

Description

The invention relates to an apparatus for reproducing information stored in the form of one or more information blocks on a record carrier, comprising first read means for reading said record carrier and control means for controlling said read means in such a way that a selected information block can be reproduced, said control means including means for transforming a sequence number corresponding to an information block into data defining the beginning of said block the carrier further comprising an index portion.

The invention also relates to a record carrier for use in an apparatus in accordance with the invention.

The apparatus of the type specified in the opening paragraph is, for example, a compact-disc digital audio player which is used with a record carrier in the form of an optically readable disc carrying digitally encoded audio information.

An example of such a compact-disc digital audio player is disclosed in IEEE Spectrum, March 1984, pages 35—39. Another example of such a compact-disc digital audio player is the player which is commercially available from N. V. Philips' Gloeilampenfabrieken under the type designation CD303 at the date of filing of the present application. Before a disc is played on this player it is possible to key in a selection to be reproduced. For this purpose use is made of a subcode which is interleaved with the digital audio information and which inter alia contains a running indication for the track number being reproduced, an index (part of a "track"), and relative and absolute time. In the various known players the parameters which can be programmed are track number, index, and/or time. The keyed-in selection may be stored in a memory as long as playing proceeds.

It is the object of the invention to improve the ease of operation of the known apparatus by speeding up the process of searching for the next track of the selection thus made.

To this end the apparatus is characterized in that it comprises:

—a memory having a number of n storage locations each location allocated to a respective fixed portion of the record carrier, the memory storing in each of said storage locations a sequence number corresponding to an information block, if present, whose beginning is situated in a respective portion of the record carrier, and

—first means for the storage of or for deriving data relating to the size and location of the portions on the record carrier. In this respect it is to be noted that the size and the location of the portions of or on the record carrier may be expressed in and therefore characterized by both units of "time" and units of "length".

In the current "compact-disc" player an information block to be reproduced next (hereinafter referred to as "track") is searched as follows.

Assume that at a specific instant track i is being reproduced and via the keys it is requested to reproduce track j , j being for example greater than i . Since the numbers of the tracks on the record carrier increase from the centre towards the periphery, not necessarily starting with 1, the control means know that the track number j must be situated further towards the periphery of the record carrier. In order to speed up the search process the control means then control the read means so as to make radial jumps of 256 tracks each towards the periphery of the record carrier and after every jump tracking is restored and the location of the read means relative to the track is derived from the subcode. If track number j is not yet reached a new jump over 256 tracks towards the periphery of the record carrier is made. This continues until after such a jump the track j is reached, for example in that after this jump the read means are already situated at track j . Subsequently, a backward jump over 128 tracks is made and again the number of the track at which the read means are now located is derived from the subcode. If the read means are now located at track number $j-1$ a forward jump over 64 tracks is made. In this way the beginning of track j is reached by forward or backward jumps which each time become factor of 2 smaller. Such a search procedure is also referred to as the "binary search" code procedure. This "binary search" procedure may take much time, in particular if the tracks j and i are situated far from one another.

In the foregoing reference has been made to "jumps over a number of tracks". It is to be noted that record carriers such as compact discs comprise only one track which extends along the spiral path from the centre towards the periphery of the record carrier. Therefore, the statement "jumps over a number of tracks" is to be understood to mean in fact jumps which equal the size of a number of times the track pitch, which is the radial displacement of the read means in one revolution of the record carrier.

Further, it is to be noted that the choice of the jumps over 256 tracks is dictated by the fact that the lead-out track which is situated after the end of the last track number on the record carrier should have a width of at least 300 tracks. Using jumps over 256 tracks ensures that the lead-out track is always reached in the case of an outward search movement over the record carrier.

It is possible to store the data contained in the lead-in track of the record carrier and relating to the number of tracks and the starting times of each track number in an associated memory in the apparatus. If, moreover, a conversion table in which the times on the record carrier are plotted versus the radial positions on the record carrier (for example in numbers of "tracks", i.e. the number of track pitches from the lead-in track) is stored in the apparatus, the search process can be carried out much faster.

After the instruction to reproduce track j the apparatus determines the radial positions corresponding to the starting times of the tracks i and j . Subtracting the two positions yields the number of tracks over

which the control means should cause the read means to jump in a radial direction to reach at least the vicinity of track j . Subsequently, the beginning of the track j is located by means of the "binary search" procedure. The relevant track number j or the number $j+1$ or $j-1$ is now already reached by making only one large jump over a number of tracks which is (substantially) larger than 256, in particular if the tracks are situated far from each other, so that the searching time can be reduced significantly.

It is to be noted that it is known *per se* to read data relating to the location of tracks on a record carrier from the track at the beginning of the record carrier and to store this data in a memory of an apparatus for reproducing information. Refer to, for example, European Patent Specification No. 29.946. This Specification relates to an apparatus for reading information from a magnetic record carrier.

Since the lead-in track of the record carrier can store 99 track numbers and their starting times, the above proposal would mean that the reproducing apparatus should have a memory which in the extreme case can store the data relating to these 99 track numbers. This requires a comparatively large memory, which may be very unfavourable in view of the architecture and the capacity of the microcomputer system to be used in the apparatus. In other words, the use of a smaller memory is to be preferred. Moreover, in view of the accuracy of the search procedure, which accuracy depends on the inaccuracy in the track pitch and the tangential speed and which is of the order of magnitude of 10% of the jump size, it is neither necessary nor useful to store all track data in the apparatus.

In accordance with the invention the record carrier is divided into a number of n (n for an apparatus such as a compact-disc-digital-audio player being smaller than 99, but suitably not more than 10) fictitious fixed portions. The fixed portions are bounded by their inner and outer diameters. In other words, each portion corresponds to a parameter which indicates the number of tracks by which the beginning is spaced from the lead-in track. A number of ten portions has been selected because the record carrier is approximately 20,000 tracks (*i.e.* 20,000 times the track pitch) wide, so that portions having a width of 2048 tracks each are defined. This number is favourable because 2048 is a power of 2.

In the present example this yields for example the numbers 0, 2048, 4096, 6144 etc. These numbers correspond to times in conformity with the aforementioned conversion table. Now the associated memory in the apparatus should have only the aforementioned n storage locations and can therefore be substantially smaller than the previously mentioned memory. The number of a track in the relevant portion, for example the first or the last track in this portion (*i.e.* that track whose beginning is situated nearest the beginning or the end of the relevant portion of the record carrier) but preferably the first track number, may now be stored in a storage location of the memory which corresponds to a specific portion of the record carrier.

If the first track numbers of a portion are stored in the corresponding storage locations, the contents of the memory may be for example as follows: 1, 3, 4, 7, 9. The first portion of the record carrier contains track number 1 and (the beginning of) track number 2. The second portion of the record carrier contains the (beginning of) track number 3.

The third portion of the record carrier contains the track numbers 4 and 5 and (the beginning of) track number 6. The fourth portion contains track number 7 and (the beginning of) track number 8. The fifth portion contains (the beginning of) track number 9. Suitably, the memory also contains a number which indicates the total number of tracks on the record carrier. In that case the memory has one storage location more than the number of portions into which the record carrier has been divided.

If the total number of tracks in the preceding example is ten, the fifth portion will therefore contain the entire track number 9 and (the beginning of) track number 10.

In the storage location corresponding to a portion of the record carrier which does not contain the beginning of a track it is possible to store an associated indication. This indication is preferably the number "zero".

The apparatus may be characterized further in that the memory comprises an additional storage location for the storage of a number representing the number of information blocks on the record carrier.

The memory with n storage locations may be filled in various manners.

In a first embodiment the apparatus may be characterized in that it further comprises

—second read means for, prior to the reproduction of the information, reading from the index portion of the record carrier, the sequence numbers to be stored in the memory.

This is possible only if the relevant sequence numbers are contained in the lead-in track of the record carrier, which is not yet the case.

A second embodiment may be characterized in that it further comprises

—second read means for reading data relating to the location of the beginning of the one or more information blocks on the record carrier from the index portion of the record carrier prior to the reproduction of the information, and

—second means for comparing the data relating to the location of the beginnings of the information blocks on the record carrier with the data relating to the location of the portions on the record carrier and for generating not more than once for a portion of the record carrier a control signal for storing the sequence number of the information block, if present, whose beginning is situated in said portion of the record carrier in the storage location corresponding to the said portion.

This enables the currently available record carriers to be used and the sequence numbers corre-

sponding to the portions of the record carrier to be determined in the apparatus itself and to be stored in the memory.

The apparatus may be characterized further in that it further comprises:

- third means for comparing the sequence number of a selected information block with the sequence member stored in the memory and for generating a control signal to be applied to the control means, in such a way that the first read means are positioned at the beginning of the selected information block and subsequently said information block can be reproduced.

Thus, as stated previously, the first read means can be positioned in two steps. Firstly, a coarse step, in which a large jump corresponding to the width of one or more adjoining portions of the record carrier is made, and, subsequently, a fine-search step, in which the beginning of the track is located by means of the "binary search" procedure. Determining the size of the coarse step, i.e. determining when the first read means have carried out the jump corresponding to the width of one or more portions of the record carrier, may be effected by, for example, counting the number of track transitions detected during the radial movement of the first read means over the record carrier. Another possibility is to determine the displacement of a cursor on the actuator which forms part of the third means and which drives the first read means, which cursor indicates the position of the actuator and hence of the first read means.

The invention has been described above with reference to a compact-disc-digital-audio player, where in the lead-in track of the record carrier used in the apparatus 99 track numbers and their starting times can be stored. It should be noted however that the invention is equally well applicable to apparatuses for reproducing information of a record carrier having a larger or smaller contents and where information concerning more or less than 99 (say x) tracks can be stored in a lead-in track. This means that in that case $n < x$. Preferably, n being one order of a magnitude smaller than x .

Embodiments of the invention will now be described in more detail, by way of example, with reference to the accompanying drawings. In the drawings

Figure 1 shows an apparatus in accordance with the invention,

Figure 2 shows a part of a record carrier in cross-sectional view and the memory used in the apparatus of Figure 1,

Figure 3 is a flow chart which represents how the memory is filled, and

Figure 4 is a flow chart which represents how a selected track is searched.

Figure 1 is a diagram representing the principle of a "compact disc" player in so far as it is relevant to the present invention. The diagram is based on commercially available "compact disc" players, such as for example the player which is available from N. V. Philips' Gloeilampenfabrieken under the type number 303. These known players comprise a program-selection and control panel 1, for example, a row of keys each corresponding to a specific track number and a display 2 on which the selected number is displayed, for example a row of lamps which each correspond to a specific track number. In addition to program selection by the track number it may be possible to select by index (parts of tracks), time within a track, or absolute time. A microcomputer 3 scans the control panel 1 and drives the display 2. Further, the microcomputer 3 can read the selected program into and out of a program memory 4 in order to control the player in such a way during playing of the disc that the selected program is reproduced. For this purpose, the microcomputer 3 receives from a subcode decoding device 5 the subcode which is interleaved between the music data on the disc and in which *inter alia* the track numbers, index and time have been encoded in running form, so that the microcomputer receives information about the location on the disc where reproduction is effected.

In accordance with the invention, the apparatus further comprises a memory 6 having n storage locations 6.1, 6.2 . . . 6. n , where $n < 99$ and preferably not more than 10, and an additional storage location 6. $n+1$. Further, the apparatus comprises first means 7 for the storage of or containing data relating to the size and the locations of n portions on the record carrier or for the storage of or containing data from which the size and the location of n portions on the record carrier can be derived.

Figure 2 shows a part of the record carrier 20 in cross-sectional view. The record carrier has been divided into five portions P1 to P5. The portions are characterized by their boundaries r_{p1} to r_{p5} and r_m . If the beginning of the record carrier is taken as a reference, which means that $r_{p1} = 0$, then r_{p2} to r_{p5} represent the distance of the beginning of a portion from the beginning of the record carrier. The distances r_{p1} to r_{p5} may be expressed in units of "time" or in units of "length" (denoting the time or the number of revolutions required for the read means to proceed from, for example, r_{p1} to r_{p2}).

Figure 2 shows that the portions P1 to P5 all have the same width b (which, in general, is not strictly necessary!). If r_{p1} to r_{p5} are expressed in units of "length" and if $r_{p1} = 0$, then $r_{pi} = (i-1)r_{p2}$, where $i \geq 3$. This means that r_{p3} to r_{p5} are multiples of r_{p2} . In the previously mentioned example this means that $r_{p1} = 0$, $r_{p2} = 2,048$, $r_{p3} = 4,096$, . . . etc. If r_{p1} to r_{p5} are expressed in units of "time", then r_{p1} may be 0, $r_{p3} - r_{p2}$ will be larger than r_{p2} , $r_{p4} - r_{p3}$ will be larger than $r_{p3} - r_{p2}$ etc., because the speed of revolution of the record carrier decreases as a track which is situated nearer the periphery of the record carrier 20 is reproduced. It will be evident that there is a (known) relation between r_{pi} expressed in units of "length" and r_{pi} expressed in units of "time". This relation is defined by a mathematical formula, previously referred to as the conversion table.

The parameters r_{p1} to r_{p5} may now be stored in the first means 7 expressed in units of "time" or units of "length". If the portions P1 to P5 have the same width b , it may even be adequate to store only the value of

r_{p2} expressed in units of "length".

Moreover, if the number of portions (namely 5) is known, whilst r_m is also known for record carriers of the "compact-disc" type, the other values r_{p3} to r_{p5} can be derived (in the microcomputer 3). If the aforementioned formula or conversion table is also stored in the microcomputer 3 or in the first means 7, all the information as regards the location and size of the portions P1 to Pn (n being 5 in Figure 2) on the record carrier is known or can be derived.

In the memory 6 in Figure 1 the sequence number of one information block (if present) whose beginning is situated in a portion P_i of the record carrier 20 corresponding to a storage location is stored in the various storage locations 6.1 to 6.n. The storage location 6.n+1 contains the number m which represents the number of tracks on the record carrier.

Figure 2 shows that the record carrier 20 contains (m=) six tracks N1 to N6. Figure 2 also shows the corresponding contents of the memory 6. The various storage locations of the memory contain the sequence number of that track whose beginning (i.e. the left-hand boundaries of the tracks of N_i) is situated nearest the beginning (i.e. the left-hand boundaries of the portions P_j) of an associated portion P_j . Figure 2 clearly shows that the portions P3 and P5 do not contain a beginning of a track. The portion P5 even contains no information at all. In such a case for example a 0 may be stored in the corresponding storage locations. The storage location 6.6 contains the number 6.

The memory 6 may be filled in various ways.

For a first possibility it is assumed that the relevant sequence numbers (i.e. the contents of the memory) have been recorded in the lead-in track of the record carrier. The apparatus in Figure 1 comprises second read means 8 for, prior to the reproduction of the information, reading from the record carrier the sequence numbers to be stored in the memory. For this purpose the second read means are coupled to the microcomputer 3, which transfers the relevant data from the second read means 8 to the memory 7. Thus, in the example of Figure 2 the second read means will read the numbers 1-3-0-5-0 from the record carrier 20. Moreover, the number (m=) 6 is read from the lead-in track and is stored in the storage location 6.6.

In accordance with a second possibility, which will be described in more detail with reference to the flow chart of Figure 3, the second read means 8 read the data relating to the location of the beginning of one or more information blocks on the record carrier from the lead-in track before reproduction from the record carrier 20. For this purpose the apparatus also comprises second means 9 having a first input coupled to the read means 8 and a second input coupled to the first means 7, and an output coupled to the memory 6, for comparing the data relating to the location of the beginning of the information blocks on the record carrier 20 with the data relating to the location of the portions on the record carrier and for generating not more than once for one portion of the record carrier a control signal for the storage of the sequence number of that information block whose beginning is situated in the relevant portion of the record carrier in the storage location corresponding to this portion.

This method operates as follows, see Figure 3. The program is started in block 30. In block 32 the memory 6 is completely filled with "zeros". This means that a zero is stored in all the storage locations 6.1 to 6.n+1 inclusive. Subsequently, in block 34 the number m indicating the number of tracks on the record carrier and the sequence number i_0 of the first track are read from the lead-in track of the record carrier via the second read means. In block 35 a running variable i, representing the sequence number of the track, is set to the value i_0 and a running variable j, representing the number of the portion of the record carrier, is set to the value 2. In block 36 the value i ($=i_0$) is stored in the first storage location 6.1 and the value m is stored in the storage location 6.n+1. Subsequently, in block 38 the variable i is incremented by one. Now, the second read means read the starting time of the next track from the lead-in track and in block 42 the starting time is converted into a starting position r_{Ni} by means of the aforementioned conversion formula or table. After this it is ascertained in a program step 44 whether i is equal to $m+i_0+1$. If i is not equal to the value $m+i_0+1$ the program proceeds from 44 to block 46, in which it is ascertained whether r_{Ni} is smaller than r_{pj} . If this is the case (which means that the beginning of track i is still situated in the preceding portion P_j), the program returns to block 38 via the branch 48. For track number 2 in the example of Figure 2 the program actually proceeds via this branch 48. If it is found in block 46 that r_{Ni} is greater than or equal to r_{pj} the program proceeds via block 50, in which the variable j is incremented by one, to block 52, in which r_{Ni} is again compared with the beginning r_{pj} of the next portion on the record carrier. If $r_{Ni} < r_{pj}$ the beginning of the track N_i is situated in the portion P with the number j-1 and the number i is stored in storage location j-1 of the memory 6 in block 56. If in block 52 r_{Ni} is still greater than or equal to r_{pj} the program proceeds to block 50 via branch 54. This happens if a portion P does not contain a beginning of a track, such as portion P3 in Figure 2. From block 56 the program proceeds to block 58, in which it is ascertained whether j is equal to n+1. If this is not the case, the program proceeds to block 38 via branch 60 for eventually storing a following track number in a following storage location. If it is found in block 44 and block 58 that i and j are equal to $m+i_0+1$ and n+1, respectively the program proceeds to block 66 via branches 62 and 64, respectively, in which block the program is terminated. From block 58 it appears that the variable j can assume a value equal to n plus one. For $r_{p,n+1}$ the value r_m , see Figure 2, should be taken, which value is also available in the apparatus.

Figure 4 illustrates a possible method of searching for a selected track. For this purpose the apparatus also comprises third means 10 having a first input coupled to the control panel 1, a second input coupled to the memory 6, and an output coupled to the control means 11. The control means are adapted to control

the first read means in such a way that a selected information block can be reproduced. The third means 10 are adapted to compare the sequence number of a selected information block with the sequence numbers stored in the memory and to supply a control signal for the control means 11, in such a way that the read means are positioned at the beginning of a selected information block (track) and subsequently the information block can be reproduced.

Searching may be effected as follows. In Figure 4 the search process starts in block 68, after which in block 70 the instruction is given to play track number x . The apparatus has the information that it has reached track number y , which is situated in portion u (i.e. P_u) of the record carrier. In block 72 it is checked whether $y > x$. If this is not the case, i.e. if number x is situated further than number y , a running variable i is made equal to $u+1$ in block 74, and the number M_i , stored in the i^{th} storage location of the memory 6, is read out in block 76. Subsequently, in block 78 it is ascertained whether $x < M_i$. If x is actually smaller than M_i , this means that number x and number y are apparently situated in the same portion P_u of the record carrier. The program then also proceeds to block 82 via the branch 80, in which block the beginning of track x is located by means of the fine-search or binary-search process, and the search program is terminated in block 83.

If in program step 78 it is found that $x \geq M_i$, the program proceeds to block 84, in which the running variable is incremented by one, and the number M_i stored in the next storage location of the memory 6 is read out in block 86. Subsequently, in block 88 it is again checked whether $x < M_i$. If this is the case, the beginning of track x is apparently situated in the next portion P_{u+1} or, in general, in portion P_{i-1} . In block 90 a jump equal to the width of $i-u-1$ portions P is made to the portion in which the beginning of track x is situated and, subsequently, in block 82 the beginning of the track x is located by means of the fine-search process. If in block 88 it appears that $x \geq M_i$, the program returns to block 84 via the program branch 89 and, subsequently, in blocks 86 and 88 it is checked whether (the beginning of) track x is situated in an adjoining portion P of the record carrier.

If it is found that $y > x$ in program step 72, the program proceeds to block 92 in which a running variable i is made equal to u . In block 94 M_i is read out of the i^{th} storage location of the memory 6. Subsequently, in step 96 it is ascertained whether M_i is zero. If it is, the beginning of the track is situated in portion u and the program proceeds to block 100 via branch 99. If in 96 it is found that M_i is not zero, the program proceeds to 98 where it is checked whether $x \geq M_i$. If this is the case, the beginning of track x is situated in portion u . The program then proceeds to block 82 via branch 103, after which by means of the fine-search process the beginning of track x is located. If it is found in 98 that $x < M_i$, the program also proceeds to block 100 in which the running variable i is decremented by one. Again it is checked in 102 whether the contents of M_i is zero. If it is (information block i does not contain the beginning of a track), the program proceeds to 100 via branch 106. If M_i is not zero, the program proceeds to block 104 in which it is checked whether $x \geq M_i$. If this is the case, the beginning of track x is situated in portion i . In block 108 one jump the size of the width of $u-i$ portions is made to portion i in which the beginning of the track i is situated, and subsequently the beginning of the track is reached in block 82.

If in program step 104 it is found that $x < M_i$, which means that the beginning of track x is not situated in portion i , the program also returns to block 100 via the branch 106.

If after the fine-search process in block 82 the beginning of track x is found, the search program is terminated in block 83. Subsequently, the apparatus can reproduce the track.

The method as described with reference to Figures 3 and 4 may be used in the case that the track numbers of tracks whose beginnings are situated nearest the beginning of the relevant portions P have been stored in the corresponding storage locations. If other track number, for example the numbers of those tracks whose beginnings are situated nearest the ends of the relevant portions P have been stored in the corresponding storage locations, the methods will proceed in a different way and will have a different set-up. It will also be evident that the sequence of some steps in the methods as described with reference to Figures 3 and 4 may be changed without the operation being affected.

TABLE 1—Legend to Figure 3

	Block No.	Designation
5	30	Start
	32	Initial filling of memory
	34	Read m and i_0 (first sequence number)
	35	$i=i_0, j=2$
10	36	Store i in 6.1 and m in 6.n+1
	38	$i=i+1$
	40	Read starting time i^{th} track
	42	Conversion into position
	44	$i=m+i_0+1?$
15	46, 52	$r_{N1} < r_{Pj}?$
	50	$j=j+1$
	56	Store i in $(j-1)$ th storage location
	58	$j=n+1?$
	66	Stop

TABLE 2—Legend to Figure 4

	Block No.	Designation
25	68	Start
	70	Reproduce no. x
	72	$y > x?$
	74	$i=u+1$
	76, 86	Read M_i from storage location i
30	78, 88, 94	$x < M_i?$
	82	Fine or binary search of no. x
	84	$i=i+1$
	90	Coarse jump forward over width of $i-u-1$ portions
	92	$i=u$
35	96, 102	$M_i=0?$
	98, 104	$x \geq M_i?$
	100	$i=i-1$
	108	Coarse jump backward over width of $u-i$ portions
	83	Stop.

40 Claims

1. An apparatus for reproducing information stored in the form of one or more information blocks (N1—6) on a record carrier, comprising first read means for reading said record carrier and control means for controlling said read means in such a way that a selected information block can be reproduced said control means including means for transforming a sequence number (i) corresponding to an information block into data (r_{N1} — r_{N6}) defining the beginning of said block the carrier further comprising an index portion, characterized in that the apparatus comprises

—a memory (6) having a number of n storage locations each location allocated to a respective fixed portion (P1—P5) of the record carrier the memory storing in each of said storage locations a sequence number (i) corresponding to an information block, if present whose beginning (r_{N1} — r_{N6}) is situated in a respective portion (P1—P5) of the record carrier, and

—first means (7) for the storage of or for deriving data relating to the size and the location of the portions (P1—P5) on the record carrier.

2. An apparatus as claimed in Claim 1, the carrier being a compact-disc comprising up to 99 blocks, characterized in that $n < 99$.

3. An apparatus as claimed in Claim 2, characterized in that n is at the most 10.

4. An apparatus as claimed in Claim 1, 2 or 3, characterized in that if the beginnings (r_{N3} , r_{N4}) of at least two information blocks are situated in the same portion of the record carrier, the sequence number of that information block (N3) whose beginning is situated nearest the beginning of said portion (P2) of the record carrier is stored in the relevant storage location.

5. An apparatus as claimed in any one of the preceding Claims, characterized in that in the storage location which corresponds to a portion of the storage carrier which does not contain the beginning of a track a corresponding indication is stored.

6. An apparatus as claimed in any one of the preceding Claims, characterized in that the memory comprises an additional storage location (6.6) for the storage of a number representing the number of

TABLE 1—Legend to Figure 3

	Block No.	Designation
5	30	Start
	32	Initial filling of memory
	34	Read m and i_0 (first sequence number)
	35	$i=i_0, j=2$
	36	Store i in 6.1 and m in 6.n+1
10	38	$i=i+1$
	40	Read starting time i^{th} track
	42	Conversion into position
	44	$i=m+i_0+1?$
15	46, 52	$r_{Ni} < r_{pj}?$
	50	$j=j+1$
	56	Store i in $(j-1)^{\text{th}}$ storage location
	58	$j=n+1?$
	66	Stop

TABLE 2—Legend to Figure 4

	Block No.	Designation
25	68	Start
	70	Reproduce no. x
	72	$y > x?$
	74	$i=u+1$
	76, 86	Read M_i from storage location i
30	78, 88, 94	$x < M_i?$
	82	Fine or binary search of no. x
	84	$i=i+1$
	90	Coarse jump forward over width of $i-u-1$ portions
	92	$i=u$
35	96, 102	$M_i=0?$
	98, 104	$x \geq M_i?$
	100	$i=i-1$
	108	Coarse jump backward over width of $u-i$ portions
	83	Stop.

40 Claims

1. An apparatus for reproducing information stored in the form of one or more information blocks (N1—6) on a record carrier, comprising first read means for reading said record carrier and control means for controlling said read means in such a way that a selected information block can be reproduced said control means including means for transforming a sequence number (i) corresponding to an information block into data (r_{N1} — r_{N6}) defining the beginning of said block the carrier further comprising an index portion, characterized in that the apparatus comprises

—a memory (6) having a number of n storage locations each location allocated to a respective fixed portion (P1—P5) of the record carrier the memory storing in each of said storage locations a sequence number (i) corresponding to an information block, if present whose beginning (r_{N1} — r_{N6}) is situated in a respective portion (P1—P5) of the record carrier, and

—first means (7) for the storage of or for deriving data relating to the size and the location of the portions (P1—P5) on the record carrier.

2. An apparatus as claimed in Claim 1, the carrier being a compact-disc comprising up to 99 blocks, characterized in that $n < 99$.

3. An apparatus as claimed in Claim 2, characterized in that n is at the most 10.

4. An apparatus as claimed in Claim 1, 2 or 3, characterized in that if the beginnings (r_{N3} , r_{N4}) of at least two information blocks are situated in the same portion of the record carrier, the sequence number of that information block (N3) whose beginning is situated nearest the beginning of said portion (P2) of the record carrier is stored in the relevant storage location.

5. An apparatus as claimed in any one of the preceding Claims, characterized in that in the storage location which corresponds to a portion of the storage carrier which does not contain the beginning of a track a corresponding indication is stored.

6. An apparatus as claimed in any one of the preceding Claims, characterized in that the memory comprises an additional storage location (6.6) for the storage of a number representing the number of



information blocks on the record carrier.

7. An apparatus as claimed in any one of the preceding Claims, characterized in that the apparatus further comprises

—a second read means for, prior to the reproduction of the information, reading from the index portion of the record carrier the sequence numbers to be stored in the memory.

8. An apparatus as claimed in any one of the Claims 1 to 6, characterized in that the apparatus further comprises

—second read means for reading data relating to the location of the beginning of the one or more information blocks on the record carrier from the index portion of the record carrier prior to the reproduction of the information, and

—second means for comparing the data relating to the location of the beginnings of the information blocks on the record carrier with the data relating to the location of the portions on the record carrier and for generating not more than once for a portion of the record carrier a control signal for storing the sequence number of the information block, if present, whose beginning is situated in said portion of the record carrier in the storage location corresponding to said portion.

9. An apparatus as claimed in any one of the preceding Claims, characterized in that it further comprises

—third means for comparing the sequence number of a selected information block with the sequence numbers stored in the memory and for generating a control signal to be applied to the control means, in such a way that the first read-means are positioned at the beginning of the selected information block and subsequently said information block can be reproduced.

10. An apparatus as claimed in claim 5, characterized in that the corresponding indication is the number zero.

11. A record carrier intended for use in an apparatus as claimed in Claim 7 or 9 when appendant to Claim 7, characterized in that the track on the record carrier also contains n sequence numbers stored in n storage locations in the track, each location being allocated to a respective fixed portion of the record carrier, each sequence number corresponding to an information block, if present, whose beginning (r_{n1} — r_{n6}) is situated in a respective portion (P1—P5) of the record carrier.

Patentansprüche

1. Gerät zur Wiedergabe von auf einem Aufzeichnungsträger in Form von einem oder mehreren Informationsblöcken (N1—6) aufgezeichneten Informationen, mit ersten Lesemitteln zum Lesen des Aufzeichnungsträgers und mit Steuermitteln zum derartigen Steuern der Lesemittel, daß ein ausgewählter Informationsblock erzeugbar ist, wobei die Steuermittel Mittel zum Umsetzen einer Folgennummer (i) entsprechend einem Informationsblock in den Anfang des Blocks bestimmende Daten (r_{n1} — r_{n6}), und der Träger weiter einen Indexteil enthält, dadurch gekennzeichnet, daß das Gerät folgende Elemente enthält:

—einen Speicher (6) mit einer Anzahl von n Speicherstellen, wobei jede Stelle einem jeweiligen festen Teil (P1—P5) des Aufzeichnungsträgers zugeordnet ist, und der Speicher an jeder der Speicherstellen eine Folgennummer (i) entsprechend einem möglicherweise vorhandenen Informationsblock speichert, dessen Anfang (r_{n1} — r_{n6}) sich in einem jeweiligen Teil (P1—P5) des Aufzeichnungsträgers befindet, und

—erste Mittel (7) zum Speichern oder Ableiten von Daten zur Bezeichnung der Abmessung und der Stelle der Teile (P1—P5) auf dem Aufzeichnungsträger.

2. Gerät nach Anspruch 1, wobei der Aufzeichnungsträger eine Compact Disc mit bis zu 99 Blöcken ist, dadurch gekennzeichnet, daß $n < 99$ ist.

3. Gerät nach Anspruch 2, dadurch gekennzeichnet, daß n höchstens 10 ist.

4. Gerät nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß, wenn die Anfänge (r_{n3} , r_{n4}) von wenigstens zwei Informationsblöcken sich im gleichen Teil des Aufzeichnungsträgers befinden, die Folgennummer des Informationsblocks (N3), dessen Anfang sich nächst zum Anfang des betreffenden Teils (P2) des Aufzeichnungsträgers befindet, an der betreffenden Speicherstelle gespeichert wird.

5. Gerät nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß an der Speicherstelle entsprechend einem Teil des Aufzeichnungsträgers, der nicht den Anfang eines Informationsblocks enthält, eine entsprechende Anzeige gespeichert wird.

6. Gerät nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß der Speicher eine zusätzliche Speicherstelle (6.6) zum Speichern einer Zahl zur Darstellung der Anzahl von Informationsblöcken auf dem Aufzeichnungsträger enthält.

7. Gerät nach einem oder mehreren der vorangehenden Ansprüche, dadurch gekennzeichnet, daß das Gerät außerdem enthält

—eine zweites Lesemittel zum Lesen der in den Speicher einzuschreibenden Folgennummern aus dem Indexteil des Aufzeichnungsträgers vor der Wiedergabe der Information.

8. Gerät nach einem oder mehreren der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß das Gerät weitere Elemente enthält:

—zweite Lesemittel zum Lesen von Daten bezüglich der Stelle des Anfangs des einen oder mehrerer Informationsblöcke auf dem Aufzeichnungsträger aus dem Indexteil des Aufzeichnungsträgers vor der Wiedergabe der Information und



—zweite Mittel zum Vergleichen der Daten bezüglich der Stelle der Anfänge der Informationsblöcke auf dem Aufzeichnungsträger mit den Daten bezüglich der Stelle der Teile auf dem Aufzeichnungsträger und zum Erzeugen von nur einmal einem Steuersignal für einen Teil des Aufzeichnungsträgers zum Speichern der Folgenummer des möglicherweise vorhandenen Informationsblocks, dessen Anfang sich im betreffenden Teil des Aufzeichnungsträgers an der Speicherstelle entsprechend dem betreffenden Teil befindet.

9. Gerät nach einem oder mehreren der vorangehenden Ansprüche, dadurch gekennzeichnet, daß außerdem dritte Mittel zum Vergleichen der Folgenummer eines ausgewählten Informationsblocks mit den in Speicher gespeicherten Folgenummern und zum Erzeugen eines den Steuermitteln derart zuzuführenden Steuersignals, daß das erste Lesemittel am Anfang des gewählten Informationsblocks positioniert wird und anschließend dieser Informationsblock wiedergegeben werden kann.

10. Gerät nach Anspruch 5, dadurch gekennzeichnet, daß die betreffende Anzeige die Zahl Null ist.

11. Aufzeichnungsträger zur Verwendung in einem Gerät nach Anspruch 7 oder 9, wenn abhängig vom Anspruch 7, dadurch gekennzeichnet, daß die Spur auf dem Aufzeichnungsträger ebenfalls an n Speicherstellen in der Spur gespeicherte n Folgenummern enthält, wobei jede Speicherstelle einem jeweiligen festen Teil des Aufzeichnungsträgers zugeordnet wird, und jede Folgenummer einem möglicherweise vorhandenen Informationsblock entspricht, dessen Anfang (r_{N1} — r_{N6}) sich in einem jeweiligen Teil ($P1$ — $P5$) des Aufzeichnungsträgers befindet.

Revendications

1. Appareil pour reproduire de l'information stockée sous la forme d'un ou plusieurs blocs d'information ($N1$ — 6) sur un support d'information, comportant de premiers moyens de lecture pour lire ledit support d'enregistrement et des moyens de commande pour commander lesdits moyens de lecture de façon à permettre de reproduire un bloc d'information sélectionné, lesdits moyens de commande comportant des moyens pour transformer un numéro d'ordre (i) correspondant à un bloc d'information en données (r_{N1} — r_{N6}) définissant le début dudit bloc, le support comportant en outre une partie d'index, caractérisé en ce qu'il comporte:

—une mémoire (6) ayant un nombre de n emplacements de mémoire qui sont attribués chacun à une partie fixe correspondante du support d'enregistrement, la mémoire stockant dans chacun desdits emplacements de mémoire un numéro d'ordre (i) correspondant à un bloc d'information, si présent, dont le début (r_{N1} — r_{N6}) est situé dans une partie correspondante ($P1$ — $P5$) du support d'enregistrement et

—de premiers moyens (7) pour stocker ou déduire des données relatives à la taille et à l'emplacement des parties ($P1$ — $P5$) sur le support d'information.

2. Appareil selon la revendication 1, le support étant un disque compact comportant jusqu'à 99 blocs, caractérisé en ce que $n < 99$.

3. Appareil selon la revendication 2, caractérisé en ce que n est au plus égal à 10.

4. Appareil selon la revendication 1, 2 ou 3, caractérisé en ce que, si les débuts (r_{N3} , r_{N4}) d'au moins deux blocs d'information sont situés dans la même partie du support d'enregistrement, le numéro d'ordre du bloc d'information ($N3$) dont le début est le plus rapproché du début de ladite partie ($P2$) du support d'enregistrement est stocké dans l'emplacement de mémoire correspondant.

5. Appareil selon l'une quelconque des revendications précédentes, caractérisé en ce que, dans l'emplacement de mémoire correspondant à une partie du support d'enregistrement qui ne contient pas le début d'une piste, est stockée une indication correspondante.

6. Appareil selon l'une quelconque des revendications précédentes, caractérisé en ce que la mémoire comporte un emplacement de mémoire supplémentaire (66) pour stocker un nombre représentant le nombre de blocs d'information sur le support d'enregistrement.

7. Appareil selon l'une quelconque des revendications précédentes, caractérisé en ce qu'il comporte en outre

—de deuxièmes moyens de lecture servant, avant la reproduction de l'information, à lire dans la partie d'index du support d'enregistrement les numéros d'ordre devant être stockés dans la mémoire.

8. Appareil selon l'une quelconque des revendications 1 à 6, caractérisé en ce qu'il comporte en outre —de deuxièmes moyens de lecture servant, avant la reproduction de l'information, à lire dans la partie d'index du support d'enregistrement des données relatives à l'emplacement du début de l'un ou plusieurs blocs d'information sur le support d'enregistrement et

—de deuxièmes moyens pour comparer les données relatives à l'emplacement des débuts des blocs d'information sur le support d'enregistrement avec les données relatives à l'emplacement des parties sur le support d'enregistrement et pour engendrer au plus une seule fois pour une partie du support d'enregistrement un signal de commande pour stocker dans l'emplacement de mémoire correspondant à ladite partie le numéro d'ordre du bloc d'information, si présent, dont le début est situé dans cette partie du support d'enregistrement.

9. Appareil selon l'une quelconque des revendications précédentes, caractérisé en ce qu'il comporte en outre

—de troisièmes moyens pour comparer les numéros d'ordre d'un bloc d'information sélectionné avec les numéros d'ordre stockés dans la mémoire et pour engendrer un signal de commande destiné à être appliqué aux moyens de commande, de telle manière que les premiers moyens de lecture soient



positionnés au début du bloc d'information sélectionné et que, ensuite, ledit bloc d'information puisse être reproduit.

10. Appareil selon la revendication 5, caractérisé en ce que l'indication correspondante est le nombre zéro.

5 11. Support d'enregistrement destiné à être utilisé dans un appareil selon la revendication 7 ou la revendication 9, en tant que dépendante de la revendication 7, caractérisé en ce que la piste sur le support d'enregistrement contient également n numéros d'ordre stockés dans n emplacements de mémoire dans la piste, chaque emplacement étant attribué à une partie fixe correspondante du support d'enregistrement et chaque numéro d'ordre correspondant à un bloc d'information, si présent, dont le début (r_{N1} — r_{N6}) est situé
10 dans une partie correspondante (P1—P5) du support d'enregistrement.

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