

Information recording on a multitrack record carrier.

The invention relates to an apparatus for recording an information signal in a plurality of tracks running in the longitudinal direction of a longitudinal record carrier, such as a magnetic record carrier, to a record carrier and to a method of recording. An apparatus as defined in the foregoing is known from USP 4,318,141, document D1 in the list of related documents that can be found at the end of this description.

Conventional organisation of recording of information signals on a longitudinal record carriers is sequential, with information signals being recorded serially in one or more tracks along the length of the record carrier. Information signals are typically recorded in one or more tracks from the beginning of the record carrier to the end of the record carrier. If the information signal to be recorded is longer than the length of the record carrier, the transport mechanism steps the one or more heads to one or more different tracks and the recording process continues back from the end toward the beginning of the record carrier. Consequently, the multiple tracks are recorded in a serpentine like manner on the record carrier. The known apparatus has the disadvantage of a long access time for accessing the information recorded on the record carrier.

The invention aims at providing an improved apparatus for recording the information signal on a record carrier, which results in shorter access times for accessing the information.

The apparatus for recording an information signal in a plurality of tracks running in the longitudinal direction of a longitudinal record carrier, the apparatus comprising

- input means for receiving the information signal,
- signal processing means for processing the information signal so as to bring it in a form in which it can be recorded in the plurality of tracks on the record carrier,
- transport means for transporting the record carrier in either a first longitudinal direction or in a second longitudinal direction, which is reverse to the first direction,
- writing means for writing the processed information signal in said tracks on the record.

carrier in a serpentine like manner, starting from a start location viewed in the first longitudinal direction of the record carrier towards a first end of the record carrier, the apparatus further comprising

- means for dividing the total length of the record carrier between said start location and said
- 5 first end of the record carrier into a plurality of sub portions of the record carrier,
- the writing means being further adapted to write the processed information signal in a first track in a specific first portion, in the first direction from a first end to a second end of said first portion, the transporting means being further adapted to reverse the direction of transport into the second direction upon reaching the second end of said first portion, the
- 10 writing means being further adapted to write the processed information signal in a second track in said first portion from said second end towards said first end, the transporting means being further adapted to reverse the direction of transport into the first direction upon reaching the first end, the writing means being further adapted to write the processed information signal in a third track in the first portion from said first end towards said second
- 15 end of said first portion.

The invention is based on the following recognition. By dividing the total length between the start location and said first end of the record carrier into a plurality of sub portions, it is possible to make 'shorter' serpentines by reversing the transport direction of the record carrier upon reaching each end of a portion and switching over to another track.

- 20 When a film is recorded in this way, it is possible to easily and quickly access other moments in time in the film by simply changing tracks.

- These and other objects of the invention will become apparent from and further
- 25 elucidated with reference to the embodiments described in the following figure description, in which

- figure 1 shows schematically the record carrier,
- figure 2 shows an apparatus in accordance with the invention,
- figure 3 shows the record carrier obtained with the apparatus of figure 2 in
- 30 more detail, and
- figure 4 a schematic picture of a TV screen for priority setting.

Figure 1 shows the record carrier 2, schematically over its total length. The start end of the record carrier 2 is indicated by BOT (beginning-of-tape) and the final end is

indicated by EOT (end-of-tape). A lead-in portion and a lead-out portion are shown, being the portions between the start end (BOT) of the record carrier and the line l_1 and the final end (EOT) of the record carrier and the line l_2 respectively. A data area for recording the information signal is available between the lead-in portion and the lead-out portion of the record carrier 2.

Tracking signals may be recorded in the record carrier in order to enable recording of the information so as to obtain information tracks T_1 to T_n , as shown in figure 1. Reference is made to the documents D2 to D6 which further describe the tracking signals and the use of such tracking signal. Where necessary, those documents are assumed to be incorporated by reference in the present application.

Figure 2 shows an embodiment of an apparatus for recording an information signal on the record carrier 2 of figure 1, which has tracking signals prerecorded on it. Figure 3 shows how the information signal is recorded on the record carrier 2. The apparatus of figure 2 has an input terminal 30 for receiving the information signal. The input terminal is coupled to an input of a formatter unit 32, which converts the information signal into a format suitable for recording on the record carrier 2. An output of the formatter unit 32 is coupled to a write unit 33 comprising a write/read head 34. The formatted information signal is supplied to the write/read head 34 and recorded in one of the tracks $T_1, T_2, \dots, T_n$ on the record carrier 1. The record carrier as shown in figure 2 is supposed to be transported in directions indicated by the arrow 31.

The head 34 is further adapted to read tracking signals recorded in the record carrier. The tracking signals are supplied to a filter unit 36, which has a bandpass filter characteristic with a centre frequency equal to the specific frequency of the tracking signals. As the frequency of the tracking signals is low relative to the frequency content of the formatted information signal, it is possible to read the tracking signals from the record carrier, while writing the formatted information signal into the track T_1 .

A generator unit 38 is present for generating a control signal in response to the tracking signals read by the head 34. This control signal is supplied to an input 50 of an actuator unit 40. The actuator unit 40 actuates a movable mounting 42 on which the head 34 is mounted. The movable mounting can have any form. One preferred embodiment of a mounting is described in EP patent application no. 95202926.2, document D2 of the list of related documents, filed recently in the name of applicant, but not yet published. Further, the functioning of the tracking servo mechanism is extensively described in document D6 of the list of related documents.

A control unit 42 is present for controlling a motor transport unit 44. By controlling the motor transport unit, the record carrier 2 is transported in one of the two directions shown by the arrow 31.

Figure 3 shows an example of the record carrier after having recorded an
5 information signal, such as a movie on the record carrier 2. The width of the record carrier is largely exaggerated in order to better explain the record carrier and the functioning of the apparatus. In total twelve tracks T_1 to T_{12} are shown in this example.

As can be seen, the total length of the record carrier between the start point, which is the line s , and the end of the record carrier, which is the line l_2 , is divided into a
10 number of portions, denoted P_1 to P_4 . The portions are in this example of equal length, which is expressed in time, as being of a length of 4 minutes of recording or reproduction time.

When recording a movie on the record carrier, indicated by movie #1, recording starts in track T_1 indicated by the dot, at the start location indicated by the line s .
15 As can be seen, in this example, the start location is not at the beginning of the record carrier but distance away from the beginning of the record carrier. Expressed in recording or reproduction time, the start position is located two minutes away from the beginning of the record carrier, which is the line l_1 . During recording the first four minutes of the movie, in this example, the record carrier is transported in such direction that recording takes place in
20 the track T_1 , in the direction towards the end l_2 of the record carrier. Thus, a portion of the information signal is recorded in that part of the track T_1 lying in the first portion P_1 . After four minutes have lapsed, the transport direction of the record carrier is reversed. Further, the head is positioned so that recording continues in track T_2 in a direction towards the start position, that is the line s . Thus, a portion of the information signal is recorded in that part
25 of the track T_2 lying in the first portion P_1 . Upon reaching the start position, the transport direction of the record carrier is again reversed. Further, the head is replaced so that recording continues in the track T_3 in a direction towards the end, the line l_2 , of the record carrier. Recording continues for the next 8 minutes, until the transport direction of the record carrier is again reversed. Thus, a portion of the information signal is recorded in that part of
30 the track T_3 lying in the portions P_1 and P_2 . The head is positioned in cooperation with the track T_2 and recording continues for 4 minutes, until the head reaches the boundary line between the portions P_1 and P_2 . Next, upon reaching the said boundary line, the head is positioned above the track T_1 and the transport direction of the record carrier is reversed. The next portion of the information is thus recorded in that part of the track T_1 located in the

portion P_2 . Recording continues in that part of the track T_1 located in the portion P_3 . Next, upon reaching the boundary line between the portions P_3 and P_4 , the head is positioned above the track T_2 and the transport direction of the record carrier is reversed again.

Recording continues in the track T_2 , until the boundary between the portions P_2 and P_3 is reached. The head is positioned above the track T_3 and the transport direction is reversed. After having reached the boundary between the portions P_3 and P_4 , the head is positioned above the track T_1 so that the final part of the track T_1 can be filled with recorded information. Upon reaching the end of the record carrier, which is the boundary line l_2 , separating the information area from the lead out area, the head is positioned above the track T_2 and the direction of transport is reversed, so that the final part of the track T_2 can be filled with information. Upon reaching the boundary between the portions P_3 and P_4 , the head is positioned above the track T_3 and the direction of transport of the record carrier reversed so that the final part of the track T_3 can be filled with information.

Upon again reaching the end of the record carrier, the head is positioned above the track T_4 and the direction of transport reversed so that the information can be recorded in the track T_4 . In the present example, the movie is 64 minutes long, so that the remaining part of the movie can be recorded in the track T_4 , until the head has reached the starting position s .

Upon programming a movie for recording in the apparatus, the length of the movie is inputted in any form into the apparatus. Using this information, the apparatus is capable of choosing such a recording path through the various portions that the start and the end of the recording are at the same position viewed in the length direction of the record carrier, namely the position indicated by the line s .

In another embodiment, the information signal itself comprises information about the length of the movie. The apparatus is now capable of retrieving this length information from the information signal received, so that the apparatus is again capable of choosing the appropriate recording path through the various portions.

Other programs may not require the specific recording method as described above for movie # 1. As an example, another program, denoted 'special presentation' is recorded in the well known way in the tracks T_5 and T_6 and again another program, denoted 'time shift' is recorded in the portions P_1 , P_2 and P_3 of the tracks T_7 and T_8 and another program, also denoted 'time shift' is recorded in the portions P_1 and P_2 of the tracks T_{11} and T_{12} .

The program denoted 'movie # 2' is also characterized by the specific recording

method as described above. The method is advantageously used in order to fill the empty portions in the tracks T_7 , T_8 , T_{11} and T_{12} behind the programs denoted 'time shift'.

As has been said earlier, the start location, indicated by the line s , is not at the beginning of the record carrier, but at a distance therefrom. This enables the recording of
5 further programs in the area between the beginning of the record carrier, indicated by the line l_1 , and the start location, indicated by the line s . Those recordings can also start at the start location. The part of the record carrier between the beginning l_1 and the start location s of the record carrier is also divided into a number of, in this example two, portions P_5 and P_6 of one minute of recording-reproduction time each. As can be seen in figure 3, a
10 directory (table-of-contents) is recorded in the parts of the tracks T_1 and T_2 inside the portion P_5 . The directory starts at the start location s and can be read by scanning the track T_1 in the second direction, that is from right to left in figure 3. Upon reaching the boundary between the portions P_5 and P_6 , the direction of transport of the record carrier is reversed and the head is positioned above the track T_2 , so that the remaining part of the direction recorded in
15 the track T_2 and within the portion P_5 can be read. Positioning the directory in the way as shown has the advantage that, after having recorded a movie, such as the movie#1, the directory can be updated very quickly. After having terminated the recording of the movie#1, the head is positioned on track T_4 , at the start position line s . Updating the directory can be realized by repositioning the head in the vertical direction as seen in figure 3 towards a
20 position where the head is positioned above the track T_1 , so that the directory can quickly be updated, whilst after terminating the update, the head is again at the start location, line s .

The remaining part of the record carrier at the left hand side of the line s can be used for recording news items, as shown in the tracks T_9 and T_{10} .

The apparatus could further be used in combination with a service provider for
25 supplying services on demand of a customer. This is called 'custom-cast'. A custom-cast service provider may be capable of transmitting a so-called 'custom cast' message to the user. This message is received via some transmission chain and recorded automatically on the record carrier, as shown in figure 3 by the two items denoted 'customs cast' in the tracks T_7 and T_8 in the portions P_5 and P_6 . The user may switch the apparatus into a reproduction
30 mode for a reproduction of the 'custom cast' information recorded. This could lead to a screen as shown in figure 4. This screen shows all subjects of information that can be chosen by the user. Upon choosing a subject and a corresponding priority, the priorities will be retransmitted to the service provider, which will transmit at a later moment information regarding the items chosen. Those items can be recorded automatically on the record carrier,

such as the items in the tracks T_{11} and T_{12} denoted 'segments', for a later retrieval.

More specifically, the items are recorded such on the record carrier that items having the highest priority are recorded first, and items having a lower priority are recorded 'later', in the sense that upon starting the reproduction mode by the user for those items, the
5 items having the highest priority are reproduced first and the items having a lower priority are reproduced later.

The service provider is also capable of transmitting general information as regards programs and movies that can be obtained from the service provider. Such general information is recorded automatically on the record carrier, denoted by 'opening', in the
10 tracks T_3 and T_4 in the portion P_5 and the tracks T_1 to T_4 in the portion P_6 . Further, commercials specifically related to the chosen priorities can be supplied by the service provider and recorded in the tracks T_6 and T_7 , in the portions P_5 and P_6 .

Whilst the invention has been described with reference to preferred embodiments thereof, it is to be understood that these are not limitative examples. Thus, various
15 modifications may become apparent to those skilled in the art, without departing from the scope of the invention, as defined by the claims. As an example, the invention has been described with reference to a recording of an information signal by one head in one track on a record carrier. It should however be noted that the invention is equally well applicable to apparatuses in which the information is recorded using a plurality of heads in a plurality of
20 tracks. The apparatus described is very well suitable in multi-media applications, as it enables an automated cooperation with a service provider's network.

Further, the invention lies in each and every novel feature and combination of features.

Related documents

- (D1) USP 4,318,141
- 5 (D2) EP pat. appln. no. 95202926.2 (PHN 15.520), filing date 30.10.95
- (D3) EP pat. appln. no. 95203028.6 (PHN 15.543), filing date 08.11.95
- (D4) EP pat. appln. no. 95203029.4 (PHN 15.545), filing date 08.11.95
- (D5) EP pat. appln. no. 95203192.0 (PHN 15.563), filing date 21.11.95
- (D6) EP pat. appln. no. 95203380.1 (PHN 15.594), filing date 07.12.95

CLAIMS

1. Apparatus for recording an information signal in a plurality of tracks running in the longitudinal direction of a longitudinal record carrier, the apparatus comprising
- input means for receiving the information signal,
 - signal processing means for processing the information signal so as to bring it in a form in
- 5 which it can be recorded in the plurality of tracks on the record carrier,
- transport means for transporting the record carrier in either a first longitudinal direction or in a second longitudinal direction, which is reverse to the first direction,
 - writing means for writing the processed information signal in said tracks on the record carrier in a serpentine like manner, starting from a start location viewed in the first
- 10 longitudinal direction of the record carrier towards a first end of the record carrier, the apparatus further comprising
- means for dividing the total length of the record carrier between said start location and said first end of the record carrier into a plurality of sub portions of the record carrier,
 - the writing means being further adapted to write the processed information signal in a first
- 15 track in a specific first portion, in the first direction from a first end to a second end of said first portion, the transporting means being further adapted to reverse the direction of transport into the second direction upon reaching the second end of said first portion, the writing means being further adapted to write the processed information signal in a second track in said first portion from said second end towards said first end, the transporting means
- 20 being further adapted to reverse the direction of transport into the first direction upon reaching the first end, the writing means being further adapted to write the processed information signal in a third track in the first portion from said first end towards said second end of said first portion.
2. Apparatus as claimed in claim 1, the transporting means being further adapted
- 25 to reverse the direction of transport into the second direction upon reaching the second end of said first portion, the writing means being further adapted to write the processed information signal in a fourth track in the first portion from said second end towards said first end, the transporting means being further adapted to reverse the direction of transport into the first direction upon reaching the first end, the writing means being further adapted to write



the processed information signal in a fifth track in the first portion from said first end towards said second end of said first portion.

3. Apparatus as claimed in claim 1, the writing means being further adapted to write the processed information signal in a second portion directly following the first portion,
- 5 in one of said first, second and third tracks, from the first end towards the second end of said second portion, the transporting means being further adapted to reverse the direction of transport into the second direction upon reaching the second end of said second portion, the writing means being further adapted to write the processed information signal in a second one of said first, second and third tracks in the second portion from said second end towards
- 10 said first end of said second portion, the transporting means being further adapted to reverse the direction of transport into the first direction upon reaching the first end of the second portion, the writing means being further adapted to write the processed information signal in a third one of said first, second and third tracks in the second portion from said first end towards said second end of said second portion.
- 15 4. Apparatus as claimed in claim 3, wherein the first one of said first, second and third tracks is the third track, the second one of said first, second and third tracks is the second track and the third one of said first, second and third tracks is the first track.
5. Apparatus as claimed in claim 1, wherein the start location does not coincide with the second end of the record carrier.
- 20 6. Apparatus as claimed in claim 5, further being adapted to record another information signal in tracks starting from said start location in said second direction towards the second end of said record carrier.
7. Apparatus as claimed in claim 6, wherein the means for dividing is further adapted to divide the total length of the record carrier between said start location and said
- 25 second end of the record carrier into a plurality of sub portions of the record carrier,
- the writing means being further adapted to write the processed other information signal in the second direction in a third portion lying on the other side of the start location than the first portion, in a seventh track from a first end towards a second end of the third portion, the transporting means being further adapted to reverse the direction of transport into the
- 30 first direction upon reaching the second end of said third portion, the writing means being further adapted to write the processed other information signal in an eighth track in the third portion from said second end towards said first end, the transporting means being further adapted to reverse the direction of transport into the second direction upon reaching the first end, the writing means being further adapted to write the processed other information signal



in a ninth track in the third portion from said first end towards said second end of said third portion.

8. Apparatus as claimed in claim 7, wherein the seventh track is the first track, the eighth track is the second track and the ninth track is the third track.

5 9. Record carrier obtained with the apparatus as claimed in anyone of the preceding claims.

10. Method of for recording an information signal in a plurality of tracks running in the longitudinal direction of a longitudinal record carrier, the method comprising the steps
- receiving the information signal,

10 - processing the information signal so as to bring it in a form in which it can be recorded in the plurality of tracks on the record carrier,

- transporting the record carrier in either a first longitudinal direction or in a second longitudinal direction, which is reverse to the first direction,

15 - writing the processed information signal in said tracks on the record carrier in a serpentine like manner, starting from a start location viewed in the first longitudinal direction of the record carrier towards a first end of the record carrier, the apparatus further comprising the step of

- dividing the total length of the record carrier between said start location and said first end of the record carrier into a plurality of sub portions of the record carrier,

20 - the writing step and transporting step being further characterized by writing the processed information signal in a first track in a specific first portion, in the first direction from a first end to a second end of said first portion, reversing the direction of transport into the second direction upon reaching the second end of said first portion, writing the processed information signal in a second track in said first portion from said second end towards said first end,
25 reversing the direction of transport into the first direction upon reaching the first end, writing the processed information signal in a third track in the first portion from said first end towards said second end of said first portion.