The invention concerns a method for generating a controlling or a measuring signal in order to measure or control to a desired value the tangential angle and the radial angle of a light beam directed onto a rotating recording medium for reading data, wherein the light beam is reflected from the recording medium onto a photodetector, the output signal of which represents the data signal.

For reading the data of an optical disc, for example, a so-called compact disc in a CD-player or a magneto-optical disc, a light beam is focused, by means of a focusing control circuit, onto the disc which reflects it onto one or more photodiodes, from the output signals of which the electrical data signal is obtained. The light beam scanning the data is guided along the circular or spiral shaped data tracks of the disc by means of a tracking control circuit.

A known optical recording medium is, for example, the CD-disc, in which a light-reflective aluminium coating follows the transparent layer. The light-reflective aluminium layer has depressions or raised parts, so-called pits, which represent the data stored on the CD-disc. The data on the CD-disc can be read by means of an optical scanning device because the reflective behaviour of the light-reflective aluminium coating depends on the pattern formed by the depressions on the disc. Less light is reflected from a depression, also frequently called a groove, or from a raised part than from a region without depressions or raised parts, often designated as a land.

Therefore, from the intensity of the light reflected from the CD-disc the optical scanning device detects whether the scanned bit is, for example, a logical one or a logical zero or a jump in amplitude which appears when the

light beam scans the transition from a depression to a raised part or from a raised part to a depression.

In order to be able to scan the data on the disc, the light beam should strike the surface of the disc as perpendicular as possible because even deviations of ±1 degree lead to a sharp increase in the bit error rate. The angle which the light beam forms in the tangential plane with the perpendicular is hereinafter designated the tangential angle, while for the angle which the light beam forms with the perpendicular in the radial plane normal to the tangential plane, the expression radial angle is selected.

An optical scanning device for an optical recording and/or reproduction device is known from EP-PA 0 070 070 the objective lens of which, which focuses the light beam onto the disc, is located in a cylinder-shaped objective mount. The cylinder-shaped objective mount is freely suspended in a magnetic field generated by several coils. On the casing of the objective mount there is arranged a ridge prism, at the ridge of which the light beam from a light source is directed, with the help of a lens. Thus, the light beam emitted from the light source is split into two light beams by the ridge prism. The first light beam reflected from the ridge prism is directed onto a first four-quadrant photodetector consisting of four photodiodes; a second four-quadrant photodetector also consisting of four photodiodes is located in the beam path of the other light beam reflected from the ridge prism. The control signals are generated from the, in total, eight output signals from the photodiodes of the two four-quadrant photodetectors in order to control the position of the objective mount in space with reference to a fixed system of coordinates.

The objective mount has six degrees of freedom of movement. It can be moved along the optical axis of the objective lens, designated the z-axis, along the y-axis which runs parallel to the tangent to the disc, and along the x-axis which runs like a radius to the centre of the disc. The x,y and z axes form a right-angled coordinate system. In addition to these three translation movements the objective mount can be rotated about the x,y and z axes.

This known optical scanning device, the objective lens of which, is freely suspended in a magnetic field and can move in all six degrees of freedom has, however, serious disadvantages.

A first disadvantage is based on the high expenditure because an additional light source, two additional four-quadrant photodetectors, a lens and a triangular prism are required for controlling the position of the objective lens.

A second disadvantage is that the additional light source, the two additional four-quadrant photodetectors, the objective lens in the objective mount, the ridge prism on the casing surface of the objective mount and the axis of the disc turntable on which the disc to be played rests, must be adjusted precisely to each other if the light beam is to radiate perpendicularly onto the disc.

A third disadvantage is that the mass of the objective mount, which is freely suspended in the magnetic field, is increased by the mass of the ridge prism, and that an asymmetric distribution of the mass of the objective mount is caused by the ridge prism. As a freely-moving part, suspended in a magnetic field, the objective mount should, however, exhibit a mass as low as possible and a symmetric

mass distribution.

However, probably the most serious disadvantage is that the actual angle at which the light beam strikes the disc is completely undetected. Rather, only the position of the optical axis of the objective lens is controlled with respect to a reference axis fixed in space. With the known device, the axis of revolution of the disc turntable serves as the reference axis fixed in space.

If now, for example, the disc is subject to disc slap, then although the optical axis of the objective lens is fixed in space, the plane of the disc, however, alters its spatial position. Therefore, the tangential and the radial angles of the light beam are altered by disc slap as this alteration in the tangential and radial angles caused by the disc slap or chattering is not detected, they also cannot be corrected.

If the disc is not flat but has a curved or wavy surface, then the tangential and radial angles are constantly changing while the disc rotates. Further, these disturbing changes in the angles cannot be detected and so also not corrected.

Similarly, the tangential and radial angles cannot be corrected if the axis for the disc drive is not held firmly in place but execute precessional motion.

From EP-A-0313818 there is known an optical reading device in which, by evaluating a signal which is formed from the tracking error signal of the scanning light beam and the output signal of an oscillator, the position of the scanning light beam is determined. Thus this publication does not suggest simple evaluation of the amplitude and phase position of the sampled data signal, in order to

determine the angle of incidence of the scanning light beam as occurs according to the present invention.

It is the object of the invention to provide a method which actually enables the tangential and radial angles of the light beam focussed onto the disc to be measured without needing an additional measuring device, without increasing the mass of the mount for the objective lens and without causing an asymmetric mass distribution.

The invention achieves this object in that the data signal is demodulated in an amplitude demodulator and in that the control or measuring signals are generated from the amplitude and the phase position of the demodulated data signal.

There are shown:

Fig.1 a disc-type recording medium;

Fig.2 the optical scanning of the disc-type recording medium with differing radial and tangential angles;

Fig.3 the data signal HF with perpendicular incidence of the light beam on the recording medium;

Fig.4 the data signal HF and the filtered focusing error signal F in dependence upon the tangential angle;

Fig.5 the data signal HF and the filtered focusing error signal F in dependence upon the tangential angle;

Fig.6 an arrangement for executing the method according to the invention according to claim 5;

Fig.7 the data signal HF, the focusing error signal FE,

the filtered focusing error signal F, the demodulated data signal M, the digitalized focusing error signal FD, the digitalized demodulated data signal MD and a control voltage Ux;

Fig.8 an arrangement for executing the method according to the invention according to claim 5 with a device for the error correction;

Fig.9 the control voltage Ux in dependence upon differing radial and tangential angles;

Fig.10 a flow diagram for determining the value and sign of the radial and tangential angles;

Fig.11 the demodulated data signal M, the demodulated digitalized data signal MD in dependence upon differing radial and tangential angles as well as the focusing error signal FE and the digitalized focusing error signal FD;

Fig.12 an embodiment of an amplitude demodulator;

Fig.13 an embodiment of a pulse former;

Fig.14 an arrangement for measuring the radial and tangential angles of a disc-type recording medium;

Fig.15 the construction of an optical scanning device for reading the data of the disc-type recording medium;

Fig.16 the amplitude of the amplitude-modulated data signal HF in dependence upon the radial angle φR and the tangential angle φT;

Fig.17 the digital focusing error signal FD and the demodulated data signal MD;

Fig.18 a flow diagram for calculating the radial angle φR and the tangential angle φT.

In order to be able to understand the invention more easily, it will first be explained, by means of Figures 1 and 2a to 2e, how the disc slap affects the radial and tangential angles. In Figure 1 there is shown a disc CD, for example, the compact disc of a compact disc player. As a result of disc slap, the causes of which lie in the shape of the disc, the disc drive or, as is usually the case, both, point P1 of disc CD, rotating in the direction shown by the arrow, lies lower than point P2 for example.

The cross-sections A-A′ and B-B′ through the disc CD are illustrated in Figures 2a to 2e.

The data recorded on the disc are read by means of an optical scanning device AV, the objective lens O of which focuses a light beam L onto the disk CD.

In Figure 2a the point P1 lies above, as shown in Figure 1, while point P2 lies below. The radial angle φR is, therefore, zero and the tangential angle has the positive value $+\triangle\varphi T$.

In Figure 2b the disc has rotated 90° in the direction of the arrow. Point P1 is just being scanned by the light beam L. The radial angle φR now has the positive value $+\triangle\varphi R$ while the tangential angle φT is zero. After further rotation through 90°, point P1 now lies below while point P2 lies above and the radial angle is again zero; as shown in Figure 2c, the tangential angle has the negative value $^{-}\triangle\varphi T$.

After a further rotation of 90°, illustrated in Figure 2d, the light beam L radiates onto point P2. The radial angle has the negative value $-\Delta\varphi R$; on the other hand the tangential angle φT is zero.

Finally after a rotation of a further 90° the resulting position of Figure 2e is reached. The radial angle is zero and the tangential angle takes on the positive value $+\Delta\varphi T$.

The invention is now based on the first recognition that when the disc rotates, the radial angle φR alters according to a sine function and the tangential angle φT according to a cosine function but with a phase shift of 90° or vice versa according to the choice of zero point.

As is customary with optical recording and reproducing devices, the light beam focused onto the disc is reflected from the disc onto one or more photodetectors. There are, for example, optical scanning devices known which possess an optical grating in the path of the beam and said grating splits the light beam emitted from a laser into the main beam and the diffracted beams. The main beam and the diffracted beams are focused onto the disc by means of an objective lens. The main beam is reflected from the disc, through an astigmatically acting optical element, for example, a cylinder lens, and onto a four-quadrant photodetector consisting of four photodiodes. The data signal HF is generated from the summation signal of the four photodiodes. The output signals of two diagonally opposite photodiodes are added together. The two sums formed in this way are subtracted from each other in order to generate the focusing error signal FE which is the control signal for the focusing control circuit.

In Figure 3 there is shown the data signal HF when the light beam L strikes the disc CD perpendicularly. The upper and lower envelope curves for the data signal envelope HF are straight lines.

The invention is now based on the further recognition that, as a result of different refraction or reflection, less light is reflected from the disc onto the four-quadrant photodetector if the light beam no longer radiates perpendicularly onto the disc. As a consequence of this, the amplitude of the data signal HF is attenuated.

If the disc is now subject to disc slap, then the data signal HF is modulated with a sine function because of the sine-wave-form alteration of the radial angle φR; as the tangential angle φT changes according to a cosine function, the data signal HF is also simultaneously modulated with a cosine function.

In Figure 4 there are shown the data signal HF, amplitude modulated in dependence upon the radial angle φR, the radial angle φR and the sinusoidal focusing error signal FE. The upper and lower envelope curves of the data signal HF are of sine-wave form.

In Figure 5 there are shown the data signal HF, modulated in dependence upon the tangential angle φT, the tangential angle φT and the filtered focusing error signal F. The upper and lower envelope curves of the data signal HF are of cosine-wave form.

As the focusing error circuit must, as a result of the disc slap, constantly re-adjust the position of the objective lens, the filtered focusing error signal F is also of sine-wave form. It has a fixed phase relationship

to the disc slap. Owing to the fixed phase relationship to the disc slap, the filtered focusing error signal F is suitable as the reference signal to measure the phase shift of the amplitude-modulated data signal HF. Because as a result of the disc slap not only the radial angle φR but also the tangential angle φT alter, the two modulation components U1 = A*cosα and U2 = -B*sinα, caused by the radial angle φR and the tangential angle φT, are superimposed. The resulting modulation voltage Uy is equal to Uy = A*cosα - B*sinα = C*sin(α+φ). The point of inflection which coincides with the zero point can be calculated from the second derivative $d^2Uy/d\alpha^2 = 0$.

$$d^2Uy/d\alpha^2 = -A*\cos\alpha + B*\sin\alpha = 0$$

$$tg\alpha = tg\varphi = A/B$$

From which results the following:

$$A = C*\sin\varphi$$
$$B = C*\cos\varphi$$

The values of C and φ are determined by measurements. A is the modulation component which is caused by the alterations of the radial angle φR; B is the modulation component which changes in the tangential angle φT cause.

The arrangement shown in Figure 6 for executing the method according to the invention will now be described and explained.

An optical scanning device AV, the objective lens O of which focuses a light beam L onto a rotating disc CD by means of a focusing control circuit, feeds the data signal

to an amplifier V. Moreover, the optical scanning device generates the actual value IT for a tracking controller TR and the actual value IF for the focusing controller FR. The tracking controller TR supplies a tracking error signal TE to the optical scanning device AV in order to guide the light beam L along the data tracks of the disc CD. The focusing controller FR generates a focusing error signal FE for the optical scanning device AV in order to focus the light beam L onto the disc by means of the objective lens O.

In order to fix the spatial position of the objective lens O and thus be able to adjust the radial angle φR and the tangential angle φT, servo components, for example, coils, are provided in the optical scanning device AV; for simplicity, said components are, however, not illustrated in Figure 6.

The amplifier V transmits the data signal HF to a data processing unit DV and an amplitude demodulator DM, the output of which is connected to the first input E1 of a microprocessor MP and the input of a first pulse former I1. The output of the pulse former I1 is connected to the second input E2 of the microprocessor MP. The focusing error signal FE generated by the focusing controller FR is fed to the input of a low-pass filter TP, the output of which is connected to the input of a second pulse former I2. The output of the second pulse former I2 is coupled with the third input E3 of the microprocessor MP. The first output A1 of the microprocessor MP is connected to a controller RR for controlling the radial angle φR, and the second output A2 is connected to a controller RT for controlling the tangential angle φT. The control signals from the two controllers RR and RT are fed to servo components in the optical scanning device AV which adjust the spatial position of the objective lens O. However,

the spatial position of the entire optical scanning device or the disc drive axis can also be adjusted with the help of the control signals.

Figure 7 shows the amplitude-modulated data signal HF at the output of the pre-amplifier V, the focusing error signal FE, the filtered focusing error signal F at the output of the low-pass filter TP, the digitalized focusing error signal FD at the output of the second pulse former I2, the demodulated data signal M at the output of the amplitude demodulator DM and the digitalized demodulated data signal MD at the output of the first pulse former I1.

The HF oscillations of the data signal HF, which the low-pass filter TP filters out, are superimposed on the sine-wave form focusing error signal FE. The pulse former I2 converts the filtered sine-wave form focusing error signal F into a signal with square-wave form, the digitalized focusing error signal FD. The pulse former I1 converts the demodulated sine-wave form data signal M into the demodulated data signal MD with square-wave form. The microprocessor calculates from the demodulated data signal $M = C*\sin(\alpha+\gamma)$ in the manner already explained, the control signal $UR = C*\sin\gamma*\cos\alpha$ and $UT = C*\cos\gamma*\sin\alpha$ for the controllers RR and RT.

In Figure 8 the digitalized focusing error signal FD and the demodulated digitalized data signal MD are logically combined in an exclusive-OR gate EX in order to generate a control voltage Ux. The exclusive-OR gate EX can also be integrated into the microprocessor MP.

Besides the signals FD and MD, Ux is also shown in Figure 7.

Figures 9a to 9h illustrate the control voltage Ux for

different radial angles φR and tangential angles φT. Figure 9i shows the digitalized focusing error signal FD.

With the help of the flow diagram illustrated in Figure 10, it will now be explained how, for example, the radial angle φR and the tangential angle φT can be calculated according to value and sign.

Firstly, the periods T of the digitalized focusing error signal FD and the pulse width IB of the control signal Ux at the output of the exclusive-OR gate EX are measured by means of two counters in order to calculate the value IB/T. Both counters are started by the ascending flank in the digitalized focusing error signal FD. Moreover, the amplitude C of the demodulated data signal M is measured in order to calculate $A = C*\sin\varphi$ and $B = C*\cos\varphi$ as well as A/B. It is then queried whether IB/T falls in the interval from 0 to 1/4, in the interval from 1/4 to 1/2 or in the interval from 1/2 to 1. If IB/T falls in the interval 1/2 to 1 and IB = T, then the radial angle φR and the tangential angle φT are zero. The light beam is directed exactly perpendicularly onto the disc. However, if IB does not equal T, then a faulty scan is assumed.

If, on the other hand, IB/T < 1/4, then it is queried whether the flank in the control signal Ux, which stops the second counter, was a descending or an ascending flank. After decisions have been made in both cases it is subsequently checked whether A/B > 9. If A/B > 9, then the sign of the radial angle φR and the tangential angle φT is known.

If $A/B \leq 9$, then it is queried whether A/B < 0.11. After this final inquiry the sign of the radial angle φR and the tangential angle φT can be determined. The exact form of inquiry for all cases arising can be found in the flow

diagram in Figure 10.

The values 9 and 0.11 have proved to be favourable in trials. The relationship $tg\gamma = A/B = 9$ corresponds to a phase shift of approximately 84°, whereas a phase shift of about 6.3° forms the basis for the relationship $tg\gamma = A/B = 0.11$.

Using the numerical example selected in the flow diagram the radial angle φR is taken as zero with a phase shift between 84° and 90°. If the phase shift lies between 0° and 6.3°, then the value 0° is taken for the tangential angle φT.

Figures 11a to 11h show the demodulated data signal M at the output of the demodulator DM and the digitalized data signal MD at the output of the pulse former I1 for various radial angles φR and tangential angles φT. Figure 11i illustrates the focusing error signal FE and the digitalized focusing error FD at the output of the pulse former I2.

The amplitude of the amplitude-modulated data signal is shown in mV in Figure 16 in dependence upon the radial angle φR and the tangential angle φT. As a result of asymmetry in the optics, for example non-circular light spots on the recording medium or an asymmetric distribution of the light beam on the data track, a radial angle causes a different attenuation of the amplitude of the data signal than a tangential angle of the same size. In order to take this difference into account, a constant KR for the radial angle and a constant KT for the tangential angle are determined by means of the measuring curve shown in Figure 16. The amplitude AL of the data signal HF equates to $AL = AX-KR*\varphi R^2$ for $\varphi T = 0$, and $AL = AX-KT*\varphi T^2$ for $\varphi R = 0$. AX is the maximum amplitude of the

data signal HF.

The digitalized focusing error signal FD and the demodulated data signal MD are drawn superimposed on each other in Figure 17 in order to be able to recognize the phase shift PV between the signals FD and MD.

The flow diagram shown in Figure 18 for calculating the radial angle φR and the tangential angle φT will now be explained.

Firstly, the phase shift PV between the digitalized focusing error signal FD and the demodulated data signal MD, the period PE of the digitalized focusing error signal FD and the amplitude C of the amplitude-modulated data signal are measured. The radial angle φR is calculated according to the following formula:

$$\phi R = C*\sin(PV/PE)/2*KR*VP.$$

The tangential angle φT is calculated according to the formula:

$$\phi T = C*\cos(PV/PE)/2*KT*VP.$$

VP is the vertical disc slap of the recording medium.

An embodiment of an amplitude demodulator DM is illustrated in Figure 12.

The data signal HF travels via a series connection consisting of a resistor R1, a capacitor C1 and a potentiometer P1 to the base of a transistor T1. A supply voltage +UB is applied to the base of transistor T1 via a resistor R2 and to the collector via a resistor R3. A supply voltage -UB is applied to the base of transistor T1

via a resistor R4 and to the emitter via a resistor R5 parallel to which is wired a series connection consisting of a capacitor C2 and a resistor R6. The collector of transistor T1 is connected, via a series connection consisting of a capacitor C3 and a diode D1, a resistor R7 and a capacitor C4, to the output terminal AK of the amplitude demodulator DM. The connection point of capacitor C3 and diode D1 is connected to reference potential via a diode D2. The coupling point of diode D1 and resistor R7 is connected to reference potential via a parallel connection consisting of a resistor R8 and a capacitor C5.- The coupling point of resistor R7 and capacitor C4 is connected to reference potential via a resistor R9.

An example of a pulse former I1 and I2 is shown in Figure 13.

The demodulated data signal M or the focusing error signal FE is fed to the non-inverting input of a differential amplifier DV1 which is connected to reference potential via a resistor R1. The output of the differential amplifier DV1 is fed back via a resistor R2 to its inverting input which is connected to reference potential via a resistor R3. The output of the differential amplifier DV1 is connected via a resistor R4 to the inverting input of a differential amplifier DV2, the output of which is connected to the non-inverting input of the differential amplifier DV2 via a resistor R5. The non-inverting input of the differential amplifier DV2 is connected to reference potential via a resistor R6. The output of the differential amplifier DV2 is connected to reference potential via a series connection consisting of a diode D1 and a resistor R7. The demodulated digitalized data signal MD or the digitalized focusing error signal FD can be picked up at the connection point of diode D1 and

resistor R7.

The invention is suitable for optical and magneto-optical recording and reproduction devices. The method according to the invention ensures that the light beam for scanning the data strikes the disc perpendicularly.

An advantage of the invention can be seen in that the sizes of the radial angle φR and the tangential angle φT can also be indicated. It is possible, therefore, to measure the quality of discs using a precisely adjusted optical scanning device and an equally precisely adjusted disc drive. For this, the optical scanning device and the disc drive are so adjusted that the light beam radiates perpendicularly onto a test disc having a completely even surface and no disc slap.

If the disc to be tested is an ideal disc, then only the value zero is indicated for the radial angle and the tangential angle upon scanning this disc. However, if the disc is curved or wavy, then values differing from zero are indicated for the radial and tangential angles. The measured radial and tangential angles are, therefore, a measure of the quality of the disc.

A device for measuring and indicating the radial angle φR and the tangential angle φT is shown in Figure 14. This device is distinguished from the arrangement shown in Figure 8 in that the signals at the outputs A1 and A2 of the microprocessor MP are fed to a display device AZ instead of two controllers.

Therefore, the invention also enables the construction of a measuring device for establishing the quality of optical and magneto-optical discs.

Vice versa the tangential and radial angles of recording and reproduction devices can be measured using a measuring disc, the disc slap of which is known.

The construction of an optical scanning device is illustrated in Figure 15.

The light beam produced by a laser LS radiates through a lens L1 onto a prism beam splitter PS which deflects the light beam at right-angles to the objective lens O which focuses it onto the disc CD with the help of the focus control circuit. The light beam is reflected from the disc CD back to the prism beam splitter PS. The reflected light beam radiates in a straight line through the prism beam splitter PS to a cylinder lens ZL which directs it onto a four-quadrant photodetector PD with four photodiodes A,B,C and D. The output signals from the four photodiodes A,B,C and D of the four-quadrant photodetector PD are added in an adding amplifier SV. The data signal HF can be picked up at the output of the adding amplifier SV. In a differential amplifier, the focusing controller FR, the focusing error signal FE is generated by adding the output signals from the two diagonally opposite photodiodes A and C, and by subtracting the output signals from the other two diagonally opposite photodiodes B and D. The output of the focusing controller FR is coupled with the servo components SG of the objective lens O. The control signals UR and UT are also fed to the servo components SG which, for example, can be a plurality of coils. By means of the magnetic fields generated by the coils, the objective lens can be moved not only along the optical axis - the z-axis - in order to focus the light beam onto the disc CD, but also rotate about the x and y axes in order to adjust the tangential and radial angles.

* C L M S *

Claims

1. A method for generating a control or measuring signal in order to measure or control to a desired value the tangential angle (φT) and the radial angle (φR) of a light beam (L) directed onto a rotating recording medium (CD) for reading data, wherein the light beam (L) is reflected from the recording medium (CD) onto a photodetector, the output signal of which represents the data signal (HF), characterised in that the data signal (HF) is demodulated in an amplitude demodulator (DM), and that the control or measuring signals (UR, UT) are generated from the amplitude and the phase position of the demodulated data signal (M).

2. A method according to claim 1, characterised in that the control signal UR = C*synφ *cosα for the radial angle (φR) and the control signal UT = -C*cosφ *sinα for the tangential angle (φT) are generated from the demodulated data signal M = C*sin ($\alpha+\varphi$).

3. A method according to claim 1 or 2, characterised in that the phase position of the demodulated data signal (M) is compared with the phase position of a focusing error signal (FE), which serves as control signal for a focusing control circuit which focuses the light beam (L) onto the recording medium (CD).

4. A method according to claim 3, characterised in that the radial angle (φR) is calculated according to the formula φR = C*sin (PV/PE)/2*KR*VP, and that the tangential angle (φT) is calculated according to the formula φT = C*cos(PV/PE)/2*KT*VP, wherein KR and KT are constants and VP is the vertical disc slap of the recording medium.

* C L M S *

5. A method according to claim 1,2,3 or 4 characterised in that the control signal UR and the control signal UT are fed to a display device (AZ) which indicates the radial angle (φR) and the tangential angle (φT).

6. A method according to claim 1,2,3 or 4, characterised in that the control signal UR is fed to a first controller (RR) which controls the radial angle (φR) of the light beam (L), and that the control signal UT is fed to a second controller (RT) which controls the tangential angle (φT) of the light beam (L).

7. An arrangement for executing the method according to claim 5, characterised in that the light beam (L) of an optical scanning device (AV) is focused onto the recording medium (CD) by means of an objective lens (O), the optical scanning device (AV) feeds the data signal to an amplifier (V), the output of which is connected to the input of a data processing unit (DV) and to the input of an amplitude demodulator (DM), the output of the amplitude demodulator (DM) is connected to the first input (E1) of a microprocessor (MP) and with the input of a first pulse former (I1), the output of the first pulse former (I1) is connected to the second input (E2) of the microprocessor (MP), the optical scanning device (AV) supplies the actual value (IF) of the focusing control circuit to a focusing controller which generates the focusing error signal (FE) and transmits it to the optical scanning device (AV) and to a low-pass filter (TP), the output of which is connected to the input of a second pulse former (I2), the output of the second pulse former (I2) is connected to the third input (E3) of the microprocessor, and that a first output (A1) of the microprocessor (MP), which supplies the control signal UR = $C*\sin\varphi*\cos\alpha$, and a second output (A2) of the microprocessor (MP), which supplies the control signal UT = $-C*\cos\varphi*\sin\alpha$, are connected to a display

* C L M S *

device (AZ).

8. An arrangement for executing the method according to claim 6, characterised in that the light beam (L) of an optical scanning device (AV) is focused onto the recording medium (CD) by means of an objective lens (O), the optical scanning device (AV) feeds the data signal to an amplifier (V), the output of which is connected to the input of a data processing unit (DV) and to the input of an amplitude demodulator (DM), the output of the amplitude demodulator (DM) is connected to the first input (E1) of a microprocessor (MP) and to the input of a first pulse former (I1), the output of the first pulse former (I1) is connected to the second input (E2) of the microprocessor (MP), the optical scanning device (AV) supplies the actual value (IF) of the focusing control circuit to a focusing controller which generates the focusing error signal (FE) and transmits it to the optical scanning device (AV) and to a low-pass filter (TP), the output of which is connected to the input of a second pulse former (I2), the output of the second pulse former (I2) is connected to the third input (E3) of the microprocessor (MP), a first output (A1) of the microprocessor (MP), which supplies the control signal UR = C*sin φ *cosα, is connected to the input of a first controller (RR), the output of which is connected to the optical scanning device (AV), and that a second output (A2) of the microprocessor (MP), which supplies the control signal UT = -C*cos φ *sinα, is connected to the input of a second controller (RT), the output of which is connected to the optical scanning device (AV).

* C L M S *

9. An arrangement according to claim 7 or 8, characterised in that the output of the first pulse former (I1) and the second pulse former (I2) are connected to the inputs of an exclusive-OR gate (EX), the output of which is connected to the fourth input (E4) of the microprocessor (MP).