Description

BACKGROUND OF THE INVENTION

The present invention relates to magnetic tapes and methods of producing magnetic tapes.

Heretofore well known in the art is a rotary head-type PCM magnetic recorder/reproducer which converts audio signals into digital signals for recording the digital signals in a magnetic tape and reproducing the recorded digital signals. In general, a rotary head-type PCM magnetic recorder/reproducer employs error correction codes for correcting errors caused in the data upon recording/reproducing of the magnetic tape.

The error correction codes are adapted to correct the errors caused in the data following recording/reproducing of the magnetic tape thereby to reproduce high definition audio signals. However, when the number of errors is beyond the correction ability and error correction is disabled, compensation must be performed by means such as interpolation by taking the mean value of adjacent data. Further, most of the errors caused on the magnetic tape are burst errors, and hence the erroneous data are dispersed by interleaving processing for improving the ability of the error correction codes.

As hereinabove described, compensation processing is performed when the errors cannot be corrected, and mean value interpolation is employed as an effective compensation process with simple circuit structure. Such mean value interpolation is performed on condition that the adjacent data are correct.

Therefore, data of odd sample groups are separated as far as possible from those of even sample groups when the interleaving operation is performed.

Figs. 1 and 2 show magnetization patterns recorded on a magnetic tape by a conventional rotary head-type PCM magnetic recorder/reproducer.

The following description is made of a rotary head-type PCM magnetic recorder/reproducer of a two-head helical scanning system, which is taken as a typical example.

In Figs. 1 and 2, a magnetic tape T travels in the direction indicated by an arrow D and is scanned by rotary heads in the direction indicated by an arrow S. The data recorded in the magnetic tape T are of two channels A and B, and distributed into even sample groups $\bar{a}$ and odd sample groups b. For example, symbol $\bar{a}$ with symbol A + B indicates even sample groups of the channels A and B, and symbol Aa indicates an even sample group of the channel A.

The volume of interleaving is generally determined in consideration of burst length of errors and correction ability of error correction codes, and an even sample group $\bar{a}$ and an odd sample group b may be in line over a scanning interval, as shown in Fig. 1, or to the contrary.

Fig. 2 shows the even sample groups $\bar{a}$ and the odd sample groups b arrayed in equally divided scanning intervals. In the interleaving operation performed in this manner, errors are caused in continuous data when one of the rotary heads is instantaneously silted by magnetic powder coming off from the magnetic tape T, i.e., when the reproduced signals from one of the rotary heads are interrupted. Thus, it has been impossible to perform the mean value interpolation, which causes harsh noise.

GB-A-2038514 (corresponding to FR-A-2443171), US-A-4224642 and GB-A-2073935 all show arrangements in which samples of signals are permutated into groups so as to record the groups successively in a predetermined pattern in successive tracks of a tape. US-A-4224642 is concerned with recording a single channel, and discloses the recording of odd and even sample groups in alternate scanning intervals along each track. GB-A-2073935, upon which the preambles of the independent claims are based, is also concerned with the recording of a single channel. In this case interleaved samples are split into four groups, and each group is recorded along substantially the entire length of a respective track. Thus, a first group of odd samples is recorded in a first track, a first group of even samples is recorded in the next track, a second group of odd samples is recorded in the third track, and a second group of even samples is recorded in the fourth track. Sequentially occurring samples are also separated in the direction of the lengths of the tracks by a "statistically significant dropout length", to enhance the reliability of conventional dropout error concealment techniques. GB-A-2038514 is concerned with recording two channels, each of which is split into three sample groups, and the three sample groups of both channels are all recorded on a single track. All these arrangements suffer from the disadvantages referred to above.

SUMMARY OF THE INVENTION

A magnet tape and a method of producing according to the invention are set out in claims 1 and 17. Methods and apparatus for recording and reproducing digital signals, which are applicable to tapes of the present invention, are disclosed and claimed in parent European Patent Application No. 85301166.6 (Serial No. 0155101).

A preferred embodiment of the invention provides a magnetic tape which is less susceptible to noise produced on reproduction by a silted rotary

head and by errors in the tape travelling direction over a certain width along the cross direction of a magnetic tape.

In summary, the magnetic tapes of the preferred embodiment are recorded by equipment which converts analog signals of a plurality of channels into digital signals to distribute the digital signals of the plurality of channels into odd sample groups and even sample groups per each channel, and permutates the sample groups so that the odd sample groups and the even sample groups of the same channel are recorded in alternate scanning intervals and in regions occupying different positions along the direction of scanning, thereby to record the permutated odd sample groups and even sample groups of the respective channels on the magnetic tape using magnetic heads.

Therefore, according to the preferred embodiment, the signals may be readily corrected even if reproduced signals from one head are interrupted by, e.g., instantaneous silting of the head caused by magnetic powder coming off from the magnetic tape or a burst error is caused in the tape travelling direction over a wide range along the cross direction of the tape, whereby the signal-to-noise ratio of reproduced sounds or images can be improved. Further, excellent reproduced sounds and images can be obtained by properly selecting samples from the respective groups.

In the preferred embodiment of the present invention, even sample groups of a first channel and odd samples group of a second channel are arrayed in the same scanning intervals while odd sample groups of the first channel and even sample groups of the second channel are arrayed in scanning intervals adjacent to the said same scanning intervals, such that the odd sample groups and the even sample groups of the first channel are recorded in regions at different positions along the direction of scanning. Or, the even sample groups of the first channel and the even sample groups of the second channel may be arrayed in the same scanning intervals while the odd sample groups of the first channel and the odd sample groups of the second channel are arrayed in scanning intervals adjacent to the said same scanning intervals in such a manner that the odd sample groups and the even sample groups of the first channel are recorded in regions at different positions along the direction of scanning.

Preferably, the permutated odd sample group and even sample group of each channel in each scanning interval are encoded to generate error correction codes, which are arrayed in the scanning interval including information employed for generating the error correction codes.

Therefore, according to the preferred embodiment, the error correction codes are so generated and arrayed as to be completed with respect to the data included in one scanning interval, thereby to prevent increase in the clock rate required for encoding and decoding of the data.

Aspects of the present invention will now be described by way of example with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1 and 2 are illustrations showing conventional magnetization patterns;

Figs. 3 and 4 are illustrations showing magnetization patterns according to an embodiment of the present invention;

Fig 5 is a schematic block diagram showing a recorder/reproducer for recording signals on and reproducing signals from a tape of the present invention;

Fig. 6 is a schematic block diagram showing a memory address control circuit as shown in Fig. 5;

Fig. 7 is an illustration showing respective sample groups stored in a memory circuit as shown in Fig. 5;

Fig. 8 illustrates a magnetization pattern showing a frame array recorded in the memory circuit as shown in Fig. 7;

Fig. 9 is an illustration showing a magnetization pattern according to another embodiment of the present invention;

Fig. 10 is a schematic block diagram showing another recorder/reproducer for use with tapes of the present invention;

Fig. 11 is a schematic block diagram showing a memory address control circuit as shown in Fig. 10;

Fig. 12 is a timing chart showing operation of the memory circuits as shown in Fig. 10;

Fig. 13 is an illustration showing sample groups stored in the memory circuit as shown in Fig. 10;

Fig. 14 illustrates a magnetization pattern showing a frame array recorded by the sample groups as shown in Fig. 13; and

Fig. 15 is an illustration showing a magnetization pattern according to still another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 3 is an illustration showing a magnetization pattern recorded on a magnetic tape in an embodiment of the present invention. The principle of the present embodiment is now described with reference to Fig. 3. In a rotary head-type magnetic recorder/reproducer for use with tapes according to

the present embodiment, interleaving processing is characterized in that even sample groups and odd sample groups of the same channel are arrayed in alternate scanning intervals and in different regions, so that the regions are at different positions along the direction of scanning by rotary heads. By virtue of such array, at least either the even sample groups or the odd sample groups of the same channel can necessarily be obtained even if signals in one of two rotary heads are interrupted by the aforementioned silting, and hence no continuous sample errors are caused. Further, with respect to a burst error caused along the tape travelling direction in a certain width from the edge of the magnetic tape, either the even sample groups or the odd sample groups of the same channel can be obtained to half the width of the magnetic tape in the cross direction as shown in Fig. 3, whereby no continuous sample errors are caused in the same channel.

Fig. 4 is an illustration showing another example of the magnetization pattern. Also in the example as shown in Fig. 4, even sample groups and odd sample groups of the same channel are arrayed in alternate scanning intervals and in different regions located at different positions along the direction of scanning, and hence no sample errors are caused by interruption of signals similarly to the example as shown in Fig. 3.

Fig. 5 is a schematic block diagram showing a recorder/reproducer for tapes of the present invention and Fig. 6 is a schematic block diagram showing a memory address control circuit as shown in Fig. 5.

Description is now made of the structure of the recorder/reproducer with reference to Figs. 5 and 6. A rotary head-type PCM magnetic recorder/reproducer consists of a recording system and a reproducing system. A two-channel input terminal 1 of the recording system receives analog audio signals. The analog audio signals inputted in the input terminal 1 are supplied to a low-pass filter 2 to be band-restricted. Then the analog audio signals passed through the low-pass filter 2 are inputted in a sample-and-hold/A-D converter circuit 3. The sample-and-hold/A-D converter circuit 3 converts the analog audio signals into digital signals. The digitally converted signals are supplied to a memory circuit 4 to be stored therein. The memory circuit 4 is address-controlled by a memory address control circuit 5.

As shown in Fig. 6, the memory address control 5 is formed by a sample writing address generator circuit 501, a coding address generator circuit 502, a data reading address generator circuit 503 and a selector 504 which receives respective outputs from the sample writing address generator circuit 501, the coding address generator circuit 502 and the data reading address generator circuit 503 for making selective outputs at an address output terminal 505. A coding circuit 6 is provided in relation to the memory circuit 4. The coding circuit 6 generates codes for correcting and detecting errors in the digital signals stored in the memory circuit 4. The digital signals read from the memory circuit 4 are supplied to a modulation circuit 7 to be modulated by the same. The modulated digital signals are amplified by a recording amplifier 8, to be supplied to either a rotary head 10 or 11 which is selected by a first selection switch 9.

The digital signals reproduced by the rotary heads 10 and 11 are inputted through a second selection switch 12 for selecting the rotary head 10 or 11 in a reproducing amplifier 13. The reproducing amplifier 13 amplifies the reproduced digital signals to supply the same to a demodulation circuit 14. The demodulation circuit 14 demodulates the reproduced digital signals, to supply the demodulated outputs to a memory circuit 15. The memory circuit 15 is connected with a memory address control circuit 16, which controls addresses of the memory circuit 15. The memory circuit 15 is further connected with a decoding circuit 17. The decoding circuit 17 is adapted to correct and detect errors in the reproduced digital signals. The reproduced digital signals read from the memory circuit 15 are supplied to a D-A converter circuit 18, to be converted into analog signals. The converted analog signals are outputted at an output terminal 20 through a low-pass filter 19.

Operation in the recording system is now described. The input terminal 1 receives analog audio signals of left and right channels, which are respectively band-restricted by the low-pass filter 2. The outputs from the low-pass filter 2 are supplied to the sample-and-hold/A-D converter circuit 3, to be converted into digital signals W_{Ln} and W_{Rn}. Symbol n represents order of sampling, and the analog signals of the left and right channels are successively sampled to be alternately outputted as digital signals W_{L0}, W_{R0}, W_{L1}, W_{R1}, W_{L2}, W_{R2}, ... The digital signals W_{Ln} and W_{Rn} are supplied to the memory circuit 4 to be successively written in the same with memory addresses being controlled by the sample writing address generator circuit 501 of the address control circuit 5 provided in relation to the memory circuit 4. The address control operation is hereinafter described in detail.

The coding circuit 6 provided in relation to the memory circuit 4 reads necessary samples included in the digital signals stored in the memory circuit 4 for generating error correction codes and again writing the same in the memory circuit 4. The digital signals and the error correction codes are subsequently read by the address control cir-

cuit 5. The read digital signals are inputted in the modulation circuit 7, to be converted into signals appropriate for recording in the magnetic tape. The converted signals are amplified by the recording amplifier 8, to be recorded in the magnetic tape by the two rotary heads 10 and 11 through the first selection switch 9. The first selection switch 9 is adapted to switch the circuits to be connected with the rotary heads 10 and 11 in recording and reproducing of the signals.

Operation in the reproducing system is now described. The reproduced digital signals read from the two rotary heads 10 and 11 are supplied to the second selection switch 12 through the first selection switch 9. The second selection switch 12 is adapted to supply the signals read from the rotary heads 10 and 11 to the reproducing amplifier 13 as single-system signals. The reproduced digital signals are amplified by the reproducing amplifier 13, to be supplied to the demodulation circuit 14. The demodulation circuit 14 demodulates the reproduced digital signals to those before modulation, to supply the same to the memory circuit 15. The memory circuit 15 is address-controlled by the memory address control circuit 16, to write the reproduced digital signals. The decoding circuit 17 provided in relation to the memory circuit 15 reads necessary samples from the memory circuit 15 to correct and detect errors. The corrected samples in the memory circuit 15 are subsequently read therefrom by the memory address control circuit 16, to be supplied to the D-A converter circuit 18. The D-A converter circuit 18 converts the digital signals into analog signals, to supply the same to the low-pass filter 19. The low-pass filter 19 performs band restriction of the analog signals, to output the same from the output terminal 20.

A clock generator circuit 21 is adapted to generate clock pulses required for the respective components of the recording and reproducing systems.

In relation to the memory circuits, 4 and 15 as shown in Fig. 5, description is now made of means for performing the aforementioned data interleaving operation employed in the rotary head-type PCM magnetic recorder/reproducer.

Fig. 7 is an illustration showing an example of samples stored in the memory circuit as shown in Fig. 5. In Fig. 7, the magnetic heads 10 and 11 respectively record 32 samples of the left and right channels respectively during an interval for scanning the magnetic tape. Numerals in the lateral direction indicate column unit memory addresses (hereinafter referred to as "frame addresses") and numerals in the vertical direction indicate row unit memory addresses (hereinafter referred to as "sample addresses").

In the recording system, the A-D converted and subsequently supplied samples W_{L0}, W_{R0}, W_{L1}, W_{R1}, ... are written in the memory circuit 4 with addresses controlled by the address control circuit 5 to be in the array as shown in Fig. 7. In other words, the samples are successively written in the memory circuit 4 with sample address being set at 0 and the frame address being set at 0, 8, 12, 4, ... When the frame address comes to 7 and the sample W_{R7} is written in the memory circuit 4, the sample address is updated by 1 so that a given number of samples are written in the memory circuit 4 with the frame addresses being again controlled. The samples are thus arrayed in the form of a matrix of 4 x 16, while even sample groups and odd sample groups of the respective channels are already separated from each other. With respect to the sample matrix thus formed, the coding circuit 6 as shown in Fig. 5 performs encoding of the samples read by the coding address generator circuit 502 of the memory address control circuit 5, whereas explanation of such encoding operation is omitted since the same is not the substance of the present invention. It is to be noted that codes C_{Ln} and C_{Rn} are utilized as error correction codes in the unit of frames.

The data reading address generator circuit 503 of the memory address control circuit 5 successively reads the samples from the memory circuit 4 in the unit of frames with four vertical samples and one error correction word processed as one frame. In other words, the memory address control circuit 5 sets the frame address at 0 and subsequently updates the sample address as 0, 1, 2, ..., and when an error correction word is read at the sample address of 4, it updates the frame address by 1 to read the samples. The data to the frame address of 7 are arrayed in one scanning interval, and scanning of the whole data in the memory circuit 4 is completed by performing the operation for two scanning intervals.

The data thus read from the memory circuit 4 are in the magnetization pattern as shown in Fig. 8 on the magnetic tape, and are arrayed as shown in Fig. 3. In the signals recorded in the aforementioned manner, no continuous error takes place even if a burst error is caused by interruption of signals in one scanning interval or in the tape travelling direction in half the width of the magnetic tape from the edge thereof, and hence compensation by mean value interpolation is enabled.

The aforementioned operation for controlling the addresses in writing of the samples in the memory circuit 4 may appropriately be changed for obtaining the magnetization pattern as shown in Fig. 4.

As hereinabove described, the present embodiment is characterized in that even samples and odd samples are permutated into groups and that the samples in the respective groups are recorded

in regions located at different positions along the direction of scanning from those in continuity therewith as shown in Fig. 8. For example, with respect a frame ℓ_{L2} including a sample W_{L2}, frames ℓ_{L1} and ℓ_{L3} including data W_{L1} and W_{L3} which are in continuity with the sample W_{L2} are arrayed in positions separated from the frame ℓ_{L2} along the tape travelling direction in Fig. 8, and in a region which is different from the region containing frame ℓ_{L2}. More specifically, the data W_{L2} and W_{L1} are separated from each other by a distance X_2, and no continuous sample error is caused by a burst error in the tape travelling direction extending over a width smaller than the length X_2.

Assuming that α frames are recorded in one scanning interval, the distance X_2 is found as follows:

$$X_2 = (\alpha/2 - 1)X_1/\alpha$$

In practice, 200 to 300 frames are generally recorded in one scanning interval, and hence $X_2 \simeq X_1/2$, and hence no continuous sample error takes place even if an error is caused in the tape travelling direction over about half the width of the magnetic tape. Further, as hereinabove described, no continuous sample error takes place by signal interruption caused in one scanning interval, and hence compensation by mean value interpolation is enabled.

Fig. 9 is an illustration showing another example of the sample array. Although the frame arrangement of the left channel in the sample array as shown in Fig. 9 is different in order from that shown in Fig. 8, a similar effect is obtained also by such an array as a matter of course. The magnetization pattern as shown in Fig. 9 can be implemented by simply changing the address control circuits 5 and 16 as shown in Fig. 5.

Fig. 10 is a schematic block diagram showing another recorder/reproducer for tapes of the present invention, and Fig. 11 is a schematic block diagram of a memory address control circuit as shown in Fig. 10. A rotary head-type PCM magnetic recorder/reproducer as shown in Fig. 10 is substantially identical to that shown in Fig. 5 except that a correction circuit 22 is provided between a memory circuit 15 and a D-A converter circuit 18 of the reproducing system and a memory address control circuit 51 is structured as shown in Fig. 11. The correction circuit 22 is adapted to perform correction by the aforementioned mean value interpolation of samples not corrected though errors are detected.

The memory address control circuit 51 comprises a sample writing address generator circuit 501, a first coding address generator circuit 502, a data reading address generator circuit 503, a second coding address generator circuit 506, a second selector 507 for receiving and selectively outputting the outputs from the first and second coding address generator circuits 502 and 506 and a first selector 504 for receiving the outputs from the sample writing address generator circuit 501, the data reading address generator circuit 503 and the second selector 507 and selectively outputting the same at an address output terminal 505.

Fig. 12 is a timing chart showing operation of the memory circuits as shown in Fig. 10. In Fig. 12, the rotary head-type PCM magnetic recorder/reproducer performs two-head recording/reproducing operation by 90° tape winding, and hence signal recording/reproducing intervals of 90° and pause intervals of 90° alternately appear in the recorded/reproduced waveforms as shown in Fig. 12(a). In other words, a signal recording/reproducing interval of 90° corresponds to recording/reproducing operation in one scanning interval. Within signals for two scanning intervals sampled in a writing interval WT to the memory circuit 4 as shown in Fig. 12(b), signals for one scanning interval to be read in a reading interval RD for subsequent reading from the memory circuit 4 are encoded in an encoding interval EN to be read in the reading interval RD. Then the signals for the remaining scanning interval are encoded in the subsequent encoding interval EN, to be read in the reading interval RD.

Shown in Fig. 12(c) is the operation of the memory circuit 15 in a reproducing operation. In the writing interval WT, the reproduced sample signals for one scanning interval are written in the memory circuit 15, and are decoded in a subsequent decoding interval DE to be written in the memory circuit 15. Then the sample signals for the remaining scanning interval are written in the memory circuit 15 in the subsequent writing interval WT, to be decoded in the subsequent decoding interval DE. The decoded samples for two scanning intervals are read in the reading interval RD. In a recording operation, the samples supplied as W_{L0}, W_{R0}, W_{L1}, ... are subjected to memory address control by the sample writing address generator circuit 501 of the memory address control circuit 51 and written in the memory circuit 15, to be in the array as shown in Fig. 12.

Fig. 13 is an illustration showing an example of samples stored in the memory circuits as shown in Fig. 10. Fig. 13 is different from Fig. 7 in that 26 words are stored as error correction codes in addition to 32 samples of the left and right channels as data for two scanning intervals.

Operation of another embodiment of the present invention is now described with reference to Fig. 13. Encoded first are samples ℓ_{L0}, ℓ_{L2}, ℓ_{L4}, ℓ_{L6}, ℓ_{R1}, ℓ_{R3}, ℓ_{R5} and ℓ_{R7} to be recorded in the

form of a matrix of 8 x 4. Then the second coding address generator circuit 506 generates error correction codes P_0 to P_4, and then generates error correction codes C_{L0}, C_{L2}, C_{L4}, C_{L6}, C_{R1}, C_{R3}, C_{R5} and C_{R7} with respect to samples read by the first coding address generator circuits 502. The encoded data of frame addresses of 0 to 8 are subsequently read in order of frame numbers by the data reading address generator circuit 503 of the memory address control circuit 51 in the unit of frames, with a frame ℓ_{P0} of the error correction code being read after a frame number 3 to be inserted between intervals La and Rb, thereby recorded in the magnetic tape.

After reading of the samples for one scanning interval is completed, the samples for the remaining scanning interval are similarly encoded to be recorded in the adjacent scanning interval. Although continuous samples in the respective groups are thus distributed in two scanning intervals, the error correction codes are completed with respect to data for one scanning interval to be recorded in the magnetic tape, and are not extended over two scanning intervals.

In a reproducing operation, the data are written in the memory circuit 15 in the unit of frames contrary to the recording operation, and are corrected by the error correction codes to be subsequently read as W_{L0}, W_{R0}, W_{L1}, ... The error correction codes are completed in one scanning interval as hereinabove described, and hence the samples can be decoded upon reading of the data for one scanning interval. This operation is identical to that hereinabove described with reference to Fig. 12, and since data for two scanning intervals are gathered in codes extended over two scanning intervals, the data must be decoded with respect to two scanning intervals in the subsequent decoding interval of 90°. However, the data are decoded per scanning interval in the present embodiment, and hence the clock rate required for encoding and decoding of the data is not increased by data interleaving for two scanning intervals.

Fig. 14 illustrates the magnetization pattern recorded on the magnetic tape by the memory circuit structure as shown in Fig. 13. In Fig. 14, symbol X_1 indicates the width of the magnetic tape and symbol X_2 indicates the width of the burst error capable of correction by mean value interpolation. In the example as shown in Fig. 14, reading addresses in recording operation are so controlled that frames ℓ_{P0} and ℓ_{P5} of error correction codes are located in the middle of one scanning interval, whereas the frames ℓ_{P0} and ℓ_{P5} may be located in any position of the scanning interval.

As hereinabove described, no continuous sample errors are caused in the magnetization pattern as shown in Fig. 14 even if the signals are interrupted for one scanning interval and a burst error is caused in the tape travelling direction over half the tape width from the edge of the magnetic tape, whereby mean value interpolation is enabled.

Fig. 15 illustrates a magnetization pattern according to still another embodiment of the present invention. The magnetization pattern as shown in Fig. 15 is applied to four channels A, B, C and D. Also in the case of four channels, no continuous sample errors are caused in the respective channels even if the signals are interrupted for one scanning interval and a burst error is caused in the tape travelling direction over half the tape width from the edge of the magnetic tape, whereby mean value interpolation is enabled similarly to the case of two channels.

Although each of the tapes described above is recorded or reproduced by a rotary head type PCM magnetic recorder/reproducer which processes audio signals, the present invention may, needless to say, be applied to tapes recorded with signals correctable by mean value interpolation such as video signals, and further to tapes handled by digital signal recording/reproducing systems other than the PCM system.

Claims

1. A magnetic tape having a recording of digital signals comprising odd and even samples of at least one channel, the samples being arrayed in an interleaved manner in such a way that the odd and even samples of said channel are arrayed in different tracks, and sequentially occurring odd and even samples are separated along the length of the tracks,

   characterised in that the digital signals comprise samples of a plurality of continuous signals of respective channels (A,B; A-D) and are arrayed in such a manner that, for each channel, the odd samples are arrayed in a group in a region of one track, and the even samples are arrayed in a group in a region of a different track, which region occupies a portion of the length of the different track which excludes the portion corresponding in location to that occupied in said one track by the region containing the odd samples.

2. A magnetic tape in accordance with claim 1, wherein each track has first and second regions, and either the even samples or the odd samples of a first channel are arrayed in a group in the first region of the first of a pair of tracks, and either the even samples or the odd samples of a second channel are arrayed in a group in the second region of said first track, and the other of the even samples and the odd

form of a matrix of 8 x 4. Then the second coding address generator circuit 506 generates error correction codes P_0 to P_4, and then generates error correction codes C_{L0}, C_{L2}, C_{L4}, C_{L6}, C_{R1}, C_{R3}, C_{R5} and C_{R7} with respect to samples read by the first coding address generator circuits 502. The encoded data of frame addresses of 0 to 8 are subsequently read in order of frame numbers by the data reading address generator circuit 503 of the memory address control circuit 51 in the unit of frames, with a frame ℓ_{P0} of the error correction code being read after a frame number 3 to be inserted between intervals La and Rb, thereby recorded in the magnetic tape.

After reading of the samples for one scanning interval is completed, the samples for the remaining scanning interval are similarly encoded to be recorded in the adjacent scanning interval. Although continuous samples in the respective groups are thus distributed in two scanning intervals, the error correction codes are completed with respect to data for one scanning interval to be recorded in the magnetic tape, and are not extended over two scanning intervals.

In a reproducing operation, the data are written in the memory circuit 15 in the unit of frames contrary to the recording operation, and are corrected by the error correction codes to be subsequently read as W_{L0}, W_{R0}, W_{L1}, ... The error correction codes are completed in one scanning interval as hereinabove described, and hence the samples can be decoded upon reading of the data for one scanning interval. This operation is identical to that hereinabove described with reference to Fig. 12, and since data for two scanning intervals are gathered in codes extended over two scanning intervals, the data must be decoded with respect to two scanning intervals in the subsequent decoding interval of 90°. However, the data are decoded per scanning interval in the present embodiment, and hence the clock rate required for encoding and decoding of the data is not increased by data interleaving for two scanning intervals.

Fig. 14 illustrates the magnetization pattern recorded on the magnetic tape by the memory circuit structure as shown in Fig. 13. In Fig. 14, symbol X_1 indicates the width of the magnetic tape and symbol X_2 indicates the width of the burst error capable of correction by mean value interpolation. In the example as shown in Fig. 14, reading addresses in recording operation are so controlled that frames ℓ_{P0} and ℓ_{P5} of error correction codes are located in the middle of one scanning interval, whereas the frames ℓ_{P0} and ℓ_{P5} may be located in any position of the scanning interval.

As hereinabove described, no continuous sample errors are caused in the magnetization pattern as shown in Fig. 14 even if the signals are interrupted for one scanning interval and a burst error is caused in the tape travelling direction over half the tape width from the edge of the magnetic tape, whereby mean value interpolation is enabled.

Fig. 15 illustrates a magnetization pattern according to still another embodiment of the present invention. The magnetization pattern as shown in Fig. 15 is applied to four channels A, B, C and D. Also in the case of four channels, no continuous sample errors are caused in the respective channels even if the signals are interrupted for one scanning interval and a burst error is caused in the tape travelling direction over half the tape width from the edge of the magnetic tape, whereby mean value interpolation is enabled similarly to the case of two channels.

Although each of the tapes described above is recorded or reproduced by a rotary head type PCM magnetic recorder/reproducer which processes audio signals, the present invention may, needless to say, be applied to tapes recorded with signals correctable by mean value interpolation such as video signals, and further to tapes handled by digital signal recording/reproducing systems other than the PCM system.

Claims

1. A magnetic tape having a recording of digital signals comprising odd and even samples of at least one channel, the samples being arrayed in an interleaved manner in such a way that the odd and even samples of said channel are arrayed in different tracks, and sequentially occurring odd and even samples are separated along the length of the tracks,

   characterised in that the digital signals comprise samples of a plurality of continuous signals of respective channels (A,B; A-D) and are arrayed in such a manner that, for each channel, the odd samples are arrayed in a group in a region of one track, and the even samples are arrayed in a group in a region of a different track, which region occupies a portion of the length of the different track which excludes the portion corresponding in location to that occupied in said one track by the region containing the odd samples.

2. A magnetic tape in accordance with claim 1, wherein each track has first and second regions, and either the even samples or the odd samples of a first channel are arrayed in a group in the first region of the first of a pair of tracks, and either the even samples or the odd samples of a second channel are arrayed in a group in the second region of said first track, and the other of the even samples and the odd

* C L M S *

samples of said second channel are arrayed in a group in the first region of a second of the pair of tracks and the other of the even samples and the odd samples of said first channel are arrayed in a group in the second region of said second track.

3. A magnetic tape in accordance with claim 2, wherein all the samples of said first and second channels for a predetermined time period are contained in said first and second tracks.

4. A magnetic tape in accordance with claim 3, wherein

(a) the even samples of each channel include the earliest sample in said predetermined time period;

(b) the even samples of the first channel are arrayed in the first region of the first track in the same order as the even samples of the second channel are arrayed in the first region of the second track, and such that the general trend is for higher-numbered samples to be disposed closer to the center of the track than lower-numbered samples; and

(c) the odd samples of the second channel are arrayed in the second region of the first track in the same order as the odd samples of the first channel are arranged in the second region of the second track, and such that the general trend is for lower-numbered samples to be disposed closer to the center of the track than higher-numbered samples.

5. A magnetic tape in accordance with claim 3, wherein:

the first and second regions of each of said tracks are positioned in respective halves in the longitudinal direction of the track, said first region including a plurality of subregions at different positions along the length thereof, with the subregions ordered in succession from the end of the region remotest from the center of the track to the end closest to the center, and said second region including a plurality of subregions at different positions along the length thereof, with the subregions ordered in succession from the end of the region closest to the center of the track to the end remotest from the center; and

a first sample group including a plurality of first channel samples each of whose sample number is 2n (n is an integer) is recorded on the first region of said first track, the number of the earliest sample in said predetermined time period being 0, a second sample group including a plurality of second channel samples each of whose sample number is 2n is recorded on the first region of said second track, a third sample group including a plurality of first channel samples each of whose sample number is 2n+1 is recorded on the second region of said second track, and a fourth sample group including a plurality of second channel samples each of whose sample number is 2n+1 is recorded on the second region of said first track; and

the samples of each sample group are disposed in respective subregions in order of sample number, so that higher-numbered samples are disposed in higher-ordered subregions.

6. A magnetic tape according to claim 2, 3, 4 or 5, wherein for each channel, even samples and odd samples are each arrayed in alternate tracks.

7. A magnetic tape in accordance with claim 5, in which two channels of digital signals have been arrayed.

8. A magnetic tape in accordance with claim 7, wherein said first and second regions are included in the first and second halves, respectively, of each track.

9. A magnetic tape in accordance with claim 7 or 8, wherein said first and second tracks are adjacent tracks.

10. A magnetic tape in accordance with any one of claims 7 to 9, wherein said even samples (Aa in Fig. 3) of said first channel and said odd samples (Bb) of said second channel are arrayed on one of the first and second tracks and said odd samples (Ab) of said first channel and said even samples (Ba) of said second channel are arrayed on the other of said first and second tracks.

11. A magnetic tape in accordance with any one of claims 7 to 9, wherein said even samples (Aa in Fig. 4) of said first channel and said even samples (Ba) of said second channel are arrayed on one of said first and second tracks and said odd samples (Ab) of said first channel and said odd samples (Bb) of said second channel are arrayed on the other of said first and second tracks.

12. A magnetic tape in accordance with claim 1, wherein four channels (A,B; A-D) of digital signals have been arrayed such that signals representing samples of all the channels are

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arrayed on each track.

13. A magnetic tape in accordance with any preceding claim, including a redundancy signal which has been derived from the digital signals for correcting errors therein.

14. A magnetic tape in accordance with claim 13, wherein said redundancy signal is arrayed on a track including information which was employed for generating said redundancy signal.

15. A magnetic tape in accordance with claim 13 or 14, wherein at least a part of said redundancy signal is arrayed in a region substantially in the middle of a track, and wherein odd and even samples are arrayed on respective sides of said middle region.

16. A magnetic tape in accordance with any preceding claim, wherein the respective regions of the tracks in which said odd or even samples are arrayed all have the same length.

17. A method of producing a recorded magnetic tape as claimed in any preceding claim, the method comprising providing a tape and recording thereon digital signals comprising odd and even samples of at least one channel in an interleaved manner such that the odd and even samples of said channel are recorded in different tracks and sequentially occurring odd and even samples are separated along the length of the tracks,

characterised in that the digital signals of a plurality of channels (A,B; A-D) are recorded, and in that, for each channel, the odd samples are recorded in a group in a region of one track, and the even samples are recorded in a group in a region of a different track, the region containing the even samples occupying a portion of the length of the different track which excludes the portion corresponding in location to that occupied in the said one track by the region containing the odd samples.

Patentansprüche

1. Magnetband mit einer Aufzeichnung von digitalen Signalen, die ungerade und gerade Proben von mindestens einen Kanal enthalten, wobei die Proben in einer verschachtelten Weise derart angeordnet sind, daß die ungeraden und geraden Proben des Kanales in verschiedenen Spuren angeordnet sind und aufeinanderfolgend auftretende ungerade und gerade Proben entlang der Länge der Spuren getrennt sind, dadurch gekennzeichnet, daß die digitalen Signale Proben einer Mehrzahl von kontinuierlichen Signalen von entsprechenden Kanälen (A; B; A bis D) aufweisen und auf solche Weise angeordnet sind, daß für jeden Kanal die ungeraden Proben in einer Gruppe in einem Bereich einer Spur angeordnet sind und die geraden Proben in einer Gruppe in einem Bereich einer anderen Spur angeordnet sind, welcher Bereich einen Abschnitt der Länge der anderen Spur belegt, der den Abschnitt ausschließt, der in der Anordnung dem entspricht, der in der einen Spur durch den die ungeraden Proben enthaltenen Bereich belegt ist.

2. Magnetband nach Anspruch 1, bei dem jede Spur einen ersten und zweiten Bereich aufweist und entweder die geraden Proben oder die ungeraden Proben eines ersten Kanales in einer Gruppe in dem ersten Bereich von einer ersten eines Paares von Spuren angeordnet sind und entweder die geraden Proben oder die ungeraden Proben eines zweiten Kanales in einer Gruppe in den zweiten Bereich der ersten Spur angeordnet sind und die anderen der geraden Gruppen oder ungeraden Gruppen des zweiten Kanales in einer Gruppe in dem ersten Bereich einer zweiten des Paares von Spuren angeordnet sind und die anderen der geraden Gruppen und der ungeraden Gruppen des ersten Kanales in einer Gruppe in den zweiten Bereich der zweiten Spur angeordnet sind.

3. Magnetband nach Anspruch 2, bei dem alle Gruppen des ersten und zweiten Kanales für eine vorbestimmte Zeitdauer in der ersten und zweiten Spur enthalten sind.

4. Magnetband nach Anspruch 3, bei dem
   (a) die geraden Probengruppen eines jeden Kanales die frühesten Proben in der vorbestimmten Zeitdauer enthalten;
   (b) die geraden Proben des ersten Kanales in dem ersten Bereich der ersten Spur in der gleichen Reihenfolge angeordnet sind, wie die geraden Proben des zweiten Kanales in dem ersten Bereich der zweiten Spur angeordnet sind, und so, daß der allgemeine Trend dahin geht, daß die höher bezifferten Proben näher zu dem Zentrum der Spur vorgesehen sind als die niedriger bezifferten Proben; und
   (c) die ungeraden Proben des zweiten Kanales in dem zweiten Bereich der ersten Spur in der gleichen Reihenfolge angeordnet sind, wie die ungeraden Proben des ersten Kanales in dem zweiten Bereich der zweiten Spur angeordnet sind, und so, daß

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der allgemeine Trend dahin geht, daß die niedriger bezifferten Proben näher zu dem Zentrum der Spur vorgesehen sind als die höher bezifferten Proben.

5. Magnetband nach Anspruch 3, bei dem:
der erste und zweite Bereich einer jeden Spur in entsprechenden Hälften in der Längsrichtung der Spur positioniert sind, wobei der erste Bereich eine Mehrzahl von Unterbereichen an verschiedenen Positionen entlang der Länge davon enthält, wobei die Unterbereiche in Reihenfolge von dem Ende des Bereiches geordnet sind, der sich am weitesten von dem Zentrum der Spur befindet, zu dem, der am nähesten zu dem Zentrum ist, und der zweite Bereich eine Mehrzahl von Unterbereichen an verschiedenen Positionen entlang der Länge davon enthält, wobei die Unterbereiche in der Reihenfolge von dem Ende des Bereiches geordnet sind, der sich am nähesten zu dem Zentrum der Spur befindet, zu dem Ende, das am entfernsten von dem Zentrum ist; und
eine erste Probengruppe, die eine Mehrzahl von ersten Kanalproben enthält, deren Probennummer jeweils 2n (n ist ganze Zahl) ist, in dem ersten Bereich der ersten Spur aufgezeichnet ist, wobei die Nummer der frühesten Probe in der vorbestimmten Zeitdauer 0 ist, eine zweite Probengruppe, die eine Mehrzahl von zweiten Kanalproben enthält, deren Probennummer jeweils 2n ist, in dem ersten Bereich der zweiten Spur aufgezeichnet ist, eine dritte Probengruppe, die eine Mehrzahl von ersten Kanalgruppen enthält, von denen jeweils die Probennummer 2n + 1 ist, in dem zweiten Bereich der zweiten Spur aufgezeichnet ist, und eine vierte Probengruppe, die eine Mehrzahl von zweiten Kanalproben enthält, von denen jeweils die Probennummer 2n + 1 ist, in dem zweiten Bereich der ersten Spur aufgezeichnet ist; und
die Proben einer jeden Probengruppe in den entsprechenden Unterbereichen in der Reihenfolge der Probennummern vorgesehen sind, so daß die Proben mit höherer Nummer in den höheren Unterbereichen vorgesehen sind.

6. Magnetband nach Anspruch 2, 3, 4 oder 5, bei dem für jeden Kanal gerade Proben und ungerade Proben alle in abwechselnden Spuren angeordnet sind.

7. Magnetband nach Anspruch 5, bei dem zwei Kanäle von digitalen Signalen angeordnet sind.

8. Magnetband nach Anspruch 7, bei dem der erste und zweite Bereich in der ersten bzw. zweiten Hälfte einer jeden Spur enthalten sind.

9. Magnetband nach Anspruch 7 oder 8, bei dem die erste und zweite Spur benachbarte Spuren sind.

10. Magnetband nach einem der Ansprüche 7 bis 9, bei dem die geraden Proben (Aa) in Figur 3 des ersten Kanales und die ungeraden Proben (Bb) des zweiten Kanales in einer von der ersten und zweiten Spur angeordnet sind und die ungeraden Proben (Ab) des ersten Kanales und die geraden Proben (Ba) des zweiten Kanales in der anderen der ersten und zweiten Spur angeordnet sind.

11. Magnetband nach einem der Ansprüche 7 bis 9, bei dem die geraden Proben (Aa in Figur 4) des ersten Kanales und die geraden Proben (Ba) des zweiten Kanales in einer von der ersten und zweiten Spur angeordnet sind und die ungeraden Proben (Ab) des ersten Kanales und die ungeraden Proben (Bb) des zweiten Kanales in der anderen von der ersten und zweiten Spur angeordnet sind.

12. Magnetband nach Anspruch 1, bei dem vier Kanäle (Ab; A bis D) von digitalen Signalen so angeordnet sind, daß Signale, die Proben aller Kanäle darstellen, in jeder Spur angeordnet sind.

13. Magnetband nach einem der vorhergehenden Ansprüche mit einem Redundanzsignal, das aus den digitalen Signalen zum Korrigieren von Fehlern darin abgeleitet ist.

14. Magnetband nach Anspruch 13, bei dem das Redundanzsignal auf einer Spur angeordnet ist, die Information enthält, die zum Erzeugen des Redundanzsignales verwendet wurde.

15. Magnetband nach Anspruch 13 oder 14, bei dem mindestens ein Teil des Redundanzsignales in einem Bereich angeordnet ist, der im wesentlichen in der Mitte der Spur ist, und bei dem ungerade und gerade Proben auf entsprechenden Seiten des mittleren Bereiches angeordnet sind.

16. Magnetband nach einem der vorhergehenden Ansprüche, bei dem die entsprechenden Bereiche der Spuren, in denen die ungeraden oder geraden Proben angeordnet sind, alle die gleiche Länge aufweisen.

17. Verfahren zum Erzeugen eines aufgenommenen Magnetbandes nach einem der vorherge-

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henden Ansprüche, wobei das Verfahren aufweist Vorsehen eines Bandes und Aufzeichnen darauf von digitalen Signalen, die ungerade und gerade Proben von mindestens einem Kanal in verschachtelter Weise so aufweisen, daß die ungeraden und geraden Proben des Kanales in verschiedenen Spuren aufgezeichnet sind und aufeinanderfolgend auftretende ungerade und gerade Proben entlang der Länge der Spur voneinander getrennt sind,
dadurch gekennzeichnet, daß die digitalen Signale einer Mehrzahl von Kanälen (A, B; A bis D) aufgezeichnet werden und das für jeden Kanal die ungeraden Proben in einer Gruppe in einem Bereich einer Spur aufgezeichnet werden und die geraden Proben in einer Gruppe in einem Bereich einer anderen Spur aufgezeichnet werden, wobei der Bereich, der die geraden Proben enthält, einen Abschnitt der Länge der anderen Spur belegt, der den Abschnitt ausschließt, der in der Anordnung dem entspricht, der in der einen Spur durch den die ungeraden Proben enthaltenen Bereich belegt ist.

Revendications

1. Une bande magnétique portant un enregistrement de signaux numériques comprenant des échantillons impairs et pairs d'au moins un canal, les échantillons étant disposés d'une manière entrelacée de façon telle que les échantillons impairs et pairs du canal soient disposés dans des pistes différentes, et que des échantillons impairs et pairs apparaissant séquentiellement soient séparés le long des pistes,

   caractérisée en ce que les échantillons numériques sont des échantillons d'un ensemble de signaux contigus de canaux respectifs (A, B ; A-D) et sont disposés d'une manière telle que, pour chaque canal, les échantillons impairs soient disposés en un groupe dans une région d'une piste, et les échantillons pairs soient disposés en un groupe dans une région d'une piste différente, cette région occupant une partie de la longueur de la piste différente qui exclut la partie dont la position correspondant à celle qui est occupée dans la piste mentionnée en premier par la région contenant les échantillons impairs.

2. Une bande magnétique selon la revendication 1, dans laquelle chaque piste comporte des première et seconde régions, et les échantillons pairs ou les échantillons impairs d'un premier canal sont disposés en un groupe dans la première région de la première piste d'une paire de pistes, et les échantillons pairs ou les échantillons impairs d'un second canal sont disposés en un groupe dans la seconde région de la première piste, tandis que les autres échantillons parmi les échantillons pairs et les échantillons impairs du second canal sont disposés en un groupe dans la première région d'une seconde des pistes de la paire de pistes, et les autres échantillons parmi les échantillons pairs et les échantillons impairs du premier canal sont disposés en un groupe dans la seconde région de la seconde piste.

3. Une bande magnétique selon la revendication 2, dans laquelle tous les échantillons dans les premier et second canaux pour une durée prédéterminée sont contenus dans les première et seconde pistes.

4. Une bande magnétique selon la revendication 3, dans laquelle
   (a) les échantillons pairs de chaque canal comprennent l'échantillon qui est apparu en premier dans la durée prédéterminée ;
   (b) les échantillons pairs du premier canal sont disposés dans la première région de la première piste dans le même ordre que les échantillons pairs du second canal dans la première région de la seconde piste, avec la tendance générale selon laquelle les échantillons ayant des numéros supérieurs sont disposés plus près du centre de la piste que les échantillons ayant des numéros inférieurs ; et
   (c) les échantillons impairs du second canal sont disposés dans la seconde région de la première piste dans le même ordre que les échantillons impairs du premier canal dans la seconde région de la seconde piste, avec la tendance générale selon laquelle les échantillons de numéros inférieurs sont disposés plus près du centre de la piste que les échantillons de numéros supérieurs.

5. Une bande magnétique selon la revendication 3, dans laquelle :

   les première et seconde régions de chacune des pistes sont placées dans des moitiés respectives dans la direction longitudinale de la piste, la première région contenant un ensemble de sous-régions à différentes positions sur sa longueur, avec les sous-régions ordonnées en succession à partir de l'extrémité de la région la plus éloignée du centre de la piste, vers l'extrémité la plus proche du centre, et la seconde région contenant un ensemble de sous-régions à différentes positions sur sa longueur, avec les sous-régions ordonnées en

succession à partir de l'extrémité de la région la plus proche du centre de la piste, jusqu'à l'extrémité la plus éloignée du centre ; et

un premier groupe d'échantillons comprenant un ensemble d'échantillons du premier canal, ayant chacun un numéro d'échantillon égal à 2 n (en désignant par n un entier) est enregistré dans la première région de la première piste, le numéro de l'échantillon qui est apparu en premier au cours de la durée prédéterminée étant 0, un second groupe d'échantillons comprenant un ensemble d'échantillons du second canal, ayant chacun un numéro d'échantillon égal à 2n, est enregistré dans la première région de la seconde piste, un troisième groupe d'échantillons comprenant un ensemble d'échantillons du premier canal ayant chacun un numéro d'échantillon égal à 2n+1, est enregistré dans la seconde région de la seconde piste, et un quatrième groupe d'échantillons comprenant un ensemble d'échantillons du second canal, ayant chacun un numéro d'échantillon égal à 2n+1, est enregistré dans la seconde région de la première piste ; et

les échantillons de chaque groupe d'échantillons sont disposés dans des sous-régions respectives dans l'ordre des numéros d'échantillon, de façon que des échantillons ayant des numéros élevés soient disposés dans des sous-régions d'ordre élevé.

6. Une bande magnétique selon la revendication 2, 3, 4 ou 5, dans laquelle, pour chaque canal, des échantillons pairs et des échantillons impairs sont respectivement disposés dans des pistes alternées.

Une bande magnétique selon la revendication 5, dans laquelle on a disposé deux canaux de signaux numériques.

8. Une bande magnétique selon la revendication 7, dans laquelle les première et seconde régions sont respectivement incluses dans les première et seconde moitiés de chaque piste.

9. Une bande magnétique selon la revendication 7 ou 8, dans laquelle les première et seconde pistes sont des pistes adjacentes.

10. Une bande magnétique selon l'une quelconque des revendications 7 à 9, dans laquelle les échantillons pairs (Aa sur la figure 3) du premier canal et les échantillons impairs (Bb) du second canal sont disposés dans l'une des première et seconde pistes, et les échantillons impairs (Ab) du premier canal et les échantillons pairs (Ba) du second canal sont disposés dans l'autre des première et seconde pistes.

11. Une bande magnétique selon l'une quelconque des revendications 7 à 9, dans laquelle les échantillons pairs (Aa sur la figure 4) du premier canal et les échantillons pairs (Ba) du second canal sont disposés dans l'une des première et seconde pistes, et les échantillons impairs (Ab) du premier canal et les échantillons impairs (Bb) du second canal sont disposés dans l'autre des première et seconde pistes.

12. Une bande magnétique selon la revendication 1, dans laquelle quatre canaux (A, B ; A-D) de signaux numériques ont été disposés de façon que des signaux représentant des échantillons de tous les canaux soient disposés dans chaque piste.

13. Une bande magnétique selon l'une quelconque des revendications précédentes, comprenant un signal de redondance qui a été élaboré à partir des signaux numériques pour corriger des erreurs dans ces signaux.

14. Une bande magnétique selon la revendication 13, dans laquelle le signal de redondance est disposé sur une piste contenant une information qui a été employée pour produire ce signal de redondance.

15. Une bande magnétique selon la revendication 13 ou 13, dans laquelle au moins une partie du signal de redondance est disposée dans une région se trouvant pratiquement au milieu d'une piste, et dans laquelle des échantillons impairs et pairs sont disposés sur des côtés respectifs de la région médiane.

16. Une bande magnétique selon l'une quelconque des revendications précédentes, dans laquelle les régions respectives des pistes dans lesquelles les échantillons impairs ou pairs sont disposés, ont toutes la même longueur.

17. Un procédé pour produire une bande magnétique enregistrée, conforme à l'une quelconque des revendications précédentes, ce procédé comprenant la fourniture d'une bande et l'enregistrement sur celle-ci de signaux numériques comprenant des échantillons impairs et pairs d'au moins un canal, d'une manière entrelacée, de façon que les échantillons impairs et pairs de ce canal soient enregistrés dans des pistes différentes, et que des échantillons impairs et pairs apparaissant séquentiellement

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soient séparés sur la longueur des pistes,

caractérisé en ce qu'on enregistre les signaux numériques d'un ensemble de canaux (A, B ; A-D), et en ce que, pour chaque canal, on enregistre les échantillons impairs en un groupe dans une région d'une piste, et on enregistre les échantillons pairs en un groupe dans une région d'une piste différente, la région qui contient les échantillons pairs occupant une partie de la longueur de la piste différente qui exclut la partie dont la position correspond à celle occupée dans la piste mentionnée en premier, par la région qui contient les échantillons impairs.