Method for Reading the Data of a Rotating Recording Medium.

The invention concerns a method for reading the data of a rotating recording medium on which the data are recorded in data tracks, on which the data are divided into blocks and on which, for achieving redundancy, in each case at least two identical blocks are arranged in succession on the data tracks.

Such a method can be provided, for example, in a CD player, in order to read the directory of the rotating recording medium, the so-called compact disk, frequently abbreviated to CD.

Which data are stored on a compact disk and how they are processed by the CD player is described in the article "Zusammenstellen eines CD-Programms" ("Assembling a CD Program") in "Funkschau" No. 15, July 18, 1986, pp 26 through 28.

Every CD contains a directory in which data are stored which provides information about the number of program blocks stored on the disk and their start times, as well as information on the total playback time of the disk. The individual program blocks are normally musical items but they could be, for example, in the form of spoken words or various sound effects for dubbing flims or slides. Up to 99 program blocks can be stored on one CD, but a music CD normally only has 10 to 20 different musical items.

The CD directory has the data format illustrated in Figure 1. The first block A0 carries the title of the first muscial item, the second block A1 that of the final musical

item, and the third block A2 the total playback time of the CD. The start times of the individual n musical items, which are stored on the disk, are carried in the following blocks D1 through Dn. In order to achieve redundancy, several identical blocks are provided. In the example shown in Figure 1, three identical blocks are arranged in succession on the data track in each case. Three blocks A0 are followed by three blocks A1, three blocks A2, three blocks D1, three blocks D2, and so on until, finally, the last three blocks Dn form the end of the directory.

After inserting a CD into a CD player, the CD's directory is read. The data present in the directory are stored in a memory of the CD player. Only after all the necessary directory data has been read and then stored in the aforementioned memory of the CD player can the CD player begin to play back the individual musical items. Therefore, after having inserted a CD into his or her CD player for the purpose of playback, the CD listener must wait until his or her CD player has read the directory and stored the data from this.

The time required by the CD player to do this, usefully called the read-in time, is an important feature in terms of the quality of a CD player.

Therefore, it is the object of the invention to shorten the read-in time of a CD player in order to offer the CD listener greater convenience and also improve the quality of the device.

The invention-type method according to the preamble of claim 1 solves this task in that a reading device, after reading the data of one block, jumps to another track in order to continue reading the data of another block there.

There is shown in

Figure 2 the arrangement of the blocks on the data tracks of a CD for illustrating a first embodiment example;

Figure 3 the arrangement of the blocks on the data tracks of a CD for illustrating a second embodiment example;

Figure 4 the arrangement of the blocks on the data tracks of a CD for illustrating a third embodiment example.

A helical data track of a CD is shown in Figure 1. As is already illustrated in Figure 2, in each case three identical blocks AO, three identical blocks A1, three identical blocks A2, three identical blocks D1, D2, D3, D4,D5, D6 and D7 are arranged in succession on the helical data tracks. Therefore, the CD directory is recorded three times redundantly in these blocks. The individual musical items follow the final block D7.

The optical scanning device of the CD player begins, for example, with the reading of the first block A0 and afterwards jumps one track radially outwards where it meets roughly the center of the second block A2. It now remains on this track in order to read the following third block A2. The optical scanning device now jumps one track outwards to meet the end of the first block D3; the following second block B3 is now read. After this, the optical scanning device jumps one track radially inwards where it meets the start of the first block D1. The optical scanning device continues to scan this track in order to read the second block D1. As another identical block D1 – the third block D1 – follows on the end of the second block D1, the optical

scanning device jumps one track radially inwards where it meets the end of the first block A1. It now reads the following second block A1. As another block A1 follows in this track, the optical scanning device jumps one track radially outwards where it meets roughly the center of the first block D2. The second block D2 is read. As the third block D2 follows, the scanning device jumps one track outwards where it lands roughly in the first third of the third block D5. As another block, the first block D6, follows the third block D5, the scanning device remains on this track in order to read the block D6. However, as a further block D6 follows the first block D6, the scanning device jumps one track inwards where it meets the block D3, which has already been read. Therefore, the scanning device jumps one track outwards where it meets the second block D6, the contents of which have already been read too. However, as another block D6 follows - the third block D6, the scanning device again jumps one track inwards. As it meets the second block D3 here, the contents of which have already been read, it again jumps one track outwards. There it meets the end of the third block D6. However, as another block, the first block D7, now follows, the scanning device remains in this track in order to read the block D7.

At the end of the first block D7 this scanning device jumps one track outwards. Since however in this track there is no further data recorded to be stored, the scanning device jumps again one track inwards where it meets the second block D7. At the end of the second block D7 it jumps one track inwards, because the block D7 has already been read, and meets the end of the first block D4. It then reads the subsequent second block D4, at the end of which it jumps one track outwards, where again there is no more data to be read. It therefore again jumps one track inwards,

where it encounters about the first third of the third block D4. Finally, the first block D5 is read when the scanning device reaches the end of the third block D4.

The optical scanning device has now read all blocks AO, A1, A2 and D1 through D7 in the following sequence: AO, A2, D3, D1, A1, D2, D5, D6, D7, D4 and D5.

The time required for reading the directory of a CD is considerably shortened by the inventive measure of jumping radially inwards or outwards to another track if a block which has already been read follows. Not all blocks are read three times, as is the case with the state of the art where the scanning device travels from the inside to the outside along the helical data tracks in order to read all blocks in the correct sequence ,

The embodiment example shown in Figure 3 will now be explained.

The scanning device begins to read the first three blocks A0 as well as the following block A1. After the first block A1, the scanning device jumps one track outwards where it lands roughly on the first quarter of the third block D1. It remains in this track in order to read the block D2 following the third block D1. After reading the first block D2, the scanning device jumps one track inwards where it land roughly on the first third of the third block A1. It reads the first block A2 following on from the third block A1 and subsequently jumps one track outwards. There the scanning device meets the final quarter of the third block D2, which it has already read. It now reads in the same track the block D3 following on from the third block D2. After reading the first block D3, the scanning device again jumps one track inwards because the second block D3 follows the first block D3. In doing this it meets the start of the third block A2. After the end of the third block A2, the scanning device remains in the same track in order to read the following block D1; after doing so said scanning device jumps one track outwards because the second block D1 follows the first block D1. It meets roughly the first quarter of the first block D4. It now reads the second block D4, which follows the first block D4, and upon reaching the end of this block jumps one track inwards where it meets approximately the center of the third block D1, which was read earlier. As the third block D1 is followed by block D2, which has already been read, the scanning device jumps one track outwards to meet roughly the final third of the third block D4, which too has already been read. However, it now reads the first block D5 following on from the third block D4; after doing so, said scanning device jumps one track inwards to the first block D2. At the end of the first block D2 the scanning device jumps one

track outwards because the contents of the following second block D2 have alrready been read. It now scans the second block D5; however, this was read earlier. Therefore, upon reaching the end of the second block D5, the scanning device jumps one track inwards where it meets the final third of the second block D2. At the end of this it again jumps outwards because another block D2 follows. It now moves along the final half of the third block D5 in order to read the first block D6 following on from the end of the third block D5 in the same track. At the end of the first block D6 the scanning device jumps one track radially inwards where it lands approximately on the center of the first block D3, the contents of which, however, have already been read. At the end of the first block D3 the scanning device jumps one track outwards because, again, a block D3 follows. At the end of the second block D6 the scanning device again jumps inwards where it lands approximately in the center of the third block D3. However, as this block D3 has already been read, it jumps one track outwards upon reaching the end of said block D3 where it lands approximately on the final fifth of the third block D6. As the first block D7, which has not yet been read, now follows on from the third block D6, the scanning device remains in this track in order to read block D7.

The scanning device has now read all blocks in the following sequence: A0, A1, D2, A2, D3, D1, D4, D5, D6 and D7.

The embodiment example shown in Figure 4 will now be explained. Here, a total of just seven different blocks, the lengths of which are selected to be different, are stored redundantly on the CD.

The scanning device begins with the reading of the first block A0. It jumps one track outwards where it lands

roughly in the center of the third block A2. It now reads in this track the following first block D1, at the end of which it jumps one track inwards where it lands roughly in the second half of the second block A0. At the end of the second block A0 it jumps one track outwards because the third block A0 follows, the data of which has already been read. However, as with this jump the scanning device meets the third block D1, it again jumps back one track inwards where it meets the start of the third block A0. At the end of the block A0, the scanning device reads the following first block A1 and jumps one track outwards upon reaching the end of this block where it lands roughly on the center of the third block D2. It now reads the first block D3 which follows on from the third block D2. After reading the first block D3 the scanning device jumps one track inwards where it meets roughly the end of the second block A1. However, as the contents of this block have already been read, at the end of the first block A1 the scanning device jumps one track outwards where it meets roughly the center of the second block D3, the contents of which, however, have also already been read. Therefore, the scanning device again jumps one track inwards where it meets approximately the first half of the first block A1. However, as the block A2, which has not yet been read, follows the third block A1, the scanning device now reads the first block A2. At the end of this the scanning device jumps one track outwards where it meets approximately the center of the second block D4. It now reads the following third block D4 because this block has not yet been read. At the end of the third block D4 the scanning device jumps one track inwards where it meets the third block A2. At the end of this it jumps one track outwards because the first block D1, which was read earlier, follows on from the third block A2. However, as there are no more blocks to be read on this track, the scanning device jumps one track inwards where it meets the center of the first block D1, which it has already read.

Therefore, at the end of the first block D1 the scanning device jumps one track inwards where it meets the center of the second block AO. At the end of the second block AO the scanning device jumps one track outwards onto the start of the third block D1, which, likewise, has already been read. Therefore, the scanning device jumps one track inwards where it meets the start of the third block AO. At the end of this it jumps one track outwards because the first block A1, which was read before, follows. The scanning device arrives shortly after the end of the second block D2 and, to conclude, reads the following third block D2. The scanning device has now read all the blocks AO, A1, A2 and D1 to D4 in the following sequence: AO, D1, A1, D3, A2, D4 and D2.

How the sequence of the individual track changes of the scanning device finally appears in the case of a certain CD depends on the total number of blocks, the number of redundant blocks and the length of the individual blocks. The greater the redundancy, or in other words the greater the number of identical blocks there are on the disk, the greater the resulting time saving with the method according to the invention.

The method according to the invention is generally suitable for the reading of the data of a rotating recording medium on which the data are recorded redundantly in concentric circles or helical data tracks divided into blocks in such a way that in each case several identical blocks follow each other on the data tracks. The method according to the invention can be particularly advantageously employed in a CD player or video disk player for reading the directory of the audio or video disk.

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Patent Claims

1. Method for reading the data of a rotating recording medium on which the data are divided into blocks and on which, for achieving redundancy, in each case at least two identical blocks are arranged following each other on the data tracks, **characterized in that** a reading device, after reading the data of a block, jumps onto another track in order to continue reading the data of another block there.

2. Method according to claim 1, **characterized in that** the reading device only jumps onto another track if it arrives at a block whose data it has read already.

3. Method according to claim 1 or 2, **characterized in that** the reading device jumps one data track alternately radially inwards and outwards on a disk provided as a recording medium.

4. Method according to claim 1, 2 or 3, **characterized in that** as recording medium a so-called compact disk is used, the directory of which is read in a CD player, and stored in a memory of said CD player.