Reader for numerical information carriers such as a compact disc

The invention relates to readers for numerical information carriers such as compact discs.

This invention relates more particularly to the portion adapted to programming these readers, which comprise generally:

- material reading means for the carrier,
- control means comprising:

means of carrier management adapted to memorise data which has been read, forming a "table of contents" identifying all the tracks of information present on at least one carrier,

means of controlling reading, adapted to cause, by reading means, reading of the "current" track of the carrier, after preselection of the latter by the user, and

means of sequential programming enabling acquisition by the user of sequence of **track numbers** to be read, and storage of this sequence in a zone forming a sequential memory after its validation by the user.

Such a sequence of tracks is habitually termed "programme".

In known devices, programming of one or a plurality of sequenced ranges of tracks can only be effected if the material reading means of the carrier are stopped.

In other words, if it is desired to memorise a sequenced range of tracks while one is in the course of reading a given track on a given disc, (called the active state), it is necessary in a first stage to address to the reading means a command to pass from the active reading state to the passive state (a state in which they do not read), then in a second stage to carry out the programming proper.

On the other hand, when reading of the tracks of a memorised programme is under way, it is not possible to modify the tracks of the said programme which remain to be read. Such an operation also requires stopping the reading means, then programming of a new sequence or modification of the old sequence previously memorised.

Moreover, with the majority of the existing readers, intended to read a multiplicity of discs (double readers, horizontal or lateral loading systems), changing a disc in the course of reading the tracks of a memorised programme involves immediate stoppage of the reading means.

In addition, in all the present devices with a single or multiple loading system, programming cannot be

carried out except if the control means know the table of contents or tables of contents of the disc or discs loaded. Consequently, as soon as a new disc is loaded, this involves invalidation of any programming. Such drawbacks considerably reduce the ease of use to the user and restrict the programming functions.

Consequently, one object of the invention is to obtain a reader for numerical information carriers which does not have the drawbacks of readers belonging to prior art.

For this purpose the invention proposes a reader in which on the one hand the means of sequential programming are functionally separated from the means of reading control, and on the other hand, the memory for the means of **carrier management** , as well as the sequential memory, are conjointly accessible to the means of sequential programming and to the means of reading control, so that the means of sequential programming may in addition be rendered operative during functioning of the reading control means, in order to allow modification of the content of the said sequential memory, in whatever state of knowledge of the tables of contents.

The functional separation of the programming and disc control units enables their independent functioning. It is thus possible to carry out programming, whatever

may be the state of functioning of the reading means controlled by the control unit.

Preferably, each item in the sequence is memorised in the sequential memory in the form of a couple of data relative to the number of track and of the carrier which contains it.

In a particularly advantageous way, the sequential programming means are adapted, when receiving a command from the reading control means and indicating opening of a mobile element enabling introduction or extraction of one of the carriers indicated by a memorised sequence, to suppress in the sequential memory all the couples comprising data relative to the said carrier accessible by the said open mobile member. By mobile member is meant also a carrier loading drawer, as well as a lid which is at least partially removable, enabling access to one or a plurality of carriers.

Thus, when a disc is replaced, either in a loading means or on a reading means, there follows automatically elimination in the memorised programme of all the couples indicating the replaced carrier.

According to another feature of the invention, the sequential programming means are adapted to store in the sequential memory a sequence of numbers of tracks to be read forming a programme, without knowing the

content of the tables of contents of the carriers indicated by the said sequence.

Otherwise, the sequential programming means are adapted, when there is a need to read one track of one sequence indicating a carrier whose table of contents is not known, to compare, after reading said table of contents, the data of the couple or couples of the said sequence indicating the said carrier to the said table of contents, and to eliminate in the sequential memory the couple or couples comprising data incompatible with the content of the said table of contents.

In this way it is no longer necessary to know the table of contents of each of the discs containing a track of a programme to be read. Henceforth, when a track must be read on a disc whose table of contents is not known, firstly its table is read, then the compatibility of the programme's track is tested in comparison with the contents of the table. If the test is conclusive (track present on the disc) reading of the track of the programme is then proceeded with.

According to another feature of the invention, the sequential programming means also comprise an auxiliary memory intended, when programming is carried out during the course of reading a given track of a carrier, to memorise a couple of data relative to the said carrier and number of the said given track.

This allows the number of the track in the course of being read to be retained in memory before the programme is launched, as well as its carrier, so that, at the end of this programme, the user is able to finish listening to the disc which he was originally listening to.

In addition, very advantageously, the sequential programming means are adapted, when a command is received from the reading control means and indicating a replacement, during reading of a programme, of the carrier containing the given track memorised in the auxiliary memory, to replace in the said auxiliary memory the couple of data relative to the said track given by a new couple of data of zero value.

Thus, when a disc is replaced in the reader, the control means are capable of knowing if the disc which was being read before the beginning of execution of the programme has been replaced.

According to another feature of the invention, the reading control means are adapted after completion of reading of the tracks of a sequence and when the auxiliary memory contains data of non-zero value, to cause reading of a track whose number is that stored in the auxiliary memory, incremented by one unit, and the carrier is that stored in the said auxiliary memory.

In this way, at the end of a programme, it is possible, by going to read the contents of the auxiliary memory, automatically to resume listening to the disc which was being read before launching of the said programme. This automated function ensures a considerable gain in time for the user, as it liberates him from a series of control commands. It also enables alternate reading between a "master" disc (with non-programmed reading) and one or a plurality of other programmed discs.

According to the invention, when the auxiliary memory contains data of zero value, the reading control means are adapted, after completed reading of the tracks of a sequence, to place the reading means into their passive state.

When the data contained in the auxiliary memory are zero, this means that programming has been carried out while the reading means were in their passive state, or that the disc which was being read before execution of the programme has been replaced. In both cases there is no need to command the reading means to go into their active state after completed execution of the programme.

According to yet another feature of the invention, the programming means are adapted, during generation of a sequence, to modify and/or suppress and/or add, on the

command of the user, at least one couple of data relative to a track number and to its carrier among the couples of the said sequence already memorised in the sequential memory.

In the same way, these programming means are adapted, during reading of the tracks of the programme, to modify and/or suppress and/or add, on the command of the user, at least one couple of data relative to a track number and to its carrier among the couples of the said programme memorised in the sequential memory.

Thus the user may at any moment revise, in whatever state of the reading means, and whether one is in the course of programmed reading or not, the sequence in the course of formation, avoiding recommencing totally the programming which is under way.

This again reinforces slightly further the flexibility of use of the programming system. Henceforth it is possible, in the case of repetitive (or loop) programming, to modify the contents of the programme which must be reused.

In a particular embodiment of the programming means there is provided the possibility that they can eliminate from the sequential memory, on the command of the user, a couple of data of a sequence in the course of reading, from the termination of reading of the

track indicated by the said couple of data, so that there exists in the said sequence only couples of data indicating the tracks remaining to be read.

Thus, consultation of the tracks of the programme which remain to be read is considerably simplified, since at any given moment there exists in the sequence only the tracks which have not yet been read.

Naturally, this function does not permit loop programming, which requires conservation of all the tracks of the programme.

In a particularly advantageous way, the programming means are adapted, after memorisation of a programme and in the case of recognition of the data of non-zero value in the auxiliary memory, to command the control means to read the tracks of the said programme.

On the other hand, after memorisation of a programme, and in the case of recognition of zero-value data in the auxiliary memory, the programming means are adapted to wait for a command from the user ordering the control means to read the tracks of the said programme.

Thus, upon simple reading of the data contained in the auxiliary memory, the programming means determine whether the programme must be launched automatically upon the end of acquisition of the programme, or

whether they must wait for a command from the user in order to carry out this launch.

The invention likewise proposes a process of controlling by programming a reader of numerical information carriers such as a compact disc.

This process comprises:

- a first stage in which acquisition is carried out of a sequence of couples of data relative to the number of a track and of the carrier which contains it, and storage of a sequence in a zone forming a sequential memory, without knowing beforehand the table or tables of contents of the carriers of the tracks of the sequence;
- a second stage in which the table of contents of the support is read, comprising the nth track to be read of the memorised sequence;
- a third stage in which the content of the table of contents of the carrier comprising the nth track of the sequence in the course of reading is compared to the data of the couples of this sequence indicating the said carrier, and in the sequential memory, or the couple or couples comprising data incompatible with the contents of the said table of contents are suppressed, and
- a fourth stage in which, as a function of the result of the comparison carried out during the third stage, there then follows either reading of the information

stored in the nth track, or reversion to the second stage in order to apply the process to the track following the nth track of the sequence to be read.

Other features and advantages of the invention will become apparent upon examining the following detailed description, made by way of example, and on examining the annexed drawings, which show:

- Figure 1 is a diagram illustrating a portion of a reader according to the invention;
- Figure 2 is a diagram illustrating a programming procedure for a reader according to the invention, and
- Figure 3 is a diagram illustrating stage 25 of the procedure illustrated in Figure 2.

Reference will firstly be made to Figure 1, which shows diagrammatically a reader 1 according to the invention, intended to read two discs 2-1 and 2-2 placed on disc turntables.

Naturally the invention also applies to readers intended to read a single disc or a plurality of discs.

Each disc 2 comprises information of the numerical type stored in tracks produced on one of its surfaces and being capable of detection by the control unit 6.

The reader 1 comprises reading means 3 of the laser diode type, capable of reading the numerical information stored in these tracks, and control means 4 intended to transcribe into signals the commands of the user. These commands may be either addressed by means of commands by activation of control keys located on the facade of the reader 1, or addressed by means of waves with the aid of a remote control box.

The control means 4 are produced with the aid of electronic components which the person skilled in the art may buy in the trade.

They comprise a management unit 5, a reading control unit 6, a sequenced programming unit 8 and an acquisition unit 7.

It is clear that the various units constituting the control means 4 of the reader are not obligatorily physically separated. It is therefore possible to envisage a single multi-tasking microprocessor or quasi-multi-tasking microprocessor combining the said units.

The acquisition unit 8 comprises the function keys placed on the facade of the reader 1, and means of display of the light-emitting diode type, or segments of liquid crystals, enabling display of information

relating to the state of functioning of the reader, to the content of the discs, and to the function keys.

The control unit 6 is designed to serve as an interface between the acquisition unit 8 and the reading means 3. Any command entered at the facade (manually or by means of waves) is thus converted into the form of one or a plurality of specific signals adapted to cause to function the reading means 3, or to cause programming with the aid of the programming unit 7, or again to interact with the disc management unit 5.

The management unit 5 ensures management of the tracks of each disc 2. It comprises a management memory 9 in which the control means 4 memorise the tables of contents of each of the discs previously loaded on the turntable platforms, and/or of which one track at least has already been read. These tables of contents contain information relating to the number of tracks on the disc (or carrier) on their respective durations and on the total duration of the disc.

Naturally, in the case of removal or replacement of a disc, its table of contents is automatically deleted from the management memory 9.

The programming unit 8 comprises a delay means 10, a sequenced memory 11 and an auxiliary memory 12.

This programming unit is connected by a first portion to the acquisition unit 7 which comprises the function keys specific to programming, carrying a second portion to the management unit 5, and more specifically to its management memory 9, permitting access to the contents of the tables of contents, and by a third portion to the reading control unit 6.

In present-day readers, the programming unit forms physically and functionally a part of the control unit. Thus it cannot function independently thereof.

Now, during elaboration of a sequence of couples of data forming a programme, a couple of data indicating a given track and the carrier which contains it, cannot be accepted by the control unit except if this couple is compatible with the table of contents of the indicated carrier. If this is not the case, the couple acquired by the user is rejected. Therefore this requires that all the tables of contents of the carriers indicated by the couples of the programme are stored in the management unit before acquisition of the programme.

Consequently, programming cannot be carried out on the one hand if the reading means are in their active state, since the latter are managed by the control means, and on the other hand if there is

incompatibility between one of the couples to be acquired and the memorised tables of contents.

On the other hand, in readers according to the invention, although the programming unit 8 and the control unit 6 are connected to one another, they can nevertheless function in a manner independently of one another.

It is thus possible to acquire couples of data without these being compatible with the tables of contents memorised in the management memory 9, or when one at least of the tables is not memorised.

Thus dynamic programming can be carried out (during the course of reading) but likewise a programme may be modified in real time while it is in the course of execution.

Naturally, such a device permits memorisation of a plurality of programmes if necessary, as well as their modification.

According to the invention, verification of compatibility of a couple of data is no longer effected during acquisition of the couples of data of the programme. It is henceforth effected by the programming unit 8 during execution of the said

programme, just after reading of the couple placed in front of it in the sequence forming the programme.

In effect, in order to gain time, upon each first occurrence of a carrier (k) in a sequence, the programming unit 8 goes to see in the management memory 9 whether it contains the table of contents of the carrier concerned. If this is not the case, the programming unit 8 asks the control unit 6 to cause reading of the table of contents of the carrier concerned by the reading means 3. This table is then memorised in the management memory 9.

Knowing the table of contents of the carrier concerned, the programming unit 8 proceeds to verify all the couples of data indicating the carrier concerned. Any couple of data indicating the carrier concerned which is incompatible with the table of contents of the carrier concerned is then automatically deleted from the sequential memory 10. Execution of the programme then proceeds either by reading the track indicated by the verified couple, or by verifying the couple following if this has not already been done.

This verification procedure will be described in detail later.

The delay means 12 is a timed counter which starts automatically as soon as the function key for main

programme is actuated, or after each acquisition of a couple of data by the user.

This main programming function key indicates to the programming unit 8 that the user wishes to begin acquisition of a sequence of tracks so as to produce a reading programme. It therefore generates a programme-initiating message which is addressed to the programming unit 8.

The duration of timing is fixed at the time of manufacture of the reader. It will be for example equal to 10 seconds.

If no programming function key is actuated during this period of 10 seconds, the programming unit considers that programming is either abandoned by the user (if no acquisition has been carried out), and thus the current state of the reader is not modified, or that there is no longer a couple of data to be acquired, and consequently the programming unit 8 inserts after the last couple acquired an end-of-programme message.

The delay means is embodied by a segment of liquid crystals which, as soon as the main programming function key has been actuated, is placed in a state in which it flashes in the vicinity of this main programming function key. At the end of the delay period, if no other programming key has been validated,

this liquid crystal segment extinguishes finally if no couple has been chosen, or it remains lit continuously in order to indicate that a programme is memorised.

This main key will likewise serve to modify a programme after its memorisation.

The auxiliary memory 12 allow storage of a couple of data (n, m) representative of the track (n) in course of reading, and of the disc (m) which contains it at the moment when programming is carried out. If programming is carried out while the reading means 3 are in their passive state, or if the disc which was being read before acquisition of the programme is replaced by another disc, the stored couple is the couple (0, 0).

Such an arrangement enables the reader according to the invention to function in accordance with at least two different modes, thus considerably increasing the ease of listening for the user.

In a first mode, after reading all the tracks of the programme, the control unit 6 commands the reading means 3 to read the track (n+1) which follows that (n) which has been memorised in the auxiliary memory 12. To this effect the control unit 6 is connected to the auxiliary memory 12. Naturally, if the content of this memory is empty, there is no appeal to the reading

means 3, which are placed by the control unit 6 in their passive state.

This first functioning mode thus ensures automatic return of the reading means 3 to the reading position, after execution of a programme.

In a second functioning mode, after reading all the tracks of a programme, the control means 6 commands stoppage of the reading means 3, thus leaving the user free either to command reading of any track of one of the discs, or to return in a semi-automatic manner to the track which follows that which had been memorised in the auxiliary memory 12.

In the latter case, there is provided a specific function key on the facade which by simple actuation enables such a return. Such a key asks the control unit 6 to read the contents of the auxiliary memory 12, then to increment by one unit the number (n) associated with the track stored in that memory, in order to command the reading means 3 to read the said corresponding track (n+1).

There may likewise be provided a specific key enabling simple display of the data stored in the auxiliary memory 12.

It is clear that one may envisage readers equipped with electronic circuits permitting the first and/or second mode of functioning. Consequently, in the hypothetical case where the reader operates only in the first mode, it will not be necessary to equip it with a specific key ensuring a totally automatic return.

On the other hand, if provision is made to couple the first and second modes, the reader must be equipped with a specific key affording access to each of the two modes. Thus, at the end of programming, if the specific key is actuated, the reader is locked in its second functional mode, which will cause a fully automatic return, while upon not actuating a specific key, the reader is locked in its second functioning mode.

Reference will now be made to Figure 2 in order to describe in more detail a possible programming mode of a reader according to the invention.

In the stage 20, actuating of the function key for main programming generates a programme-initiating message which is addressed to the programming unit 8. This on the one hand triggers counting by the delay means 11 and on the other hand verification at stage 21 of the stage of functioning of the reading means 3 by the control unit 6, said state being either active (disc

being read), or passive (reading means 3 out of operation).

The system then passes to stage 22 in which the programming unit 8 reads the contents of the memory 9 of the management unit 5, which contains in real time the number of the track being read, as well as the disc which carries it. This content is then memorised in the auxiliary memory 12 in the form of a couple of data (n, m) representative of the number (n) of the track and of the number (m) of the disc containing this track.

If the state of the reading means 3 is active, n and m are different from zero. On the other hand, if their state is passive, then n equals m equals zero.

The system then passes to stage 23 during which the sequence is generated.

This sequence, forming a programme, is stored in the sequential memory 10 of the programming unit 8 in the form of a succession of couples (j, k) of data representing a track number (j) and the number of the corresponding disc (k), in the image of the couple (n, m) memorised in the auxiliary memory 12.

These couples of data may be stored in all the forms known to the person skilled in the art, as for example

in the form of a sequence of binary numbers, or a string of characters.

The system then passes to stage 24 in which it proceeds to a new verification of the stage of functioning of the reading means 3, as described above in stage 21.

Again, two cases are presented.

If the state of the reading means is active, the system waits for the end of reading of the current track (n, m). This operation is carried out for example by effecting successive interrogations until a signal is obtained indicating that the reading means 3 are in their passive state. However there may also be envisaged a system of waiting until the control unit 6 addresses to the programming unit 8 an end-of-track signal. The reading means 3 are then placed in their passive state.

According to the invention, when the reading means has become passive, i.e. if the contents of the auxiliary memory comprises data of non-zero values, the programme is launched automatically as soon as it has been acquired and its memorisation is complete. The system then passes to stage 25, during which execution of the memorised programme is carried out.

On the other hand, when the state of the reading means 3 is passive in stage 21, i.e. when the content of the auxiliary memory comprises data of zero value, the programming unit is put in a waiting state until it receives from the user a command to launch the programme which has just been memorised. Actuation of any of the control keys located on the facade of the reader will then trigger launching of the programme in stage 25.

Naturally a specific function key may be provided authorising launching of a memorised programme.

In order to describe this stage 25, reference will be made to Figure 3.

Stage 25-1 marks the beginning of execution of the programme. At stage 25-2, the programming unit 8 establishes at value 1 a position counter indicating the position of the couple in the sequence. Then, at stage 25-3, it reads the content of the first couple (j, k) of the sequence, where j indicates the number of a track and k its carrier.

In stage 25-4, the programming unit 8 looks in the management memory 9 to see whether it contains the table of contents of the carrier concerned (k). If this is not the case, the programming unit 8 asks the control unit 6 to cause the reading means 3 to read the

table of contents of the carrier concerned (k). This table is then memorised in the management memory 9.

Knowing the table of contents of the carrier concerned, the programming unit 8 proceeds to verify all the couples of data (x, k) indicating the carrier (k) concerned. This constitutes stage 25-5.

Any couple of data indicating the support concerned (k) incompatible with the table of contents of this carrier concerned (k) is then automatically deleted from the sequence initially memorised in the sequential memory 10, thus constituting stage 25-6.

The programme is then executed at stage 25-7, either by reading the track (j) indicated by the verified couple (j, k) or by verification of the following couple, if this has not already been done, by returning to stage 25-3, and after having incremented by one unit the position counter, at stage 25-8.

In the first case, after reading the track (j) indicated by the first couple (j, k), the position counter is incremented by one unit in stage 25-8, bringing it to stage 25-3, where compatibility of the second couple of data of the sequence (except if the carrier which it indicates is the same as that of the preceding couple (k)), is verified. In this case, reading of the indicated track is directly effected,

then the system passes to the following couple, and so on until the track indicated by the last couple of the sequence is read.

According to the invention, a programme may be executed according to two sub-modes.

In a first sub-mode, the programming unit manages the position of the couples of data in the sequence memorised, with the aid of a displaceable pointer. Upon launching a programme, the pointer is positioned facing the first couple of the sequence. The programming unit 8 addresses to the control unit 6 the couple of data placed opposite the pointer, enabling this control unit 6 to command the reading means 3 to read the track corresponding to the couple of data received.

At the end of reading of this page, the control unit 6 addresses to the programming unit 8 a message indicating that the system may pass to the following track of the sequence. This automatically causes displacement of the pointer from the first couple to the second couple of the sequence. The programming unit 8 is then in a position to address, after verifying its compatibility, the second couple indicated to the control unit 6, and the operation of reading/displacement/verification/addressing is

reproduced until the pointer arrives opposite the last couple of the sequence.

In a second sub-mode, the couples of the sequence are positioned one above the other in order to produce a stack. At the start of execution of the programme, a fixed pointer is positioned at the top of the stack facing the first couple of the sequence, permitting the programming unit 8 to address this couple, after verification of its compatibility, to the control unit 6, so that it can order it to be read. At the end of reading of the track, the control unit 6 addresses to the programming unit 8 a message indicating that it can send the second couple of the sequence. On reception of this message, the couple which was facing the pointer is deleted from the stack, and all the following couples rise by one position in the stack, the second couple now being opposite the pointer, enabling the programming unit 8 simply to address this new couple to the control unit after verification of its compatibility.

In the second sub-mode, the couples of a sequence of a programme are thus deleted as they are read. As a consequence, at the end of execution of a programme it is no longer possible to recover the content of said programme. Naturally it can be envisaged that an annexe memory may be provided enabling memorisation of the initial sequence.

Whatever sub-mode may be chosen, at the end of execution of a programme the system passes to stage 26 in which the programming unit addresses to the control unit 6 a message indicating that the programme is terminated.

In the hypothetical case where the reader can function only in the first mode described above (totally automatic return) the control unit 6 reads the content of the auxiliary memory 12, constituting stage 27.

The content of this memory is the couple of data (n, m) where n is the track number and m the disc number.

If n equals m equals zero, this means that the programme which has just been executed was begun while the reading means were in their passive state, or that the disc which was being read during acquisition of the programme has been replaced. Programming is then terminated. The programming unit 8 addresses to the control unit 6 a message instructing it to put the reading means 3 into the passive state.

If n and m are both different from zero, this means that the programme which has just been executed was begun after reading of the track number n of the disc number m.

The programming unit 8 then increments by one unit the number n, which then becomes the number n + 1, which constitutes stage 28, then in stage 29 the programming unit addresses to the control unit 6 a message asking it to place the reading means 3 at the start of track n + 1 of the disc m in order to read the content thereof. The programming procedure is then terminated and reading of disc m begins again at track n + 1.

It is clear that in the hypothetical case where the reader can only operate in the second functioning mode described above (semi-automatic return), stages 27 to 29 need not exist.

In this case, resumption of reading of the disc m from track n + 1 will be carried out by actuating a specific key as described above, said key alone ensuring execution of stages 27 to 29.

During stage 23, of acquisition of the tracks of a programme, it is possible, as is known, to carry out a secondary procedure of modification of the tracks already memorised, whatever stage the reading means 3 are in (active or passive states).

Otherwise, thanks to the independent functioning of the programming unit 8 and control unit 6, it is likewise possible to modify a programme memorised while the latter is being executed.

According to the functional sub-mode selected, these modifications will apply to any one of the tracks of the programme (first sub-mode in which the couples of a sequence are maintained integrally in the sequential memory) or only on the tracks of the programme which have not yet been read (second sub-mode in which the couples of a sequence are deleted as the track corresponding thereto is read).

Otherwise, if one of the drawers which comprises one of the loaded discs indicated by one of the couples of a programme, is replaced, this automatically involves deletion from the sequential memory of all the couples comprising data indicating this replaced disc. This automatic procedure is applied whatever may be the state of the reading means or of the programming unit. It is thus applied during programming, during execution of a programme, or during conventional reading if a programme is memorised.

Finally, the acquisition means 7 likewise comprise a cancelling key mounted on the facade of the reader 1 and connected to the programming unit 8, and adapted to delete at any moment a memorised programme or the tracks of a programme being read, thus interrupting a programme during its execution.

It is clear that the procedures described above are given by way of example and may be adapted by the person skilled in the art depending on the use envisaged.

Moreover, the invention may be applied to any numerical information carrier of the compact disc, audio and/or video type, but it may also be envisaged as applied to magnetic tape readers of the audio and/or video type.

Similarly, in the present invention, the word reader must be understood in its widest sense. It likewise covers recorders. Consequently, the present invention likewise applies to these latter.

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CLAIMS

1. Reader for numerical information carriers such as a compact disc (2) of the type comprising:

- material reading means for the carrier (3),

- control means (4) comprising:

means of carrier management (5) adapted to memorise data which has been read, forming a "table of contents" identifying all the tracks of information present on at least one carrier (2),

means of controlling reading (6), adapted to cause, by reading means (3), reading of the "current" track of the carrier, after preselection of the latter by the user, and

means of sequential programming (8) enabling acquisition by the user of sequence of track numbers to be read, and storage of this sequence in a zone forming a sequential memory (10) after its validation by the user,

characterised in that the sequential programming means (8) are functionally separated from the reading control means (3), and

in that the memory (9) of the carrier management means (5) and the sequential memory (10) are jointly accessible to the sequential programming means (8) and to the reading control means (6), so that the sequential programming means (8) may also be rendered operative during functioning of the reading control

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means (6), in order to permit modification of the contents of the said sequential memory (10).

2. Reader according to claim 1, characterised in that the sequential memory (10) is adapted to memorise each item in the sequence in the form of a couple of data relative to the number of a track and of the carrier (2-i) which contains it.

3. Reader according to claim 2, characterised in that the sequential programming means (8) are adapted, when receiving a command from the reading control means (6) and indicating opening of a mobile element enabling introduction or extraction of one of the carriers indicated by a memorised sequence, to suppress in the sequential memory (12) all the couples comprising data relative to the said carrier accessible by the said open mobile member.

4. Reader according to one of claims 1 to 3, characterised in that he sequential programming means (8) are adapted to store in the sequential memory (10) a sequence of **track numbers** to be read forming a programme, without knowing the content of the tables of contents of the carriers indicated by the said sequence.

5. Reader according to claim 4, characterised in that the sequential programming means (8) are adapted, when

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there is a need to read one track of one sequence indicating a carrier whose table of contents is not known, to compare, after reading said table of contents, the data of the couple or couples of the said sequence indicating the said carrier to the said table of contents, and to eliminate in the sequential memory (12) the couple or couples comprising data incompatible with the content of the said table of contents.

6. Reader according to one of claims 1 to 5, characterised in that the sequential programming means (8) also comprise an auxiliary memory (12) intended, when programming is carried out during the course of reading a given track of a carrier, to memorise a couple of data relative to the said carrier and number of the said given track.

7. Reader according to claim 6, characterised in that the sequential programming means (8) are adapted, when a command is received from the reading control means (6) and indicating a replacement, during reading of a programme, of the carrier containing the given track memorised in the auxiliary memory (12), to replace in the said auxiliary memory the couple of data relative to the said track given by a new couple of data of zero value.

8. Reader according to one of claims 6 and 7, characterised in that the reading control means (6) are

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adapted after completion of reading of the tracks of a sequence and when the auxiliary memory (12) contains data of non-zero value, to cause reading of a track whose number is that stored in the auxiliary memory (12), incremented by one unit, and the carrier is that stored in the said auxiliary memory (12).

9. Reader according to one of claims 6 and 7, characterised in that the reading control means (6) are adapted, after completion of reading of the tracks of a sequence and when the auxiliary memory (12) contains data of zero value, to place the reading means (3) in their passive state.

10. Reader according to one of claims 1 to 9, characterised in that the programming means (8) are adapted, during generation of a sequence, to modify and/or suppress and/or add, on the command of the user, at least one couple of data relative to a track number and to its carrier among the couples of the said sequence already memorised in the sequential memory (10).

11. Reader according to one of the preceding claims, characterised in that the programming means (8) are adapted, during reading of the tracks of the programme, to modify and/or suppress and/or add, on the command of the user, at least one couple of data relative to a track number and to its carrier among the couples of

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the said programme memorised in the sequential memory (10).

12. Reader according to one of claims 1 to 11, characterised in that the programming means (8) are adapted to delete from the sequential memory (10) a couple of data of a sequence in course of being read, from the completion of reading of the track indicated by said couple of data, so that there exist in the said sequence only the couples of data indicating the tracks remaining to be read.

13. Reader according to one of claims 6 to 12, characterised in that the programming means (8) are adapted, after memorisation of a programme and in the case of recognition of the data of non-zero value in the auxiliary memory (12), to command the control means (6) to read the tracks of the said programme.

14. Reader according to one of claims 6 to 12, characterised in that the programming means (8) are adapted, after memorisation of a programme and in the case of recognition of data of zero value in the auxiliary memory (12), to wait for a command from the user to instruct the control means (6) to read the tracks of said programme.

15. Reader according to one of the preceding claims, characterised in that the programming means (8)

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comprise timing means (11) intended to count out a predefined period of time after each acquisition of a track of a sequence, and to generate an end-of-sequence signal when the said interval of time has passed without a new acquisition of a track.

16. Reader according to one of claims 1 to 15, characterised in that the acquisition means (7) comprise a cancelling key connected to the programming means (8) and adapted to cancel a memorised programme or the tracks of the said programme remaining to be read.

17. Method of control by programming of a reader of numerical information carriers, such as a compact disc, characterised in that it comprises:

- a first stage in which acquisition is carried out of a sequence of couples of data relative to the number of a track and of the carrier which contains it, and storage of a sequence in a zone forming a sequential memory (10), without knowing beforehand the table or tables of contents of the carriers of the tracks of the sequence;
- a second stage in which the table of contents of the support is read, comprising the nth track to be read of the memorised sequence;
- a third stage in which the content of the table of contents of the carrier comprising the nth track of the sequence in the course of reading is compared to the

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data of the couples of this sequence indicating the said carrier, and in the sequential memory (12), or the couple or couples comprising data incompatible with the contents of the said table of contents are suppressed, and

- a fourth stage in which, as a function of the result of the comparison carried out during the third stage, there then follows either reading of the information stored in the nth track, or reversion to the second stage in order to apply the process to the track following the nth track of the sequence to be read.