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The invention relates to a focus control system according to the preamble of the claim.

It is known that, when scanning CD discs, scanning defects, such as dropouts, black dots, fingerprint marks or scratches on the surface of the discs are corrected or suppressed by error correction or interpolation in conjunction with servo circuit technology, so that playback for the listener is not noticeably impaired or is scarcely noticeable. Obviously this only applies up to certain limits. Thus it is conceivable for example that defects, such as say corresponding scratches (e.g. dropouts, black dots, fingerprint marks) on the surface of the scanning side of the disc, so affect the focus readjustment when scanning that for a short time an "Out-of-focus" condition occurs. This means that for a certain period of time there is no focussing achieved because of the type of error, its duration and its frequency of occurence.

As a result, the scanning is affected such that an interruption in the playback can be heard as a defect.

From EP-A-0095766 a control system for playing equipment for CD discs is known, which is also usable for focus control. The control circuit is affected so that with a high defect rate the control circuit gain is low and with a low defect rate is high. The system employed here uses a microcomputer with a time generator, among other things, its gate time being longer than one revolution of the CD discs to be scanned. Here a rigid time window independent of the number of revolutions is used. In this way certain types of defect are differently evaluated, also depending on whether the defects appear inside or outside on the CD disc. The control circuit gain is adjusted for each plate and remains constant for scanning. Control systems operating in this way are both disadvantageous in track and focus control, since they cannot control away the errors occurring, i.e. the defects, which occur as a result, can still be heard.

With focus readjustment there is a closed-loop servo circuit i.e. with relatively high loop gain, in order to guarantee a sufficiently strong coupling between the disc and the focus actuator even with possible acceleration amplitudes, which may get on to the disc or the scanning system by means of a surge for example.

With this type and duration of error a high gain and thus strong coupling is not however advantageous;, the coupling is too strong for this case.

The object underlying the invention is to improve the servo circuit for focus control such that stabilisation is achieved for the types of error which arise. The solution of this object arises in accordance with the invention from the claim.

Further details and modifications of the invention are to be gathered from the description of one embodiment.

In accordance with the invention a focus control system is so equipped that a signal is available at the scanner output of the optical scanner, which contains a data signal and a servo signal. The first is supplied to the data processing (unit). The latter is available to the control circuits, in that depending on the type and rate of errors of the information carier the focus gain is so affectd that the focus coupling is high for a low error rate and and is low for a high error rate. An optimum data yield is achieved, since the error type, duration and rate are detected digitally by means for detection and counting for certain selected periods of time, and thus after D/A conversion a corresponding control signal for the gain of the servo amplifier, which signal continually adapts automatically, is produced.

The invention is explained below in connection with the drawing.

This shows in:

Figure 1 a block circuit diagram of an embodiment of the focus control system;

Figure 2 a graphic representation of the different signals at the stages of the circuit affecting the gain of the focus control circuit

Figure 1 shows an information disc 1 scanned optically from below, which is driven by the motor 2. The optical scanner 4 has a focus actuator 3, which makes it possible to focus a beam of laser light precisely on the reflecting layer of the disc 1.

During scanning there is available at the output 6 of the scanner 4 a composite signal which contains a data signal, for exammple EFM-HF (eight to fourteen modulation), and a servo signal. The first is passed via a line 9 to the connection point 10 to which is connected the data processing (unit) not shown.

The servo signal on the other hand is supplied via the line 8 to a threshold value detector A, the ouput of which is connected to a counter 8 which is set by a gate time generator C via the connection 12. The gate time generator C receives from the connection 11 pulses which correspond to the instantaneous revolution number of the disc. Thus the gate time emitted by it is variable according to the instantaneous revolution number of the disc. This gate time is fed in via the input 13 also to a latch circuit D which is connected to the output of the counter B. A digital signal is emitted by the latch circuit D to the following D/A converter F. Via the ouput line 14 of the D/A converter F a corresponding analogue signal is passed as the control magnitude for the gain to the focus servo amplifier E. As a result, the loop gain is continually affected in accordance with the type of error and error rate. Via the line 7 the focus servo amplifier E receives the servo signal which is to be

amplified variably, which signalthe amplifier passes via the line 5 to the focus actuator 3. The latter has a converter which driven by this signal ensures that through an appropriate axial movement of an optical component, a collecting lens usually, the desired focussing takes place.

Figure 2 shows how the EFM HF signal in the threshold detector A is processed into an output signal,that/which (?) is passed to the counter B, which emits an output signal to the latch circuit D set by the gate time generator C. After D/A conversion this reaches the focus servo amplifier E as a control magnitude for its instantaneous gain.

With the input of a gate time dependent on the instantaneous speed the advantage is achieved that the measuring time is always equal to one revolution of the dis and thus a new measured value is available with each rotation. The number of the errors per measuring window and rotation is thus constant and is independent of the position of the scanner on the disc (that is, the radial spacing from the centre point).

Instead of the use of a gate time generator for setting the counter it is also possible to provide an input with speeds settable to constant values. This exemplary variation of the embodiment shown is not shown as a separate block circuit diagram figure, since it is the same except for the difference mentioned.

With such an arrangement the most favourable solution of the focus control system may be achieved with regard to the stability of the scanning over disc errors and also optimum coupling in each case between the disc and the focus actuator at acceleration amplitudes which may possibly arise.

The described arrangement is more particularly of importance if CD discs have damage to the surface increasingly with frequent use.



Patent Claim

A focus control system for a device for disc-shaped, rotating information carriers (1) which are scanned optically without contact, having a focus actuator (3) containing a converter, which is controlled by a focus servo amplifier (E) with variable gain, in which at the output of an optical scanner (4) containing the focus actuator (3) a composite signal (6) is available which contains a servo signal (7) which is supplied to a control circuit containing the focus servo amplifier (E), and in which the composite signal (6) is also supplied to an error detector (A), the outut of which is connected to a counter (B) which counts the scanning errors within a predetermined gate time and the output signal of which changes the gain of the focus servo amplifier (E) via a D/A converter (F) such that the gain is high for a low error rate and low for a high error rate characterised in that the gate time is delivered by a gate time generator (C) variably in accordance with the instantaneous revolution number of the disc in which the counter (B) controls the gain depending on the error rate per disc revolution.