Description

The invention relates to an apparatus for reproducing information contained in tracks on a disc-shaped optically readable record carrier, which information includes a position code which is a continuous indication of the radial position on said record carrier, which apparatus comprises

— an optical system for projecting a light beam on the record carrier,

— a detector arranged in the light beam which has been modulated by the information structure on the record carrier, for supplying a signal which is modulated by the information recorded on the record carrier,

— a radial-position control circuit for controlling the radial position of the spot formed on the record carrier by the light beam,

— a position-code detector for extracting said position code from the detected signal,

— a loss of track detector circuit for generating a signal which is indicative of the condition that the spot formed by the light beam no longer follows the track.

Such an apparatus is commercially available in many versions as a "compact-disc-digital-audio" player, for example the player with the type number CD 100 from N.V. Philips' Gloeilampenfabrieken, as described in Philips Technical Review, Vol. 40, 1982, no. 6.

Such a player is suitable for use in motor cars, but the susceptibility to mechanical shocks and electrical disturbances in the supply voltage then poses a problem because this may give rise to loss of track.

GB—A—2060217 already discloses track error correction means, in a video disc player system for overcoming the effect of skipping forward or backward of a stylus. The correction is not in response to the time interval between the instant of loss and the instant of restoring.

It is the object of the invention to provide an apparatus of the type specified in the opening paragraph, which mitigates the adverse effects of a loss of track.

According to the invention this object is attained by an apparatus characterized by

— a storage circuit for storing position information derived from position codes read and which information is indicative of the parts of track being read,

— means for applying a start-position code for resuming reproduction after loss of track detection at a restart track position situated at such a distance after the track position indicated by the stored position information that said distance substantially corresponds to the time interval between the instant of loss of track and the instant at which reproduction is restored.

The apparatus according to the invention is advantageous in that the rhythm of the information (music) being reproduced is hardly disturbed and loss of track has the same effect as a brief signal drop-out.

A preferred embodiment may be further characterized in that the storage circuit is arranged for storing a position code read at on instant prior to the instant of loss of track, in that the means for restarting reproduction comprise means for applying a start-position code which is dictated by said stored position code for restarting the reproduction at a position determined by said start-position code, and in that there is provided a second storage circuit for storing a position code read upon locking in to another position on the record carrier after a loss of track and the means for applying the start-position code comprise a circuit for determining the interval between the start-position code to be generated and the position code stored in the first storage circuit as a function of the difference between the position codes stored in the two storage circuits.

In practice, the position code mentioned in the foregoing will generally be a time code indicating the elapsed time of the piece of music on the entire disc.

An embodiment of the invention will be described in more detail, by way of example, with reference to the accompanying drawing, which shows an apparatus in accordance with the invention.

The sole figure schematically shows a disc-shaped optically readable record carrier 1, which is rotated by means of a motor 2. A laser beam produced by a laser 3 is focussed on the disc 1 *via* a radially controllable optical system 4, in the present example a mirror 5 and a lens system 6. The radial position of the spot where said laser beam is incident can be controlled, this is represented symbolically by an arrow 7 between a radial-position control circuit 8 and the optical system 4. The laser light reflected by the disc 1 is projected on a detector 10 by means of semi-transparent mirror 9. The detector 10 supplies a signal which depends on said reflected beam to a demodulation circuit 11, which supplies a demodulated signal to an output 22. On an output 21 C and D bits (control and data bits) appear which contain a time code which is a measure of the instantaneous position of the spot formed by the laser beam. This time code may be derived from the signal on output 21, *inter alia* by loading said signal into a register 12 and decoding it by means of a decoder circuit 13, on whose output the last time code decoded is available.

The output signal of the detector 10 is also applied to a track-loss detector 14, which supplies an output signal when the spot formed by the laser beam no longer follows the data track on the disc in a correct manner.

In order to minimize the disturbance in the event of a loss of track a switch 15 is controlled by said track-loss detector 14 to transfer the state of the decoder circuit 13 to a memory 16 which stores the last time code read before losing track. This time code may be applied to the radial-position circuit 8 and in the form of a "go to" command, after which the optical system 4 is controlled so as to direct the spot of the laser

beam to a position near the track in which the loss of track occurred. However, a better correction is obtained by going to a position which would have been reached in the case of an undisturbed read-out of the disc.

In the case of a loss of track the radial-tracking mechanism ensures that the beam locks in to a new track reached by the spot of the beam after losing-track. After locking-in a time code is read out, which under control of the inverted output signal of the track-loss detector 14, which signal is inverted by means of the inverter 17, is read into a memory 19 *via* a switch 18. By means of an arithmetic circuit 20 the time code of the "go to" position is determined, for example by determining the difference between the position codes stored in the memories 16, 19 determining the time required for positioning by means of a search table, and adding this to the time code in the memory 16, the resulting signal being applied to the radial-position control circuit 8 as a "go to" command. This precludes "stalling" of the reproduction, which may happen when going back to the track-loss position if this track loss is not accidental (such as a shock) but is position-dependent. Moreover, going back to a position which would have been reached in the case of undisturbed music reproduction, has the advantage that the rhythm of this music is not disturbed.

The demodulating circuit 11, the track-loss detector 14 and the position-control circuit 8 which responds to a "go to" command are circuits known to those skilled in the art and they are used in players of the "compact-disc-digital-audio" type which are commercially available from various companies, so that these circuits need not be described in detail.

It is to be noted that in the present example the apparatus in accordance with the invention is represented as a discrete circuit. The microprocessor used in "compact-disc-digital-audio" players, however, is particularly suitable for performing most circuit functions. For example, the functions of the parts 12, 13, 15, 16, 17, 18, 19, 20 can be readily programmed in said microprocessor.

In the present apparatus the switch for sound-muting during a track-loss condition is not shown. When the invention is used this sound-muting is preferably sustained until the correct track position is found, so that no sound is reproduced until after the first lock-in following a track loss. This can be achieved simply by making use of logic switching means.

Instead of the use of the time code as position code, it is of course possible to use any other code which is representative of the position on the disc.

Claims

1. An apparatus for reproducing information contained in tracks on a disc-shaped readable record carrier which information includes a position code which is a continuous indication of the radial-position on said record carrier, which apparatus comprises:

— an optical system for projecting a light beam on the record carrier,

— a detector which is arranged in the light beam which has been modulated by the information structure on the record carrier, for supplying a signal which is modulated by the information recorded on the record carrier,

— a radial-position control circuit for controlling the radial position of the spot formed on the record carrier by the light beam,

— a position-code detector for extracting said position code from the detected signal,

— a loss of track detector circuit for generating a signal which is indicative of the condition that the spot formed by the light beam no longer follows the track, characterized by

— a storage circuit for storing position information derived from position codes read, which information is indicative of the part of track being read,

— means for applying a start-position code for resuming reproduction after loss of track detection at a restart track position situated at such a distance after the track position indicated by the stored position information that said distance substantially corresponds to the time interval between the instant of loss of track and the instant at which reproduction is restored.

2. An apparatus as claimed in Claim 1, characterised in that the storage circuit is arranged for storing a position code read at on instant prior to the instant of loss of track, in that the means for restarting reproduction comprise means for applying a start-position code which is dictated by said stored position code for restarting the reproduction at a position determined by said start-position code, and in that there is provided a second storage circuit for storing a position code read upon locking in to another position on the record carrier after a loss of track and the means for applying the start-position code comprise a circuit for determining the interval between the start-position code to be generated and the position code stored in the first storage circuit as a function of the difference between the position codes stored in the two storage circuits.

Patentansprüche

1. Gerät zur Wiedergabe von Information in Spuren auf einem plattenförmigen, optisch lesbaren Informationsträger, wobei die Information einen Positionscode enthält, der eine ununterbrochene Anzeige der radialen Position auf dem Informationsträger ist, und das Gerät enthält

— ein optisches System zum Projizieren eines Lichtstrahls auf den Informationsträger,

— einen im Lichtweg angeordneten Detektor, der durch die Informationsstruktur auf dem Informationsträger moduliert ist, zur Lieferung eines Signals, das durch die auf dem Informationsträger aufgezeichnete Information moduliert wird,

beam to a position near the track in which the loss of track occurred. However, a better correction is obtained by going to a position which would have been reached in the case of an undisturbed read-out of the disc.

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2. An apparatus as claimed in Claim 1, characterised in that the storage circuit is arranged for storing a position code read at on instant prior to the instant of loss of track, in that the means for restarting reproduction comprise means for applying a start-position code which is dictated by said stored position code for restarting the reproduction at a position determined by said start-position code, and in that there is provided a second storage circuit for storing a position code read upon locking in to another position on the record carrier after a loss of track and the means for applying the start-position code comprise a circuit for determining the interval between the start-position code to be generated and the position code stored in the first storage circuit as a function of the difference between the position codes stored in the two storage circuits.

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1. Gerät zur Wiedergabe von Information in Spuren auf einem plattenförmigen, optisch lesbaren Informationsträger, wobei die Information einen Positionscode enthält, der eine ununterbrochene Anzeige der radialen Position auf dem Informationsträger ist, und das Gerät enthält

— ein optisches System zum Projizieren eines Lichtstrahls auf den Informationsträger,

— einen im Lichtweg angeordneten Detektor, der durch die Informationsstruktur auf dem Informationsträger moduliert ist, zur Lieferung eines Signals, das durch die auf dem Informationsträger aufgezeichnete Information moduliert wird,

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— eine Radialpositionssteuerschaltung zur Steuerung der radialen Position des vom Lichtstrahl auf dem Informationsträger gebildeten Flecks,

— einen Positionscodedetektor zum Ableiten des Positionscodes aus dem detektierten Signal,

— eine Spurverlustdetektorschaltung zum Erzeugen eines Signals, das eine Anzeige des Zustands darstellt, wenn der vom Lichtstrahl gebildete Fleck die Spur nicht mehr verfolgt, gekennzeichnet durch

— eine Speicherschaltung zum Speichern von Positionsinformation aus den gelesenen Positionscodes, die den gelesenen Abschnitt der Spur anzeigt,

— ein Mittel zum Zuführen eines Startpositionscodes zum Wiederaufnehmen der Wiedergabe nach einer Spurverlustdetektion an einer Neustartspurstelle in derartigem Abstand hinter der von der gespeicherten Positionsinforamation angegebenen Spurstelle, daß dieser Abstand im wesentlichen dem Zeitintervall zwischen dem Zeitpunkt des Spurverlustes und dem Zeitpunkt der Wiederaufnahme der Wiedergabe entspricht.

2. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß die Speicherschaltung zum Speichern eines Positionscodes angeordnet ist, der an einem Zeitpunkt vor dem Zeitpunkt des Spurverlustes gelesen ist, daß das Mittel zum Neustarten der Wiedergabe ein Mittel zum Anlegen eines Startpositionscodes enthält, der durch den gespeicherten Positionscode zum Neustarten der Wiedergabe an einer Position vorgeschreiben wird, die durch den Startpositionscode bestimmt wird, und daß eine zweite Speicherschaltung zum Speichern eines Positionscodes vorgesehen ist, der bei Verriegelung in einer anderen Position auf dem Aufzeichnungsträger nach einem Spurverlust gelesen wird, und das Mittel zum Zuführen des zu erzeugenden Startpositionscodes eine Schaltung zum Bestimmen des Intervalls zwischen dem zu erzeugenden Startpositionscode und dem Positionscode enthält, der in der ersten Speicherschaltung in Abhängigkeit vom Umterschied zwischen den in den beiden Speicherschaltungen gespeicherten Positionscodes gespeichert ist.

Revendications

1. Appareil pour reproduire de l'information contenue dans des pistes sur un support d'information en forme de disque à lecture optique, information comportant un code de position qui est une indication continue de la position radiale sur ledit support d'information, comportant

— un système optique pour projeter un faisceau lumineux sur le support d'information,

— un détecteur disposé dans le faisceau lumineux modulé par la structure d'information sur le support d'information, pour fournir un signal modulé par l'information enregistrée sur le support d'information,

— un circuit de réglage de la position radiale pour régler la position radiale du spot formé par le faisceau lumineux sur le support d'information,

— un détecteur de code de position pour extraire ledit code de position du signal détecté,

— un circuit détecteur de perte de piste pour engendrer un signal qui est indicatif de l'état où le spot formé par le faisceau lumineux ne suit plus la piste, caractérisé par

— un circuit de stockage pour stocker l'information de position déduite de codes de position lus et qui est indicative de la partie de piste lue,

— des moyens pour fournir un code de position de démarrage pour reprendre la reproduction, après la détection d'une perte de piste, dans une position de piste de redémarrage située à une telle distance après la position de piste indiquée par l'information de position stockée que ladite distance correspond sensiblement à l'intervalle de temps compris entre l'instant de la perte de piste et l'instant où la reproduction est rétablie.

2. Appareil selon la revendication 1, caractérisé en ce que le circuit de stockage est conçu pour stocker un code de position lu à un instant antérieur à l'instant de la perte de piste, en ce que les moyens pour redémarrer la reproduction comportant des moyens pour fournir un code de position de démarrage imposé par ledit code de position stocké pour redémarrer la reproduction dans une position déterminée par ledit code de position de démarrage, et en ce qu'il est prévu un deuxième circuit de stockage pour stocker un code de position lu lors de l'accrochage à une autre position sur le support d'information après une perte de piste, et les moyens pour fournir le code de position de démarrage comportent un circuit pour déterminer l'intervalle de temps entre le code de position de démarrage à engendrer et le code de position stocké dans le premier circuit de stockage en fonction de la différence entre les codes de position stockés dans les deux circuits de stockage.

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