. Namely, the present invention can also be applied to performance of the above recording and reproducing operations under an application program for a computer.

Further, the present invention can also be applied to a recording/reproducing apparatus using other recording medium as well as a recording apparatus using an optical disk.

While the invention has been described in accordance with certain preferred embodiments thereof illustrated in the accompanying drawings and described in the above description in detail, it should be understood by those ordinarily skilled in the art that the invention is not limited to the embodiments, but various modifications, alternative constructions or equivalents can be implemented without departing from the scope and spirit of the present invention as set forth and defined by the appended claims.

Industrial Applicability

As having been described in the foregoing, the present invention provides an optical disk drive in which individual management information can be accessed via guide information for a extension file and an identification code indicative of the type of an extension file in consideration and recording format of the management information are allocated to the extension-file guide information to extend the disk recordability sufficiently for recording also a file of still pictures other than moving pictures.

Claims

1 A file recording apparatus, comprising:

a file recording means for managing a program area of a recording medium according to a management table recorded in a predetermined area on the recording medium and recording a desired file to the program area;

wherein, the file is a moving picture file formatted for reproduction by a dedicated reproducing apparatus for the recording medium, it being recorded in combination with management information for the moving picture file to a program area, while the address of the management information is recorded to the management table, or

when the file is an extension file other than a moving picture file formatted to be readable by a dedicated reproducing apparatus for the recording medium, it being recorded in combination with individual management information for the extension file to the program area;

guide information for the extension file, including at least the address of the individual management information, being recorded to the recording medium;

the address of the extension-file guide information being recorded to the management table; and

an identification code indicative of an extension file type in the corresponding individual management information and recording format in the management information being allocated to the extension-file guide information.

2 The apparatus as set forth in claim 1, wherein a plurality of pieces of the individual management information which are identical in extension-file identification code and recording format to each other is allocated to one of the extension-file guide information.

3 The apparatus as set forth in claim 1, wherein the extension-file guide information is recorded in an inner-circumferential area of the recording medium at a start address of the first file.

4 The apparatus as set forth in claim 1, wherein the extension-file guide information is recorded in an area next to the last extension-file guide information recorded in the recording medium.

5 The apparatus as set forth in claim 1, wherein the management table is recorded in an inner-circumferential area of the lead-in zone defined by finalization.

6 The apparatus as set forth in claim 1, wherein:

when the file is the moving picture file, the file and the management information are recorded so that the management information for the file, moving picture file and backup information for the management information to successively be laid; and

when the file is the extension file, the file and the management information for the file are recorded for the extension file and corresponding management information to successively be laid.

7 The apparatus as set forth in claim 1, wherein when the file is a moving picture file, the file and the management information for the file are set for recording in the DVD video format.

8 The apparatus as set forth in claim 1, wherein:

when recording individual management information for an additionally recorded extension file, the individual management information for the existent extent files is collectively recorded following the additionally recorded extension file; and

the guide information for the extension file and the management table are updated correspondingly to the collective recording of the management information.

9 The apparatus as set forth in claim 1, comprising a reproducing means for reading the extension file recorded in the recording medium on the basis of the extension-file guide information and individual management information.

10 The apparatus as set forth in claim 1, wherein on the basis of the management table:

the management information for all the files recorded in the recording medium is collectively recorded to a first management information recording area of the management information recording area on the recording medium; and

the management information for only the moving picture file recorded in the recording medium is collectively recorded to a second management information

recording area of the management information recording area.

11 The apparatus as set forth in claim 10, wherein:

the first management information recording area corresponds to the file management system of a computer; and

the second management information recording area corresponds to the file management system for the DVD video format.

12 A file recording method, comprising the steps of:

managing a program area of a recording medium according to a management table recorded in a predetermined area on the recording medium; and
recording a desired file to the program area,

wherein the file is a moving picture file formatted for reproduction by a dedicated reproducing apparatus for the recording medium, it being recorded in combination with management information for the moving picture file to a program area, while the address of the management information is recorded to the management table, or

when the file is an extension file other than a moving picture file formatted to be readable by a dedicated reproducing apparatus for the recording medium, it being recorded in combination with individual management information for the extension file to the program area;

guide information for the extension file, including at least the address of the individual management information, being recorded to the recording medium;

the address of the extension-file guide information being recorded to the management table; and

an identification code indicative of an extension file type in the corresponding individual management information and recording format in the management information being allocated to the extension-file guide information.

13 The method as set forth in claim 12, wherein a plurality of pieces of the individual management information which are identical in extension-file identification code and recording format to each other is allocated to one of the extension-file guide information.

14 The method as set forth in claim 12, wherein the extension-file guide information is recorded in an inner-circumferential area of the recording medium at a start address of the first file.

15 The method as set forth in claim 12, wherein the extension-file guide information is recorded in an area next to the last extension-file guide information recorded in the recording medium.

16 The method as set forth in claim 12, wherein the management table is recorded in an inner-circumferential area of the lead-in zone defined by finalization.

17 The method as set forth in claim 12, wherein:

when the file is the moving picture file, the file and the management information are recorded so that the management information for the file, moving

picture file and backup information for the management information to successively be laid; and

when the file is the extension file, the file and the management information for the file are recorded for the extension file and corresponding management information to successively be laid.

18 The method as set forth in claim 12, wherein when the file is a moving picture file, the file and the management information for the file are set for recording in the DVD video format.

19 The method as set forth in claim 12, wherein:

when recording individual management information for an additionally recorded extension file, the individual management information for the existent extent files is collectively recorded following the additionally recorded extension file; and

the guide information for the extension file and the management table are updated correspondingly to the collective recording of the management information.

20 The method as set forth in claim 12, wherein on the basis of the management table:

the management information for all the files recorded in the recording medium is collectively recorded to a first management information recording area of the management information recording area on the recording medium; and

the management information for only the moving picture file recorded in the recording medium is collectively recorded to a second management information recording area of the management information recording area.

21 The method as set forth in claim 20, wherein:

the first management information recording area corresponds to the file management system of a computer; and

the second management information recording area corresponds to the file management system for the DVD video format.

22 A program for recording a file on a recording medium, comprising:

program code for managing a program area of the recording medium according to a management table recorded in a predetermined area on the recording medium; and

program code for recording a desired file to the program area;

wherein, the file is a moving picture file formatted for reproduction by a dedicated reproducing apparatus for the recording medium, it being recorded in combination with management information for the moving picture file to a program area, while the address of the management information is recorded to the management table, or

when the file is an extension file other than a moving picture file formatted to be readable by a dedicated reproducing apparatus for the recording medium, it being recorded in combination with individual management information for the

extension file to the program area;

guide information for the extension file, including at least the address of the individual management information, being recorded to the recording medium;

the address of the extension-file guide information being recorded to the management table; and

an identification code indicative of an extension file type in the corresponding individual management information and recording format in the management information being allocated to the extension-file guide information.

23 The program as set forth in claim 22, wherein a plurality of pieces of the individual management information which are identical in extension-file identification code and recording format to each other is allocated to one of the extension-file guide information.

24 The program as set forth in claim 22, wherein on the basis of the management table:

the management information for all the files recorded in the recording medium is collectively recorded to a first management information recording area of the management information recording area on the recording medium; and

the management information for only the moving picture file recorded in the recording medium is collectively recorded to a second management information recording area of the management information recording area.

25 The program as set forth in claim 24, wherein:

the first management information recording area corresponds to the file management system of a computer; and

the second management information recording area corresponds to the file management system for the DVD video format.

26 A recording medium having a program code recorded in said medium, said program code comprising:

program code for managing a program area of a data recording medium according to a management table recorded in a predetermined area on the data recording medium; and

program code for recording a desired file to the program area;

wherein the file is a moving picture file formatted for reproduction by a dedicated reproducing apparatus for the data recording medium, it is recorded in combination with management information for the moving picture file to a program area, while the address of the management information is recorded to the management table, or

when the file is an extension file other than a moving picture file formatted to be readable by a dedicated reproducing apparatus for the data recording medium, it is recorded in combination with individual management information for the extension file to the program area;

guide information for the extension file, including at least the address of the individual management information, is recorded to the data recording medium;

the address of the extension-file guide information being recorded to the management table; and

an identification code indicative of an extension file type in the corresponding individual management information and recording format in the management information are allocated to the extension-file guide information.

27 The recording medium as set forth in claim 26, wherein the program is arranged such that a plurality of pieces of the individual management information which are identical in extension-file identification code and recording format to each other is allocated to one of the extension-file guide information.

28 The recording medium as set forth in claim 26, wherein the program is arranged such that on the basis of the management table:

the management information for all the files recorded in the data recording medium is collectively recorded to a first management information recording area of the management information recording area on the data recording medium; and

the management information for only the moving picture file recorded in the data recording medium is collectively recorded to a second management information recording area of the management information recording area.

29 The recording medium as set forth in claim 28, wherein the program is arranged such that the first management information recording area corresponds to the file management system of a computer; and

the second management information recording area corresponds to the file

management system for the DVD video format.