The invention relates to a method for the compensation of offset voltages in a focusing control loop by means of which a light beam of a light source is focused on a record carrier, and/or in a tracking control loop by means of which the light beam is guided onto the data tracks of the record carrier, wherein the light beam is reflected from the record carrier onto a photo-detector having several photo-diodes from whose output voltages the focusing error and/or tracking error signal is produced by formation of a difference.

In apparatus for the reproduction of data which is readable by means of an optical scanning device from the data tracks of a record carrier, a light beam is focused on the record carrier by means of a focusing control loop and is guided onto the data tracks of the record carrier by means of a tracking control loop. The optical scanning device in such apparatus as e.g. CD players, recording and play-back magneto optic devices, recording and play-back devices for draw-disc or optical disc players is equipped with a laser diode, a plurality of lenses, a prismatic beam splitter, a diffraction grating and a photo-detector. Construction and method of operation of an optical scanning device, of 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 values for the focusing and for the tracking control loop 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 used for the control value for the tracking control loop.

A coil serves as the adjusting member for the focusing control loop, an object lens being moveable along the optical axis by means of its magnetic field. By displacement of the object lens, the focusing control loop thus causes the light beam emitted by the laser diode to be 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 also often referred to as a radial drive. As a result, the light beam can be guided along the spirally shaped tracks of 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 consisting of the laser diode, the lenses, the prismatic beam splitter, the diffraction grating 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.

The photo-detector PD of the optical scanning device of a CD player in which the three laser beams L1, L2 and L3 are focused on the compact disc is shown in Fig. 1. In the above mentioned reference, such a scanning device is referred to as a "three-beam pick-up".

The central light beam L1 is the main beam, the two light beams L2 and L3 are the +1. and -1. order beams which are generated by means of the diffraction grating from the main beam L1.

In the photo-detector PD, four square shaped photodiodes A, B, C and D are fitted together such that they form yet another square. Two further, similarly square shaped photodiodes E and F are located diagonally opposite to each other with reference to this square formed by the four photodiodes A, B, C and D.

The central light beam L1 which is focused on the four photodiodes A, B, C and D produces the data signal HF = AS + BS + CS + DS and the focusing error signal FE = (AS + CS) - (BS + DS). The two outer light beams L2 and L3, of which the front one L2 falls on the photodiode E and the rear one L3 on the photodiode F, produce the tracking error signal TE = ES - FS. The photo-electric voltages of the photodiodes A, B, C, D, E and F are referenced respectively AS, BS, CS, DS, ES and FS. Because an effectively astigmatic collimator lens is provided in the optical path of the central light beam L1 in the optical scanning device, the central light beam L1 is in the shape of a circle when focused exactly on the large square which is formed by the photodiodes A, B, C and D while it takes on the form of an ellipse when defocused.

Figure 1a shows the case of the focusing and also of the exact tracking which will be gone into later on. Because the light patch formed on the large square by the light beam L1 has the form of a circle, the ensuing focusing error signal is FE = (AS + CS) - (BS + DS) = 0. The focusing control loop recognises that there is an exact focusing from the zero value of the focusing error signal FE.

One of the cases of defocusing, where the object lens is located too far from the compact disc, is illustrated in Figure 1b. The focusing error signal FE is negative: FE = (AS + CS) - (BS + DS) < 0. The focusing control loop recognises that the distance between the object lens and the compact disc is too large from the negative value of the focusing error signal FE. Consequently, the object lens is moved towards the compact disc by the adjusting member of the focusing control loop until such time as the focusing error signal FE becomes zero.

The other case of defocusing, where the object lens is too close to the compact disc, is shown in Figure 1c. The focusing error signal FE has a positive value: FE = (AS + CS) - (BS + DS) > 0. The focusing control loop recognises that the object lens is too close to the compact disc from the positive value of the focusing error signal FE. Therefore, the object lens is moved away from the compact disc by the adjusting member until such time as the focusing error signal FE becomes zero.

It will now be explained how the tracking control is effected by means of the tracking control loop.

The light beams L1, L2 and L3 in Figures 1a, 1b and 1c are following the track exactly. The tracking error signal TE has the value zero. TE = ES - FS = 0.

The case is illustrated in Figure 1b that the light beams L1, L2 and L3 are displaced to the right of the track. The tracking error signal TE takes on a negative value: TE = ES - FS < 0. The adjusting member of the tracking control loop now moves the optical scanning device to the left until such time as the tracking error signal TE becomes zero.

In the opposite case that the light beams are displaced to the left of the track, the tracking error signal is positive: TE = ES - FS > 0. The adjusting member of the tracking control loop now moves the optical scanning device to the right until such time as the tracking error signal FE becomes zero.

In order to achieve a trouble free reproduction of the data, be it for example picture and sound in an optical disc player or merely the sound in 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 track of the disc.

The servo amplifier in the focusing control loop is however, like any other servo amplifier, also subject to an off-set

voltage whose magnitude is dependent on the one hand on the temperature and on the other hand on the underlying long term drift. The drift of the off-set voltage, as well as other parameters of an amplifier, are caused by aging of the amplifier over the course of time.

The focusing error signal FE = (AS + CS) - (BS + DS) is formed in a differential amplifier. Because this differential amplifier is also subject to an off-set voltage and because, in contrast to ideal photodiodes, the photodiodes A, B, C and D produce different voltages or currents for the same degree of illumination, there arises here a further source of disturbing off-set voltages.

In order that the reproduction of the data will not be affected by the off-set voltages, a compensation in so far as possible of all the occurring off-set voltages is necessary. However, manual adjustment of a compensating potentiometer only allows an approximate compensation to be effected because changes in the off-set voltages as a result of temperature fluctuations and as a result of aging of individual components are not taken into account.

In order to compensate incorrect adjustment or even off-set voltages which are caused by drift in a focusing control loop which is known from the EP-A-0 190 438, the focusing control loop is initially opened. A micro-processor then varies a compensation voltage at the input of a servo amplifier to whose output the adjusting member, the so-called actuator, is connected, until such time as the data signal reaches a maximum. The value, which the focusing error signal assumes for a maximum data signal, is stored and then, with a closed focusing control loop, is supplied to the input of a mixer. The focusing error signal is supplied to the other input of the mixer. The output of the mixer is coupled via the servo amplifier to the adjusting member.

Thus, the object of the invention is to so arrange a method for the compensation of off-set voltages in a focusing and/or tracking control loop that an automatic compensation of the off-set voltages is enabled.

The invention achieves this object in that, with a closed control loop, the focusing error and/or tracking error signal is compared with a predefined reference value and that a compensating value is supplied to the control member of the focusing and/or tracking control loop which is varied until such time as the focusing error and/or tracking error signal is equal

to the reference value and which is maintained upon equality of the focusing error and/or tracking error signal with the reference value.

A further solution of the problem provides that, before the comparison of the focusing error and/or tracking error signal in a first method step with open or switched-off control loop and with uniform illumination of the photo-diodes, a first compensating value is added to the focusing error and/or tracking error signal and varied until such time as the sum is equal to a first reference value, that upon equality of the sum with the first reference value, the first compensating value is maintained.

A further solution of the problem resides in that, before the comparison of the focusing error and/or tracking error signal, in a first method step with open or switched-off control loop and with uniform illumination of the photo-diodes, the focusing error and/or tracking error signal is stored as reference value.

There is shown

Figure 2 a circuit arrangement for carrying-out the method in accordance with Claim 1

Figure 3 a circuit arrangement for carrying-out the method in accordance with Claim 3

Figure 4 a circuit arrangement for carrying-out the method in accordance with Claim 4

Figure 5 a circuit arrangement for carrying-out the method in accordance with Claim 5.

With the aid of the circuit arrangements illustrated in the figures, the individual methods in accordance with the invention will now be explained using the example of a focusing control loop.

In Figure 2, a voltage +U is applied to the interconnected cathodes of the photo-diodes A, B, C and D. The interconnected anodes of the photo-diodes A and C are connected to the summing input, whereas the interconnected anodes of the photo-diodes B and D are connected to the differencing input, of a differential amplifier DV whose output is connected via one resistor R1 to the input of a servo amplifier RV and via another resistor R2 to

the non-inverting input of a comparator VL. The non-inverting input of the comparator VL is attached to reference potential via a capacitor C1. A reference voltage UR is applied to the inverting input of the comparator VL whose output is connected to the input E1 of a microprocessor MP. The output A1 of the microprocessor MP is connected to the input of a digital-to-analogue converter DA1 whose output is connected to output of the servo amplifier RV and to the one terminal of the control member SG. The other terminal of the control member SG, which is in the form of a coil, is attached to reference potential.

For easier understanding of the circuit arrangement, it will be assumed initially that the focusing control loop is constructed from ideal components which are not subject to any offset voltages.

When exactly focused, the main beam L1 forms a circle on the four photo-diodes A, B, C and D, as is shown in Figure 1a. Therefore, because all four photo-diodes A, B, C and D are receiving the same luminous energy and converting it into an electrical current, they produce equal output voltages or currents. Consequently the voltage at the output of the differential amplifier DV is zero. Because the servo amplifier RV is also assumed to be ideal, the voltage at its output and therefore too at the one terminal of the control member SG is similarly zero. The control member SG, often also called actuator, therefore moves the objective of the optical scanning device until such time as the voltage at the output of the servo amplifier RV becomes zero. On the premise of ideal components, there is then an exact focusing because the voltage at the output of the differential amplifier DV also amounts to zero.

It will now be assumed that the servo amplifier RV is subject to an offset voltage while the differential amplifier DV and the photo-diodes A, B, C and D continue to be considered as ideal.

Again the control member SG moves the objective until such time as the voltage at the output of the servo amplifier RV becomes zero. Now however, due to the servo amplifier RV being assumed to be real, the input voltage and thus too the voltage at the output of the differential amplifier is different from zero. In the position in which the objective is now held by the coil, the light beam L1 is therefore no longer reproduced in circular form but rather, as in Figure 1b or 1c, in slightly elliptical form which indicates that there is not an exact focusing.

In order to achieve an exact focusing by compensation of the off-set voltage of the servo amplifier RV, the voltage at the

output of the differential amplifier DV is compared in the comparator VL with a reference voltage UR, which in the present embodiment is selected to be zero. The microprocessor MP now varies the digital values at its output A1, which the digital-to-analogue converter DA1 converts into an analogue voltage and supplies to the control member SG, until such time as the comparator VL at the input of the microprocessor MP indicates that the voltage at the output of the differential amplifier DV has become zero. Because the light beam L1 is now formed by the objective into a circlular shape on the photo-diodes A, B, C and D, there is an exact focusing. If the comparator VL indicates to the microprocessor MP that there is an exact focusing because the voltage at the output of the differential amplifier DV has become zero, the microprocessor MP maintains the value at its output A1 so that, because of the digital-to-analogue converter DA1, an analogue compensation voltage is continually applied to the control member SG.

The apparatus e.g. a CD player is now ready for use. It is particularly advantageous to effect the compensation each time the CD player is switched-on.

If the off-set voltage of the servo amplifier RV should now alter e.g. as the result of aging or temperature fluctuations, this has the consequence that the voltage at the output of the differential amplifier DV similarly alters and thus is no longer equal to the reference voltage UR. Because the comparator VL indicates this to the microprocessor MP when switching-on the CD player, the microprocessor is able to regulate the off-set compensation voltage and thus ensure an optimal compensation.

A substantial advantage of the circuit arrangement illustrated in Figure 2 may be seen in that each time the CD player is switched-on, the compensation of the off-set voltage of the servo amplifier RV automatically occurs.

The circuit arrangement shown in Figure 3 for carrying out the method in accordance with Claim 2 will now be described and subsequently explained.

The circuit arrangement of Figure 3 differs from the circuit arrangement of Figure 2 in that it is expanded by a digital-to-analogue converter DA2 whose output is connected to the output of the differential amplifier DV and whose input is connected to an output A2 of the microprocessor MP.

With the circuit arrangement in Figure 3, it is assumed that in addition to the servo amplifier RV the differential amplifier DV

is also subject to an off-set voltage. Likewise, the photo-diodes A, B, C and D are considered as real i.e. not completely identical components, which, under equal illumination, produce different voltages or currents. Therefore, in the case of focusing where the objective produces a circular shaped light beam L1 on the four photo-diodes A, B, C and D as in Figure 1a, the voltage at the output of the differential amplifier DV will not adopt the value zero as desired but a positive or negative value e.g. +a.

In a first method step, with open or switched-off focusing control loop, the four photo-diodes A, B, C and D are equally illuminated. This condition can be obtained in a simple manner by switching-off the light source whereby the photo-diodes A, B, C and D are then in darkness. Moreover, with a light source that is switching-off, it does not matter where the objective is located nor whether it is moving since there can be no feedback.

In this condition - with switched-off light source - the voltage at the output of the differential amplifier DV is compared with the reference voltage UR in the comparator VL.

The digital values, which the microprocessor MP now provides at its output A2 are converted into an analogue voltage by the digital-to-analogue converter DA2. The microprocessor MP then varies the digital values at its output A2 until such time as the comparator VL indicates that the analogue voltage at the output of the digital-to-analogue converter DA2 has compensated the voltage at the output of the differential amplifier DV. The digital value occurring at this time on the output A2 of the microprocessor MP is maintained. By these measures, it is ensured that the voltage at the input of the servo amplifier RV is zero when, with exact focusing, the light beam L1 is reproduced as a circular shape on the photo-diodes A, B, C and D as in Figure 1a.

In a second method step, the light source is switched-on and the process continues as for the circuit arrangement in Figure 2.

Unfortunately, a further off-set magnitude that has been neglected up to now and which is frequently referred to as an optical off-set has its origin in the optics of the optical scanning device. By this, one understands the following: If the light beam is exactly focused on the record carrier, then, as a result of the unavoidable optical deficiencies in the optical components - the lenses, the prismatic beam splitter and the diffraction grating - the light beam is not of a circular shape as would be the case for ideal completely error-free optical

components but appears slightly elliptically shaped on the photo-detector formed by the four photo-diodes A, B, C and D. Consequently, with exact focusing of the light beam on the record carrier, the voltage at the output of the differential amplifier DV, despite the compensation of its off-set voltage, is not zero as desired. Rather, it has a positive or negative value.

How this off-set voltage which is caused by the optical off-set can be compensated will be explained with the aid of the circuit arrangement shown in Figure 4.

This differs from the circuit arrangement in Figure 3 in that the reference voltage UR is variable. To this end, an output A3 of the microprocessor MP is connected to the control input of the reference voltage source UR which may be implemented for example as a digital-to-analogue converter.

In the first and second method steps, which proceed as for the circuit arrangement in Figure 3, a fixed value is selected for the reference voltage UR. In addition to the first and second method steps, a further third method step for the compensation of the said optical off-set is carried out during the production of the CD player which proceeds as follows.

A test compact disc is inserted into the CD player. The digital values at the outputs A1 and A2 of the microprocessor MP which were determined during the first and second method steps are maintained and not altered during the third method step. With switched-on light source, the light beam is focused exactly onto the record carrier, the test compact disc. The exact focusing is determined with the help of the test compact disc since, for exact focusing, the jitter in the HF signal is then at its lowest. The exact focusing could however also be checked for example by means of a microscope. It is now determined, by what value the reference voltage UR must be altered in order that the optical off-set be compensated since the off-set voltage of the differential amplifier DV was already compensated in the first method step and that of the servo amplifier RV in the second method step. The reference voltage UR is varied until such time as the the jitter in the HF signal reaches a minimum because the light beam is then exactly focused on the inserted test disc. The value of the reference voltage UR determined in this way is permanently stored. The CD player is then ready for use.

Should the off-set voltage of the differential amplifier DV or of the servo amplifier RV change in subsequent operation, they will be compensated in accordance with the first and second

method steps for example, each time the apparatus is switched-on.

The circuit arrangement shown in Figure 5 for carrying out the method in accordance with Claim 5 will now be described and explained.

It difers from the circuit arrangement in Figure 4 in that the digital-to-analogue converter DA2 is missing.

In a first method step, a uniform illumination of the photo-diodes A, B, C and D is ensured, as for the circuit arrangement of Figure 3, in that the light source is switched-off. In this condition, which corresponds to that of exact focusing where the light beam L1 appears as a circular shape on the photo-diodes A, B, C and D, the microprocessor MP alters the reference voltage UR until such time as the comparator VL1 indicates to it that the reference voltage UR is equal to the voltage at the output of the differential amplifier DV which may for example amount to +a.

In order to compensate the already mentioned optical off-set, the first method step is modified in the same way as for the circuit arrangement in Figure 3. During the production of the CD player and with open or switched-off focusing control loop, the light beam is focused exactly onto the compact disc and the exact focusing is checked with the help of a microscope or by determining the minimum jitter in the HF signal by means of the test compact disc. The microprocessor MP now alters the reference voltage UR until such time as the comparator VL1 indicates to it that the reference voltage UR is equal to the voltage at the output of the differential amplifier DV which may for example amount to +b.

The second method step proceeds as for the previously described circuit arrangements with switched-on light source.

Without further compensating measures, the control member SG would hold the objective in a position at which the voltage at the output of the servo amplifier RV is zero. In general however, the voltage at the input of the servo amplifier RV will not in this case amount to the desired +a or +b as would be the case for exact focusing but will take on a positive or negative value differing from zero in dependence on the magnitude of the off-set voltage of the servo amplifier RV. It is therefore arranged that the microprocessor MP alters the digital value at its output A1, which is converted by the digital-to analogue converter DA1 into an analogue compensation voltage whch is

supplied to the control member SG, until such time as the comparator VL indicates to it that the voltage at the output of the differential amplifier DV is equal to the reference voltage UR which in the assumed numerical example has the value +a or +b. THe digital value then occurring at the output A1 of the microprocessor MP is maintained so that, because of the digital-to-analogue converter DA1, the correct analogue compensation voltage is permanently applied to the control member SG. The CD player is then ready for use.

It is particularly advantageous with this circuit arrangement to carry-out the two described method steps each time the CD player is switched-on.

A manual compensation by adjustment of the potentiometer during the production, and equally, a subsequent new adjustment made necessary because of temperature fluctuations or aging of the components, is not required since the off-set voltages are automatically compensated each time the apparatus is switched-on.

Claims

1. Method for the compensation of off-set voltages in a focusing control loop by means of which a light beam of a light source is focused on a record carrier, and/or in a tracking control loop by means of which the light beam is guided onto the data tracks of the record carrier, wherein the light beam is reflected from the record carrier onto a photo-detector having several photo-diodes (A, B, C, D, E, F) from whose output voltages the focusing error and/or tracking error signal are generated by formation of a difference, characterised in that, with closed control loop, the focusing error and/or tracking error signal is compared with a predefined reference value (UR) and that a compensating value is supplied to the control member (SG) of the focusing and/or tracking control loop which is varied until such time as the focusing error and/or tracking error signal is equal to the reference value (UR) and which is maintained upon equality of the focusing error and/or tracking error signal with the reference value (UR).

2. Method according to Claim 1, characterised in that, before the comparison of the focusing error and/or tracking error signal, in a first method step with open or switched-off control loop and with uniform illumination of the photo-diodes (A, B, C, D, and/or E, F), a first compensating value is added to the focusing error and/or tracking error signal and varied until such time as the sum is equal to a first reference value, that upon equality of the sum with the first reference value (UR) the first compensating value is maintained.

3. Method according to Claim 2, characterised in that, the first and second reference values are selected to be equally great.

4. Method according to Claim 2 or 3, characterised in that, in the production of the focusing and/or tracking control loop, a third method step follows the first and second method steps, that in the third method step the first compensating value established in the first method step and the second compensating value established in the second method step are maintained, that the light beam is focused exactly on the record carrier by means of a measuring instrument and that thereafter the reference value is corrected.

5. Method according to Claim 1, characterised in that, before the comparison of the focusing error and/or tracking error signal, in a first method step with open or switched-off control loop and with uniform illumination of the photo-diodes, the

focusing error and/or tracking error signal is stored as reference value.

6. Method according to Claim 5, characterised in that, in the production of the control loop in the first method step the light beam is focused exactly on the record carrier and the exact focusing is checked by means of a measuring device.

7. Method according to Claim 4 or 6, characterised in that, a microscope is provided as the measuring device for the checking of the exact focusing.

8. Method according to Claim 4 or 6, characterised in that, for the checking of the exact focusing of the light beam on the record carrier, the minimum jitter in the HF signal is determined by means of a test record carrier.

9. Method according to Claim 2, 3, 4 or 5, characterised in that, for the achievement of an equal illumination of the photo-diodes (A, B, C, D, and/or E, F), the light intensity is selected as zero.

10. Method according to Claim 9, characterised in that, the photo-diodes (A, B, C, D, and/or E, F) are shielded by a blind from the light source.

11. Method according to Claim 9, characterised in that, the light source is switched-off.

12. Circuit arrangement for carrying out the method according to Claim 1, characterised in that, a voltage +U is applied to the interconnected cathodes of the photo-diodes (A, B, C, D) of the photo-detector, that the anodes of each second photo-diode (A and C, B and D) are connected together and to a respective input of a differential amplifier (DV) whose output is connected to the input of a servo amplifier (RV) and to the one input of a comparator (VL), that a reference voltage (UR) is applied to the other input of the comparator (VL), that the output of the comparator (VL) is connected to the input (E1) of a microprocessor (MP) whose output (A1) is connected to the input of a digital-to-analogue converter (DA1), that the output of the servo amplifier (RV) is connected to the output of the digital-to-analogue converter (DA1) and to the control member (SG), that the microprocessor (MP) supplies a compensating value to the control member (SG) of the focusing and/or tracking control loop which it alters until such time as the focusing error and/or tracking error signals are equal to the reference value (UR),

and which it maintains upon equality of the focusing error and/or tracking error signals with the reference value (UR).

13. Circuit arrangement for carrying out the method according to Claim 2, characterised in that, a voltage +U is applied to the interconnected cathodes of the photo-diodes (A, B, C, D) of the photo-detector, that the anodes of each second photo-diode (A and C, B and D) are connected together and to a respective input of a differential amplifier (DV) whose output is connected to the input of a servo amplifier (RV) and to the one input of a comparator (VL), that a reference voltage (UR) is applied to the other input of the comparator (VL), that the output of the comparator (VL) is connected to the input (E1) of a microprocessor (MP) whose first output (A1) is connected to the input of a first digital-to-analogue converter (DA1) and whose second output (A2) is connected to the input of a second digital-to-analogue converter (DA2), that the output of the servo amplifier (RV) is connected to the output of the first digital-to-analogue converter (DA1) and to the control member (SG), that the output of the second digital-to-analogue converter (DA2) is connected to the input of the servo amplifier (RV), that the microprocessor (MP) adds a first compensating value to the focusing error and/or tracking error signal and varies it until such time as the sum is equal to a first reference value, that upon equality of the sum with the first reference value (UR) the microprocessor (MP) maintains the first compensating value, that the microprocessor (MP) supplies a second compensating value to the control member (SG) of the focusing and/or tracking control loop and varies it until such time as the focusing and/or tracking error signal is equal to the second reference value (UR), and that it maintains the second reference value upon equality of the focusing error and/or tracking error signal with the reference value (UR).

14. Circuit arrangement for carrying out the method according to Claim 4 and 13, characterised in that, the other input of the comparator (VL) is connected to a controllable reference voltage source (UR) whose control input is connected to a third output (A3) of the microprocessor (MP).

15. Circuit arrangement for carrying out the method according to Claims 5, characterised in that, a voltage +U is applied to the interconnected cathodes of the photo-diodes (A, B, C, D) of the photo-detector, that the anodes of each second photo-diode (A and C, B and D) are connected together and to a respective input of a differential amplifier (DV) whose output is connected to the input of a servo amplifier (RV) and to the input of a comparator (VL), that the other input of the comparator (VL) is

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connected to a controllable reference voltage source (UR), that the output of the comparator (VL) is connected to the input (E1) of a microprocessor (MP) whose first output (A1) is connected to the input of a digital-to-analogue converter (DA1) and whose second output (A3) is connected to the control input of the adjustable reference voltage source (UR), that the output of the servo amplifier (RV) is connected to the output of the digital-to-analogue converter (DA1) and to the control member (SG), that the microprocessor (MP) supplies a compensating value to the control member of the control loop and varies it until such time as the the focusing and/or tracking error signal is equal to the stored reference value, and that the microprocessor (MP) maintains the reference value upon equality of the focusing and/or tracking error signal with the stored reference value.

16. Circuit arrangement according to Claim 14 or 15, characterised in that, the controllable reference voltage source (UR) is formed as a digital-analogue-converter.

17. Circuit arrangement according to Claim 12, 13, 14, 15 or 16, characterised in that, a first resistor (R1) is located between the differential amplifier (DV) and the servo amplifier (RV), that a series circuit consisting of the first and a second resistor (R1, R2) is located between the differential amplifier (DV) and the one input of the comparator (VL), that the one input of the comparator (VL) is attached to reference potential via a capacitor (C1) and that the one terminal of the control member (SG) which is formed as a coil is connected to the output of the servo amplifier (RV) and the other terminal is at reference potential.