Description

The present invention relates to an apparatus for recording information on a magneto-optical disk and is directed more particularly to an optical recording apparatus using an erasable and rewritable optical disk.

To know what is stored on an optical disk, such disks normally comprise a so-called table of content (TOC). A CD having such a TOC is described e. g. in EP-A-0 169 597. A similar CD, for reproduction only, will now be described with reference to Fig. 6 and then possible recording functions of a rewritable disk will be discussed referring to Fig. 3 to 5.

In the compact disc for reproduction only, the TOC region is allocated inside the data region for recording information signals. The TOC region for the CD is arranged as shown in Fig. 6. In Fig. 6, a time at POINT 01 indicates the starting time of the first music, "01" at POINT A0 indicates that the number of the first music is "1", "06" at POINT A1 indicates that the number of the last music is "6", and "65" at POINT A2 indicates that the starting time of the read-out is 65 minutes, respectively. These same values are repeatedly recorded three times on the TOC region for not only improving accuracy but also preventing errors and unreadable conditions from occurring, upon reading information by the optical pickup, due to scratches, dust or the like on the TOC region.

Next, explanation is made, with reference to Figs. 3 to 5, to a procedure of rewriting a time information signal in the TOC region corresponding to the end of a rewritten portion when re-recording has been carried out in the data region by the optical pickup, assuming that music signals are written in the first region, namely the data region.

Let it now be assumed that first to third music information signals are recorded on a new erasable optical disc with no recording as shown in Fig. 3A. Then, the TOC information as shown in Fig. 4 is recorded in the TOC region of its optical disc on the basis of the information signals recorded in the data region. To be more specific, as to the first music, the music number is recorded in a POINT column as "01", and the frame number thereof is n+3. The starting time of the first music is recorded as t_0, and the terminating time thereof as t_1. As to the second music, its music number is recorded in the POINT column as "02", and the frame number at this time is n+6. The starting time of the second music is recorded as t_1 and the terminating time thereof as t_2. As to the third music, its music number is recorded in the POINT column as "03" and the frame number at this time is n+9. The starting time of the third music is recorded as t_2 and the terminating time as t_3. When the recording opration has been terminated, the final recording terminating point is recorded as A3 in the POINT column corresponding to the frame number n. Next, a time corresponding to the final recording terminating point, that is, the terminating time t_3 of the third music is recorded in the starting time column corresponding to the frame number n. In Fig. 3A, a time period from an absolute time t_S at the read-in to the beginning time t_0 of the first music corresponds to the region in which the TOC information should be recorded, and a time period between the terminating time t_3 of the third music and an absolute time t_E at the read-out corresponds to the unrecorded portion.

Fig. 3B shows that two music signals or first and second musics are newly recorded from the head of the data region with the previously recorded music signals remaining as shown in Fig. 3A. At this time, the TOC information as shown in Fig. 4 is rewritten to the TOC information as shown in Fig. 5. Specifically, the terminating time of the first music is rewritten from t_1 to t_1', the starting time of the second music from t_1 to t_1', the terminating time of the second music from t_2 to t_2', and the time corresponding to the final recording terminating point from t_3 to t_2', repectively. At the time the rewriting has been carried out, the time corresponding to the final recording terminating point is not the terminating time of the third music information signal but that of the newly recorded second music information signal. A part of the firstly recorded second music information signal still remains in the portion corresponding to the period between the times t_2' and t_2.

When another music signal, for example, is to be recorded subsequent to the end of the newly recorded second music information signal, if the time corresponding to the final recording terminating point is not rewritten from t_3 to t_2', the next recording begins from t_3, so that the portion corresponding to the period between the times t_2' and t_2 remains without being rewritten, whereby the data region cannot be effectively utilized, leading to an uneconomic disadvantage.

Assume that a so-called automatic music sensor (AMS), which can search for the head of each music information signal, is employed for the above described rewriting operation in which two new music information signals have already been written over the previously recorded first and second music information signals and a third music information signal is to be newly recorded. The AMS can search for the head of the previously recorded third music information signal. However, if the new third music information signal is recorded from the head of the previously recorded third

music information signal, the portion corresponding to the period between the times t_2' and t_2 still remains without being rewritten.

There is also a technique for searching for the beginning of an unrecorded portion which is effective for the first recording (in the case of Fig. 3A). However, the portion corresponding to the period between the times t_2' and t_2 remains after a second rewriting operation and the following, arising the same problem as the AMS technique.

In view of the problems mentioned above, it is the object of the present invention to provide an optical recording apparatus which is capable of quickly accessing a location subsequent to the previously recorded portion to thereby sequentially record information signals.

To achieve the above object, the apparatus of the present invention comprises the following features to cooperate with a disk having a first recording region (data region) in which first information signals are recorded and having a second recording region (TOC) in which second information signals are recorded:

- an optical pickup freely arranged freely movable in the radial direction of the optical disk, and
- a control means for controlling operating conditions of said optical pickup in such a way, that when part of said first information signals is overwritten with new first information signals, second information signals recorded in a predetermined area of said second recording region (TOC) and indicating the terminating point of the last recorded first information signals is also overwritten.

As the apparatus of the present invention records the just mentioned second information on each disk, the apparatus can recognize, when such a disk is introduced again into the apparatus, where the last recording was terminated, to start the new recording of first information signals from the terminating point of the recent record.

These and other objects, features, and advantages of the present inventions will become apparent from the following detailed description of a preferred embodiment taken in conjunction with the accompanying drawings, throughout which like reference numerals designate like elements and parts.

Fig. 1 is a circuit block diagram showing a whole arrangement of an embodiment of an optical recording and/or reproducing according to the present invention;

Fig. 2 is a flowchart used for explaining the re-recording operation carried out by the apparatus shown in Fig. 1;

Figs. 3A and 3B are diagrams showing how information signals are recorded on an optical disc;

Figs. 4 and 5 are tables showing how the TOC information is written into the TOC region;

Fig. 6 is a table showing an example of a construction of the TOC information for a CD; and

Fig. 7 is a table showing an example of a construction of the TOC information for an erasable optical disc.

An embodiment of the present invention will hereinafter be described with reference to Figs. 1, 2 and 7.

The present invention provides an arrangement of the TOC region for the erasable optical disc as shown in Fig. 7, with reference to the TOC region for the CD. In the present embodiment, the second recording region, that is, the TOC region is allocated inside the first recording region, that is, the data region in the same manner as that of the CD. In Fig. 7, values 01, 02. .... in a POINT column indicate the number of respective musics, the beginning (starting time) and the end (terminating time) of which are respectively indicated by minute, second and frame. The TOC region for the erasable optical disc is rewritten every time an information signal is newly written, corresponding to the newly written information signal (in the case of recording a music information signal the number of the music and its time).

Referring to the above explanation in relation to Fig. 3B, it has to be noted, that if the time corresponding to the final recording terminating point is rewritten from t_3 to t_2' upon rewriting information signals as mentioned above, the next recording with an apparatus of the present invention begins from t_2' so that the data recording portion corresponding to the period between the time t_2' and t_2 is also rewritten, with the result that the recording medium can be effectively utilized.

Fig. 1 shows a circuit arrangement of an embodiment according to the present invention in which the present invention is adapted to an apparatus for recording and reproducing a magneto-optical disc. However, it is no saying that the present invention is limited to this embodiment and could not be adapted to phase-change type apparatus for recording and/or reproducing other erasable optical discs.

The system for recording information signals on a magneto-optical disc can be roughly classified into two, that is, one is a light modulating system in which a laser light source of an optical pickup is supplied with a modulating signal on the basis of a desired information signal to be recorded, a magneto-optical disc is intermittently irradiated with the light emitted from the laser light source to thereby record the desired information signal thereon by inverting the magnetizing direction of the recording medium, and the other is a magnetic

d modulating system in which while a recording medium is irradiated with a light beam emitted from a laser light source of an optical pickup at a constant output level, simultaneously a magnetic field generating device is supplied with a modulating signal on the basis of a desired information signal to be recorded to invert the direction of the magnetic field from the magnetic field generating device on the basis of the information signal, to thereby invert the magnetizing direction of the recording medium.

The light modulating system requires to firstly erase previously recorded information signals on a recording medium before newly recording information signals, while the magnetic field modulating system does not need the erasure operation and permits new information signal to be overwritten. The present embodiment employs the magnetic field modulating system which permits overwritting, wever, the light modulating system may be of course employed.

In Fig. 1, an input terminal 1 is fed with an analog information signal, for example an audio signal, which is analog-to-digital (A/D) converted by an A/D converter 2 and then supplied to a signal processing circuit 3. Further, another input terminal 4 is provided for supplying digital signals converted from analog audio signals or other analog information signals directly to the signal processing circuit 3. The signal processing circuit 3, after carrying out predetermined signal processings, supplies its output signal to an encoder 5 wherein the signal is encoded and then supplied to a megnetic field generating device 6. Thus, the direction of the magnetic field generated from the magnetic field generating device 6 is modulated by the output signal from the encoder 5 to be applied to an optical recording medium, specifically a perpendicular magnetization layer of an optical disc 7.

The magnetic field generating device 6 is transported by a transporting mechanism, not shown, in synchronism with the movement of an optical pickup 8 which is transported in the radial direction of the optic disc 7 by an optical pickup transporting mechanism, not shown, so as to move always facing the optical pickup 8 through the optical disc 7. Otherwise, the magnetic field generating device 6 may be formed to have the same length as the radial length of a signal recording section of the optical disc 7, wherein the above-mentioned transporting mechanism of the magnetic field generating device 6 can be removed.

In the condition as mentioned above, the light beam emitted from the laser light source of the optical pickup 8 is irradiated on the perpendicular magnetization layer of the optical disc 7 to locally elevate the temperature thereof, the magnetizing direction of a location on which the light beam is irradiated is inverted in accordance with the direction of the magnetic field which is generated from the magnetic field generating device 6 and modulated by the output signal from the encoder 5. The intensity of the magnetic field necessary for recording corresponds to the magnetic resistivity of the magnetization layer at that temperature. In general, the magnetic resistivity becomes smaller as the temperature is increased. Thus, even if the magnetic resistivity shows a large value at a room temperature, the magnetic resistiviy of only an area whose temperature is increased becomes smaller. It is therefore possible to invert the magnetizing direction of the magnetization layer even with a weak magnetic field, thereby enabling the recording on the magneto-optical disc.

By utilizing the fact that the light is an electromagnetic wave, the reproduction of the optical disc is carried out as follows. That is, when a light beam emitted from the laser light source of the optical pickup 8 is reflected on the magnetization layer, since the polarized phases of the light beam are rotated in the opposite direction to each other dependent on the magnetizing direction of the magnetization layer due to the Kerr effect, a light detector arranged in the optical pickup 8 converts the same into the intensity of the light, thereby carrying out the reprodution.

The signal reproduced by the optical pickup 8 is supplied through an RF amplifier 9 to a decoder 10 to be decoded. The output signal from the decoder 10 is supplied to a signal processing circuit 11 wherein necessary signal processing such as error detection, an error correction and so on is effected on the signal. The signal subjected to the signal processing is next supplied to a D/A converter 12 to be digital-to-analog converted and then derived at an output terminal 13 as a desired analog audio signal. Another terminal 14 is provided for directly deriving the digital signal from the signal processing circuit 11 without D/A conversion.

A microcomputer 15 is provided for controlling operations of a driving device, not shown, of the optical disc 7, a servo circuit 16, the magnetic field generating device 6 and so on in response to one of operating modes (a reproduction mode, recording mode, access mode, and so on) set by an operating section, later referred to. The servo circuit 16 is provided for effecting the focus servo and tracking servo on the objective lens arranged in the optical pickup 8 for focusing the light beam from the laser light source on the magnetization layer. A laser driving circuit 17 is provided for controlling the output level of the laser light source, for example, a laser diode arranged in the optical pickup 8. The output level is made high upon recording and low upon reproduction. The above-mentioned operating section 18 is provided with a plurality of

switches such as a play switch, a record switch, a stop switch and so on for setting an operating mode of the recording and/or reproducing apparatus. A display 19 indicates the time information for each information signal, the number of the same (the music number in the present embodiment) and so on.

Next, the re-recording operation of the embodiment shown in Fig. 1 will be explained with reference to Fig. 2.

A program for the re-recording operation is started at step 1. Next, at step 2, the microcomputer 15 reads out the time information corresponding to the final recording terminating point from the TOC information stored in a built-in RAM in the microcomputer 15 in which the data in the TOC region of the optical disc 7 read by the optical pickup 8 is stored. Then, the optical pickup 8 is transported to the final recording terminating point in the data region on the optical disc 7 by the optical pickup transporting mechanism (not shown) at step 3.

A new information signal is started to be recorded from the final recording terminating point at step 4. Next, the microcomputer 15 determines at step 5 whether or not the recording has been completed. If the answer is NO, that is, if the recording is not completed, the program repeats the step 5 until the recording is completed. When the recording has been completed, the program proceeds to step 6 wherein time codes such as the starting time and terminating time of each information signal, for example, each music information signal, the time corresponding to the final recording terminating point and so on are stored in the RAM built in the microcomputer 15.

Next, at step 7, the optical pickup transporting mechanism is driven, under the control of the microcomputer 15, to transport the optical pickup 8 to the direction of the most inner track of the optical disc 7 to access the TOC region. At step 8, on the basis of the time codes stored in the RAM built in the microcomputer 15, the music information in the TOC region, namely TOC information such as the starting time, the terminating time of each music and so on are rewritten by such amounts that they are changed by the information signal re-recorded on the data region. Then, at step 9, the time corresponding to the final recording terminating point of the re-recording is rewritten, followed by the termination of the program at step 10.

As described above, in the present embodiment the time information corresponding to the final recording terminating point is rewritten every time re-recording or recording is completed, so that the final recording terminating point at the previous recording operation can be quickly accessed upon the next recording operation.

Since the present embodiment is adapted to the case of recording music information signals, the time information corresponding to the final recording terminating point is rewritten every time re-recording or recording has been completed. Alternatively, address information may be rewritten in place of the time information, which may be rather appropriate to ordinary information signals other than music information. Therefore, it is not necessarily limited to rewriting the time information, and any other information may be rewritten if it allows the final recording terminating point to be quickly accessed, without departing from the scope of the present invention.

According to the present invention, as described above, information corresponding to the final recording terminating point is rewritten in the second recording region i.e. the TOC region when re-recording has been carried out by the optical pickup in the first recording region i.e. the data region, so that the preceding final recording terminating point can be quickly accessed to newly record information signals subsequent thereto upon the next re-recording.

Further advantageously, since a new information signal is recorded subsequent to the preceding final recording terminating point, there never remains unerased portions, thereby permitting the recording medium to be efficiently utilized.

Claims

1. An apparatus for recording information signals on an optical disk having a first recording region (data region) in which first information signals are recorded and having a second recording region (TOC) in which second information signals are recorded, said apparatus comprising:
   - an optical pickup (8) arranged freely movable in the radial direction of the optical disk (7), and
   - a control means (15 - 18) for controlling operating conditions of said optical pickup (8) such that said information signals may be recorded on the optical disk (7),

   characterized in that said control means is arranged to control the operation of said pickup means in such a way that when part of said first information signals is overwritten with new first information signals, second information signals recorded in a predetermined area of said second recording region (TOC) and

switches such as a play switch, a record switch, a stop switch and so on for setting an operating mode of the recording and/or reproducing apparatus. A display 19 indicates the time information for each information signal, the number of the same (the music number in the present embodiment) and so on.

Next, the re-recording operation of the embodiment shown in Fig. 1 will be explained with reference to Fig. 2.

A program for the re-recording operation is started at step 1. Next, at step 2, the microcomputer 15 reads out the time information corresponding to the final recording terminating point from the TOC information stored in a built-in RAM in the microcomputer 15 in which the data in the TOC region of the optical disc 7 read by the optical pickup 8 is stored. Then, the optical pickup 8 is transported to the final recording terminating point in the data region on the optical disc 7 by the optical pickup transporting mechanism (not shown) at step 3.

A new information signal is started to be recorded from the final recording terminating point at step 4. Next, the microcomputer 15 determines at step 5 whether or not the recording has been completed. If the answer is NO, that is, if the recording is not completed, the program repeats the step 5 until the recording is completed. When the recording has been completed, the program proceeds to step 6 wherein time codes such as the starting time and terminating time of each information signal, for example, each music information signal, the time corresponding to the final recording terminating point and so on are stored in the RAM built in the microcomputer 15.

Next, at step 7, the optical pickup transporting mechanism is driven, under the control of the microcomputer 15, to transport the optical pickup 8 to the direction of the most inner track of the optical disc 7 to access the TOC region. At step 8, on the basis of the time codes stored in the RAM built in the microcomputer 15, the music information in the TOC region, namely TOC information such as the starting time, the terminating time of each music and so on are rewritten by such amounts that they are changed by the information signal re-recorded on the data region. Then, at step 9, the time corresponding to the final recording terminating point of the re-recording is rewritten, followed by the termination of the program at step 10.

As described above, in the present embodiment the time information corresponding to the final recording terminating point is rewritten every time re-recording or recording is completed, so that the final recording terminating point at the previous recording operation can be quickly accessed upon the next recording operation.

Since the present embodiment is adapted to the case of recording music information signals, the time information corresponding to the final recording terminating point is rewritten every time re-recording or recording has been completed. Alternatively, address information may be rewritten in place of the time information, which may be rather appropriate to ordinary information signals other than music information. Therefore, it is not necessarily limited to rewriting the time information, and any other information may be rewritten if it allows the final recording terminating point to be quickly accessed, without departing from the scope of the present invention.

According to the present invention, as described above, information corresponding to the final recording terminating point is rewritten in the second recording region i.e. the TOC region when re-recording has been carried out by the optical pickup in the first recording region i.e. the data region, so that the preceding final recording terminating point can be quickly accessed to newly record information signals subsequent thereto upon the next re-recording.

Further advantageously, since a new information signal is recorded subsequent to the preceding final recording terminating point, there never remains unerased portions, thereby permitting the recording medium to be efficiently utilized.

Claims

1. An apparatus for recording information signals on an optical disk having a first recording region (data region) in which first information signals are recorded and having a second recording region (TOC) in which second information signals are recorded, said apparatus comprising:
   - an optical pickup (8) arranged freely movable in the radial direction of the optical disk (7), and
   - a control means (15 - 18) for controlling operating conditions of said optical pickup (8) such that said information signals may be recorded on the optical disk (7),

   characterized in that said control means is arranged to control the operation of said pickup means in such a way that when part of said first information signals is overwritten with new first information signals, second information signals recorded in a predetermined area of said second recording region (TOC) and

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indicating the terminating point of the last recorded first information signals is also overwritten.

2. An apparatus according to claim 1, **characterized in that** said control means (15 - 18) controls said optical pickup (8) to firstly access to said terminating point information in said second region when first information signals are to be recorded, for to start with a new recording from the accessed last terminating point, if no other starting point information is input via an operating means (18).

3. An apparatus according to one of the claims 1 or 2, **characterized in that** said first record region has an inner and an outer circumference and said second recording region is arranged within said inner circumference.

4. An apparatus according to one of the claims 1 to 3, **characterized in that** said information corresponding to the last recording terminating point is a time information.

5. An apparatus according to one of the claims 1 to 3, **characterized in that** said information corresponding to the last recording terminating point is an address information.

Revendications

1. Appareil pour enregistrer des signaux d'information sur un disque optique comportant une première région d'enregistrement (région de données) dans laquelle des premiers signaux d'information sont enregistrés et comportant une seconde région d'enregistrement (TOC) dans laquelle des seconds signaux d'information sont enregistrés, ledit appareil comprenant :

un lecteur optique (8) agencé de façon à se déplacer librement suivant la direction radiale du disque optique (7) ; et

un moyen de commande (15-18) pour commander des conditions de fonctionnement dudit lecteur optique (8) de telle sorte que lesdits signaus d'information puissent être réécrits sur le disque optique (7),

caractérisé en ce que ledit moyen de commande est agencé de façon à commander le fonctionnement dudit moyen de lecture de telle sorte que, lorsqu'une partie desdits premiers signaux d'information est écrite en superposition avec de nouveaux premiers signaux d'information, des seconds signaux d'infor-mation enregistrés dans une zone prédéterminée de ladite seconde région d'enregistrement (TOC) et indiquant le point de fin des derniers premiers signaux d'information enregistrés soient également écrits en superposition.

2. Appareil selon la revendication 1, caractérisé en ce que ledit moyen de commande (15-18) commande ledit lecteur optique (8) pour accéder tout d'abord à ladite information de point de fin contenue dans ladite seconde région lorsque des premiers signaux d'information doivent être enregistrés, ceci afin de démarrer un nouvel enregistrement à partir du dernier point de fin accédé si aucune information de point de début autre n'est entrée via un moyen de fonctionnement (18).

3. Appareil selon l'une des revendications 1 ou 2, caractérisé en ce que ladite première région d'enregistrement présente une circonférence interne et externe et en ce que ladite seconde région d'enregistrement est agencée à l'intérieur de ladite circonférence interne.

4. Appareil selon l'une des revendications 1 à 3, caractérisé en ce que ladite information qui correspond au dernier point de fin d'enregistrement est une information temporelle.

5. Appareil selon l'une des revendications 1 à 3, caractérisé en ce que ladite information qui correspond au dernier point de fin d'enregistrement est une information d'adresse.

Patentansprüche

1. Gerät zum Aufzeichnen von Informationssignalen auf eine optische Platte mit einem ersten Aufzeichnungsbereich (Datenbereich), in dem erste Informationssignale aufgezeichnet werden, und mit einem zweiten Aufzeichnungsbereich (TOC), in dem zweite Informationssignale aufgezeichnet werden, welches Gerät folgendes aufweist:
   - eine optische Aufnahmeeinheit (8), die in radialer Richtung der optischen Platte (7) frei beweglich ist, und
   - eine Steuereinrichtung (15 - 18) zum Steuern von Betriebsbedingungen der optischen Aufnahmeeinheit (8) in solcher Weise, daß Informationssignale auf die optische Platte (7) aufgezeichnet werden können,

dadurch gekennzeichnet, daß die Steuereinrichtung so ausgebildet ist, daß sie den Betrieb der Aufnahmeeinheit in solcher Weise steuert, daß dann, wenn ein Teil der ersten Informationssignale mit neuen ersten Informationssignalen überschrieben wird, zweite Informa-

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tionssignale, die in einem vorgegebenen Abschnitt des zweiten Aufzeichnungsbereichs (TOC) aufgezeichnet sind und den Endpunkt der zuletzt aufgezeichneten ersten Informationssignale anzeigen, ebenfalls überschrieben werden.

2. Gerät nach Anspruch 1, **dadurch gekennzeichnet,** daß die Steuereinrichtung (15 - 18) die optische Aufnahmeeinheit (8) so steuert, daß diese zuerst auf die genannte Endpunktinformation im zweiten Bereich zugreift, wenn erste Informationssignale aufzuzeichnen sind, um mit einer neuen Aufzeichnung ab dem letzten Endpunkt zu gewinnen, auf den der Zugriff erfolgte, falls keine andere Startpunktinformation über eine Betätigungseinrichtung (18) eingegeben wird.

3. Gerät nach einem der Ansprüche 1 oder 2, **dadurch gekennzeichnet,** daß der erste Aufzeichnungsbereich einen inneren und einen äußeren Umfang aufweist und der zweite Aufzeichnungsbereich innerhalb des inneren Umfangs angeordnet ist.

4. Gerät nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet,** zeichnet, daß die dem letzten Aufzeichnungsendpunkt entsprechende Information Zeitinformation ist.

5. Gerät nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet,** daß die dem letzten Aufzeichnungsendpunkt entsprechende Information Adreßinformation ist.