The invention relates to an apparatus for the reproduction of data which is readable from the data tracks of a record carrier by means of an optical scanning device, in that a light beam is guideable onto the data tracks by means of a tracking control loop, wherein, for jumping tracks, the optical scanning device is moved to the wanted track by a jump pulse and is stopped there by a braking pulse.

Such apparatus, for example CD players, recording and play-back magneto optic devices, recording and play-back devices for draw-disc or optical disc players are equipped with an optical scanning device consisting of a laser diode, a plurality of lenses, a prismatic beam splitter and a photo-detector. The construction and method of operation of an optical scanning device, a so-called optical pick-up, are described in Electronic Components and Applications, Vol. 6, No. 4, 1984 at Pages 209 - 215.

The light beam emitted by the laser diode is focused onto the compact disc by means of lenses and reflected therefrom onto a photo-detector. The data stored on the compact disc and the control value for the focusing and for the tracking control loops are recovered from the output signal of the photo-detector. In the above mentioned reference, the control value for the focusing control loop is referred to as the "focusing error" while the phrase "radial tracking error" is selected for the control value for the tracking control loop

A coil serves as adjusting member for the focusing control loop, an object lens being moveable along the optical axis by means of its magnetic field. By virtue of its displacement of the object lens, the focusing control loop is thus effective to ensure that the light beam emitted by the laser diode is always focused on the compact disc. The optical scanning device is moveable in a radial direction relative to the compact disc by means of the tracking control loop, which is often referred to as a radial drive. As a result, the light beam can be guided along the spirally shaped tracks on the compact disc.

In some devices, the radial drive is built up from a so-called coarse and a so-called fine drive. The coarse drive may, for example, be formed as a drive screw by means of which the whole optical scanning arrangement of the laser diode, the lenses, the prismatic beam splitter and the photo-detector is radially displaceable. With the fine drive, the light beam can be swept in a radial direction e.g. over a predefined small angle, so that through this tilting motion alone, the light beam can travel a short distance along a radius of the compact disc.

In order to achieve trouble free reproduction of the data, be it for example picture and sound from an optical disc or merely the sound alone from a CD player, it is necessary, that as well as being exactly focused on the optical or compact disc, that the light beam should be guided precisely along the data tracks of the disc.

A reproduction apparatus of the type first mentioned above is described in the EP 00 35 288 in which the jumping of the optical scanning device from track to track is effected by a jump pulse, which is referred to as a jump pulse in EP 00 35 288, and in which at the end of the jump the optical scanning device is stopped above the sought track by a braking pulse of constant duration which is referred to as a compensating pulse. However, because the braking pulse is always the same, it is not optimally matched in every case. Thus, it can happen, that the optical scanning device is stopped before or only after the wanted track. In both cases, the access time to the wanted data is increased because subsequent corrections are necessary.

A device for jumping tracks is known from the US-PS 4 495 608, in which the jump over one or more tracks is also initiated by a jump pulse and is ended by a braking pulse. In order to reach the wanted track more quickly and more precisely, the duration of the braking pulse is dependent on the speed at which the scanning device is jumping over the tracks. For a high speed the braking pulse is long whereas for low speed the braking pulse is short. Nevertheless, it can happen that in this device the wanted track is not found at once so that subsequent corrections are necessary. Moreover as regards the stability of this control loop, critical conditions can arise.

Consequently it is the object of the invention, for jumping tracks in an apparatus in accordance with the first part of claim 1, to optimise the braking pulse for stopping the optical scanning device and thus to avoid subsequent corrections.

This object is achieved in accordance with the invention by the following method steps.

a) a jump pulse is emitted.

b) the tracking control loop is opened at the earliest, at the start of the jump pulse, but at the latest, on leaving the data track.

c) the optical scanning device is braked by a first braking pulse of constant amplitude and duration but which is dimensioned sufficiently small that the optical scanning device is not stopped.

d) the time to reach a prefined track position relative to the next data track is measured.

e) a second braking pulse, whose duration and/or amplitude is dependent on the measured time is emitted in order to stop the scanning device in the middle of the next data track.

f) the tracking control loop is closed at the earliest, at the start of the second braking pulse but at the latest, in the middle of the next data track.

The method in accordance with the invention will now be described and explained with the help of the figure.

The tracking error signal TE, the jump pulse SI and the braking pulses B1 and B2 are depicted in the figure.

The tracking error signal TE takes the form of a sine curve. At one zero crossing, the light beam lies exactly in the middle of the track, at the next zero crossing between two tracks and at the next, once more in the middle of the following track. Whether the scanning device is in the middle of a track or standing between two tracks is determinable by the HF signal. If a HF voltage is present, the scanning device is standing on a track; if, on the other hand, it is standing between two tracks, there are no HF components present but only noise components. This is easily determined by means of a HF detector.

For jumping from one track to the next, a jump pulse SI is emitted which ends for example when the light beam has deviated by a quarter of the track width to the right of the centre M1 of the track at the minimum MI of the sinusoidally shaped tracking error signal TE. Thereupon, the tracking control loop is opened and a first braking pulse B1 of constant amplitude and duration is emitted. The tracking control loop may be opened at the start of the jump pulse SI at the earliest but it must be opened at the latest upon leaving the data track. Amplitude and duration of the first braking pulse B1 are arranged to be so small that it can only brake the optical scanning device but cannot stop it. The first braking pulse B1 may end for example before the sinusoidally shaped tracking error signal TE is positive once more, i.e. before the light beam reaches the next

data track. The two braking pulses may also blend into one another.

When the light beam now gets to the edge of the next track, the tracking error signal TE once more increases in sinusoidal manner. The time T is measured between the first, intentionally too short dimensioned braking pulse B1 and a predetermined point P of the sinusoidally shaped tracking error signal TE which may lie for example before the maximum MA of this track. In other words, that time is measured which elapses from the first braking pulse B1 until the tracking error signal TE reaches a predetermined threshold value. In order to stop the optical scanning device in the middle M2 of the track, a second braking pulse B2 is now emitted whose amplitude and/or duration is dependent on the measured time T. Thereafter the tracking control loop can be closed again. It may be closed at the earliest upon reaching the next data track but it must be closed at the latest by the middle M2 of the track.

If the measured time T in the presently described embodiment is short, then the amplitude and/or duration of the second braking pulse B2 is selected to be large; if on the other hand the measured time T is long, then the amplitude and/or duration of the second braking pulse B2 is small. In this way, there is rapid and certain jumping from one track to the next.

It is especially advantageous for the optimisation of the second braking pulse B2 to adjust both its amplitude as well as its duration. This is indicated in the figure by the dashed lines for the braking pulse B2.

If it is necessary to jump over several tracks, the method in accordance with claim 1 is repeated from track to track.

Although in the method according to the invention the optical scanning device is first stopped and then accelerated again for each track, the access time to a wanted track scarcely increases compared with the device in US-PS-4 495 608 because in the method according to the invention subsequent corrections are for the most part avoided.

The invention is suitable for CD players, optical disc players, DRAW disc players and magneto-optic apparatus.

Claims

1. Method for jumping tracks in an apparatus for the reproduction of data which is readable from the data tracks of a record carrier by means of an optical scanning device in that a light beam is guidable onto the data tracks by means of a tracking control loop, wherein for jumping tracks from one data track to the next, the optical scanning device is moved by a jump pulse and stopped by at least one braking pulse, characterised by the following method steps:

a) a jump pulse (SI) is emitted;

b) the control loop is opened at the earliest at the start of the jump pulse (SI), but at the latest on leaving the data track;

c) the optical scanning device is braked by a first braking pulse (B1) of constant amplitude and duration but which is dimensioned sufficiently small that the optical scanning device is not stopped;

d) the time (T) to reach a prefined track position (P) relative to the next data track is measured;

e) a second braking pulse (B2) is emitted, whose duration and/or amplitude is dependent on the measured time (T) in order to stop the scanning device in the middle (M2) of the next data track;

f) the tracking control loop is closed at the earliest at the start of the second braking pulse (B2) but at the latest in the middle (M2) of the next data track.

2. Method according to claim 1, characterised in that, for jumping tracks over several data tracks, the method in accordance with claim 1 is repeated from data track to data track.

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