(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 183 303**
B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication of patent specification: **28.02.90**

(51) Int. Cl.[5]: **G 11 B 7/095,** G 11 B 7/08

(21) Application number: **85201818.3**

(22) Date of filing: **08.11.85**

(54) **Apparatus for reading a disc-shaped record carrier.**

(30) Priority: **21.11.84 NL 8403534**

(43) Date of publication of application:
04.06.86 Bulletin 86/23

(45) Publication of the grant of the patent:
28.02.90 Bulletin 90/09

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI SE

(56) References cited:
EP-A-0 080 212
EP-A-0 087 718
EP-A-0 125 019
DE-A-2 935 250
FR-A-2 444 314

PATENTS ABSTRACT OF JAPAN, vol. 9, no. 33 (P-334)1756r 13th February 1985, page 27 P 334; & JP - A - 59 175 071 (HITACHI SEISAKUSHO K.K.) 03-10-1984

(73) Proprietor: **N.V. Philips' Gloeilampenfabrieken**
Groenewoudseweg 1
NL-5621 BA Eindhoven (NL)

(72) Inventor: **Overath, Hilde Maria Alda**
c/o INT. OCTROOIBUREAU B.V. Prof. Holstlaan 6
NL-5656 AA Eindhoven (NL)
Inventor: **Bierhoff, Martinus Petrus Maria**
c/o INT. OCTROOIBUREAU B.V. Prof. Holstlaan 6
NL-5656 AA Eindhoven (NL)

(74) Representative: **van der Kruk, Willem Leonardus et al**
INTERNATIONAAL OCTROOIBUREAU B.V. Prof. Holstlaan 6
NL-5656 AA Eindhoven (NL)

(56) References cited:
PATENTS ABSTRACTS OF JAPAN, vol. 8, no. 252 (P-314) 1689r, 17th November 1984, page 25 P 314; & JP - A - 59 121 633 (TOSHIBA K.K.) 13-07-1984

EP 0 183 303 B1

Courier Press, Leamington Spa, England.

Description

The invention relates to an apparatus for reading a disc-shaped record carrier in which information is stored in the form of a track of optically detectable areas, which apparatus comprises:

—means for rotating the carrier,

—a light source for producing a read beam,

—an objective system for focussing the read beam to form a read spot on the record carrier,

—a detection system for detecting the information present in the read beam after it has cooperated with the record carrier,

—radial positioning means for controlling the radial position of the read spot on the information track,

—a lock-in system for switching on the radial positioning means at an instant at which the light spot at least substantially coincides with the information track.

Such an apparatus is for example a compact-disc digital audio player, which at the time of filing of the present application is available from N.V. Philips' Gloeilampenfabrieken under type number CD 303. In this player a selection to be reproduced can be keyed in before the disc is played. For this purpose use is made of the subcode which is interleaved with the digital audio information and which includes *inter alia* a running indication for the track number being reproduced, an index (part of a "track"), and relative and absolute time. Various known players can be programmed with respect to track number, index and/or time. The keyed-in selection may be stored in a memory for the duration of the playing operation.

The time needed in the search process for a selected track is, amongst others, determined by the time in which locking in to a track is effected. In known CD players locking in to the track is not effected in an optimum manner. If the light spot is found to coincide at least substantially with the information track, the relative movement of the light spot with respect to the track, viewed in a radial direction, which movement is generally caused by an eccentricity in the record carrier for example, the center hole is slightly off-centred, may be very large, namely so large that the radial positioning means are no longer capable of keeping the light spot on the track. As a result of this, the light spot will come off the track, so that it is necessary to wait until tracking is restored, after which the radial positioning means may again fail to keep the light spot on the track. This "locking in" to the track may take a substantial time.

For speeding up the search process for a selected track, DE—A—2,935,250 discloses an apparatus as described above, further comprising means for detecting the relative radial movement between the light spot and an information track being eccentric to the axis of rotation when the radial positioning means are inoperative and the light spot is stationary, the said relative radial movement detecting means being adapted to supply a first control signal around an instant at which said relative radial movement changes its direction to an output, the lock-in system having an input coupled to the output of the relative radial movement detecting means and being adapted to switch on the radial positioning means at an instant at which the light spot substantially coincides with an information track, and if the first control signal is present.

As a result of this, locking-in can be realized at two instants during a revolution of the record carrier, namely when the distance between the light spot and the real centre of the record carrier is a minimum and when this distance is a maximum. The search process is speeded up significantly by this procedure.

It is the object of the invention to further speed up the search process for a selected track.

To this end the apparatus as set out in the first part of claim 1 is characterized in that the relative radial movement detecting means are adapted to detect the direction of the relative radial movement between the light spot and the information track, and is adapted to supply the first control signal to the lock-in system only at an instant at which the direction of said relative radial movement would change from an outward movement of the light spot over the track to an inward movement of the light spot over the track.

In this respect it is to be noted that in the foregoing and in the following "inward movement" and "outward movement" are to be understood to mean: a radial movement of the light spot towards the centre of the record carrier and a radial movement of the light spot towards the periphery of the record carrier, respectively. If the light spot were taken as a (stationary) reference, this would mean that in the case of a rotating record carrier the track would travel "outwardly" (*i.e.* towards the periphery of the record carrier) and "inwardly" (*i.e.* towards the centre of the record carrier), respectively to the light beam. Here it is assumed that the radial tracking is not operative.

The step in accordance with the invention is based on the recognition that the search process on record carriers having a centre hole which is off-centred, can still need a considerable time, especially if locking-in on the lead-in track is considered.

A lead-in track contains data relating to the number of tracks and the starting time of each track on the record carrier. If a "compact disc" record is to be played the data from the lead-in track is always read out before a track is reproduced. Since this lead-in track is situated near the centre of the record carrier, where the track has the smallest diameter and the record carrier has the highest speed of revolution, "locking-in" to the track is most difficult at this location. If now the radial positioning means are switched on only at locations where the direction of the movement of light spot relative to the track would be reversed if the radial tracking were inoperative—*i.e.* at locations where the speed in the radial direction is substantially zero—immediate locking in to the track is possible.

If the radial tracking is not switched on until the instant around which an outward movement of the light spot would change to an inward movement (again assuming that the radial tracking were inoperative, this also ensures that after locking in to the lead-in track tracking can also be maintained for the first complete revolution of the record carrier.

If locking in to the lead-in track is effected at another instant this will mean that the light spot should travel inwardly over the record carrier for a part of a revolution period of the record carrier. Viewed in the radial direction, the objective system may then be positioned against the stop—which is the extreme initial position of the objective system—so that a radial movement of the objective system is obstructed and, consequently, the track, which extends further inwards, can no longer be followed.

The apparatus may be characterised further in that the means for supplying the first control signal are adapted to derive the first control signal from a second control signal which indicates whether the light spot is positioned on or off the track and from a third control signal which indicates the relative radial direction of movement of the light spot over the track.

The second and the third control signal may be derived as follows. In an apparatus in which the detection system is capable of deriving a high-frequency data signal from which the information to be reproduced can be recovered, this detection system may be adapted to derive also the second control signal from the high-frequency data signal. In an apparatus in which the detection system is capable of deriving a radial-error signal the third signal may be derived for example from said radial-error signal. This is simple because both the high-frequency data signal and the radial-error signal are available anyway in "compact-disc" players. The means for supplying the first control signal may be adapted to detect a phase reversal of the third signal relative to the second signal and to supply the first control signal at the instant at which said phase reversal is detected. Both in the most eccentric point and the least eccentric point a phase reversal will occur. It is obvious that the detector means should mainly detect the phase reversal around the most eccentric point.

This may be achieved when the means are adapted to detect those phase reversals for which the third control signal leads the second control signal prior to the phase reversal and the third control signal lags the second control signal after the phase reversal.

An embodiment of the invention will now be described in more detail, by way of example, with reference to the accompanying drawings. In the drawings:

Fig. 1 shows a part of the apparatus in accordance with the invention,

Fig. 2a shows three adjacent rows of pits constituting the track and

Fig. 2b to Fig. 2e shows some signal wave forms as a function of the position of the light spot relative to the track,

Fig. 3 shows an eccentric record carrier,

Fig. 4 illustrates the movement of the light spot over the record carrier around the most eccentric point in the case of a stationary objective system and a disabled radial tracking,

Fig. 5 shows two signal wave forms derived from the high-frequency data signal and the radial-error signal in the case of a movement of the light spot around the most eccentric point,

Fig. 6 is a flow chart of a method of determining the instant at which the radial tracking must be switched on, and

Fig. 7 shows the other part of the apparatus in accordance with the invention.

Fig. 1 shows a part of an apparatus in accordance with the invention. This Figure shows schematically a cross-sectional view of a disc-shaped record carrier 1. This record carrier comprises a substrate 2 with a track formed by a structure of pits 3 and non-pits 4. The sectional view has been taken exactly at the location of the track and in the longitudinal direction of the track. The relief structure of tracks is coated with a reflecting layer 5 and a transparent protective coating 6. This information contained in the relief structure of tracks is read in that a laser beam generated by a laser 7 is projected and focused by an objective system 8 to form a light spot P on the track, the reflected beam being projected on a linear array of four optical detectors 11a, 11b, 11c and 11d *via* a semi-transparent mirror 9 and a beam splitter 10. The currents supplied by the photo-detectors are converted into signal voltages V_1, V_2, V_3 and V_4 by means of a current-to-voltage converter 12.

In order to ensure a correct read-out the objective system 8 is focussed by moving the lens L_1 of the objective system 8 in upward and downward directions as indicated by the arrow. Control is effected by means of a focus control signal FE. For the purpose of radial tracking the point of incidence of the laser beam in a radial direction is controlled under command of a radial control signal CE. This is achieved by moving the entire optical system 7, 8, 9, 10, 11 in a radial direction (in a manner not shown) under command of the control signal CE.

The control signals CE and FE are derived from the signals voltages V_1, V_2, V_3 and V_4. In addition to the sum

$$V_1+V_2+V_3+V_4$$

for deriving the high-frequency data signal HF, the signal

$$(V_1+V_4)-(V_2+V_3)$$

for deriving the signal FE and the signal

$$(V_1+V_2)-(V_3+V_4)$$

for deriving the signal CE are required for this purpose.

These signals are derived in the block bearing the reference numeral 13.

So far, the description corresponds to that in Philips Technical Review Vo. 40, 1982, No. 6, pp 153—154. The other part of the apparatus will be described with reference to Fig. 7.

Fig. 2 shows the wave forms of the high-frequency data signal HF and of the radial-error signal CE as a function of the radial displacement of the objective system and hence of the light spot over the track. Fig. 2a shows three adjacent rows of pits which constitute the track which extends over the record carrier along a spiral path. Fig. 2b shows the high-frequency data signal HF20 whose envelope bears the reference numeral 21. Between the rows of the pits the amount of reflected light is largest. This means that at this location the envelope is largest. However, the modulation depth is smallest at this point. Exactly on the rows the amount of reflected light is smallest. Therefore, the envelope is minimal at this point. The modulation depth is then a maximum. Comparing the envelope signal 21 with a (tracking) threshold D yields a second control signal S_2, see Fig. 2c, which is high if the envelope 21 is smaller than the threshold D and which is low if the envelope is larger than the threshold D. A comparison of Fig. 2a with Fig. 2c shows that the signal S_2 indicates whether the light spot is on the track of off the track. Fig. 2d shows the radial-error signal CE. This signal becomes positive if the light spot moves off the track to the left and becomes negative if the light spot moves off the track to the right. Thus, if the light spot moves off the track to the left or the right the radial positioning means will move the object system to the right or to the left under the influence of the signal CE, so that the light spot is again positioned on the track. Fig. 2e shows a signal S_3, which is the third control signal and which is derived from the signal CE. The signal S_3 goes high if CE is positive and low if CE is negative. The signals S_2 and S_3 are employed for determining the instant of locking in to the track and, consequently, when the radial positioning means should be switched on.

Fig. 3 shows the spiral track 25 which extends from the centre towards the periphery of a record carrier. The record carrier is not symmetrical, *i.e.* the hole 26 is not located exactly in the centre of the record carrier. If the objective system 8 is in a stationary position against the stop (not shown)—*i.e.* in its fully inward position—the light spot will describe a circular path whose centre is the point 26 if the record carrier rotates in the direction indicated by the arrow 30. Locking in to the track at a position on the circle 27 other than point 28—which is the most eccentric point on the record carrier and which is situated on the circle 27—is not possible because from this instant the light spot would have to move inwardly, viewed in a radial direction, which is not possible because the objective system is already positioned against the stop. Moreover, locking in at this point 28 and, generally speaking, also at the diametrically opposite point 29 is very favourable because the light spot has a relative radial speed of (substantially) zero with respect to the track.

Fig. 4 shows the movement of the light spot about point 28 in Fig. 3 when the objective system is stationary and the radial tracking is disabled, for four positions of the objective system. It shows one position for which the n^{th} row of pits is just not reached—curve 35— and three positions for which the n^{th} row of pits is reached—curve 36, 37 and 38. These situations are characteristic of the starting period during which locking in to the lead-in track is to be effected.

Fig. 5 shows the waveforms of the signals S_2 and S_3 in these four cases. These waveforms can be derived simply by means of Fig. 2. Before point 28 is reached the light spot first crosses the $(n-2)^{th}$ and $(n-1)^{th}$ row in accordance with curve 35 in Fig. 4. Fig. 5a shows that first S_3 and then S_2 goes "high" twice between $t=t_0$ and $t=t_1$. The falling edge of S_3 appears before that of S_2 within this time interval. Thus, S_3 may be said to lead S_2 by a phase angle of roughly 90°. After the instant t_2 in Fig. 5a, *i.e.* after the light spot has passed the point 28, the light spot again travels inwardly over the record carrier, passing the $(n-1)^{th}$ and subsequently the $(n-2)^{th}$ row. Now it is found that S_2 leads S_3 by a phase angle of roughly 90°. In the time interval between t=1 and $t=t_2$ the signal S_3 therefore has made a phase shift of roughly 180° relative to the signal S_2. This is shown in Fig. 5a in that the signal S_3 has no falling edge in the interval between $t=t_1$ and $t=t_2$ when the signal S_2 is "high", *i.e.* at point 28. The waveforms for the situations corresponding to the curves 36, 37 and 38 are identical to the corresponding waveforms in Fig. 5a in the sense that prior to $t=t_1$ and after $t=t_2$ (which are now situated at different points along the time axis) S_2 lags S_3 and S_2 leads S_3, respectively, so that within the time interval between $t=t_1$ and $t=t_2$ the signal S_2 exhibits a phase shift of substantially 180° relative to the signal S_2. In Fig. 5b this phase shift is obtained in that S_3 is briefly pulled "low" at the instant t_3 during the time that S_2 is "high". In Fig. 5c this is achieved in that between the two instants at which the light spot crosses the n^{th} row of pits the signal S_2 becomes briefly "low" at the instant t_3. In Fig. 5d this phase shift is obtained in that between the two instants at which the light spot crosses the n^{th} row of pits, the signal S_3 becomes briefly "high" at the instant t_3. In point 29 a similar situation is obtained. Again a phase shift of roughly 180° is obtained, so that the signals again coincide before $t=t_1$ and after $t=t_2$.

In accordance with the invention point 28 should now be detected to start the radial tracking from this instant, which in accordance with Fig. 4 would mean that locking in would be effected at the row n or the row n−1. As the objective system is never positioned exactly against the stop locking in to the row n−1 never presents any problem around point 29. At this point the light spot is still capable of following the track because the objective system is not yet positioned against the stop and its movement therefore not obstructed.

Fig. 6 illustrates how locking-in around position 28 can be achieved. The flow chart indicates that after starting of the program in block 45 the light beam is first focused on the record carrier. This is effected in block 47. Subsequently, it is ascertained in block 49 whether the signal S_2 is high during a specific time interval. If this is not the case, the program returns to block 49 *via* branch 51. In the consecutive time intervals in block 49 it is therefore ascertained whether the signal S_2 becomes (or is) "high". If S_2 is "high" the program proceeds to block 53 in which it is ascertained whether a falling edge is detected in S_3 during the time when S_2 is "high". Should this be the case, the light spot will be situated in the situation in Fig. 3 on the right-hand half of the circle 27 between points 28 and 29. In Figs. 5a and 5b this corresponds to a position corresponding to an instant prior to $t=t_1$. For the situation in Figs. 5c and 5d this corresponds to positions corresponding to an instant prior to $t=t_3$. If no falling edge is detected the light spot is therefore situated (just) past position 28 on the left-hand half of the circle 27 in Fig. 3. *Via* branch 51 the program then returns to block 49.

If a falling edge is detected, the program proceeds to block 55 in which it is again ascertained whether S_2 is "high". If not, the program returns to block 55 *via* branch 57. If S_2 is high, the program proceeds to block 59, in which it is ascertained whether a rising edge appears in S_3. If this is not the case, the program returns to block 55 *via* the branch 57. If a rising edge occurs—at the instant t_4 in Fig. 5a, at the instant t_5 in Fig. 5b, at the instant t_6 in Fig. 5c, and at the instant t_7 in Fig. 5d—the program proceeds to block 61 in which the radial tracking is switched on. This means, that, as shown in Fig. 5a, locking in is effected at the row $n-1$ and, as shown in Figs. 5b, 5c and 5d, at the row n. After locking in reproduction is possible—in block 63—after which the program stops at block 65.

It is obvious that if other signals S_2 and S_3 are available for deriving the first control signal, for example if one of the signals is available in an inverted form, the instant of locking in is determined in a different way.

Fig. 7 shows schematically the other part of the apparatus in accordance with the invention as shown in Fig. 1. Starting from the signals V_1 to V_4, see also Fig. 1, the high-frequency data signal HF is obtained after addition in the signal-combination unit 70 and further processing in 71, in which inter alia equalization is effected, which data signal is applied into an envelope detector and threshold device 72. This element detects the envelope 21 of the high-frequency data signal HF and compares the envelope with the threshold D, see Fig. 2b. Subsequently, the element 72 supplies the signal S_2 as its output signal. Moreover, starting from signals V_1 to V_4, after addition in the signal-combination units 73 and 74, subtraction in the signal combination unit 75 and further processing in 76, in which low-pass filtration is applied, the radial error signal Ce is derived. This signal is applied to the radial-positioning means 77, which derive a control signal S_4 from said signal CE, which control signal is applied to the control device (not shown) in the form of an actuator, for the optical system 7, 8, 9, 10, 11 see Fig. 1. This control is operative if the switch 78 in the means 77 is closed, *i.e.* occupies the position not shown. Moreover, the signal CE is applied to a device 79 which, starting from the signal CE, generates a signal S_3, see Fig. 2e, and supplies this to its output. The two signals S_2 and S_3 are applied to means 80 for detecting the direction of the relative radial movement between the light spot P and the information track and for supplying a first control signal S_1 around the instant t_4 (in Fig. 5a) and t_5, t_6 or t_7 (in Figs. 5b, 5c and 5d respectively) at which this relative radial movement would be reversed when the radial positioning means were not switched on. At this instant the radial tracking should be switched on. For this purpose the means 80 then produces a "high" signal S_1 on the output. This signal S_1 is applied to the control input 81 of the unit 77, which constitutes the lock-in system in the present example. This signal then causes the switch 78 to close and keeps the switch closed as long as the signal S_1 remains high. If the signal S_1 is low the switch 78 is open. A voltage of zero volts is now applied to the radial positioning means, so that no control is effected and the lens system 8 is stationary. In the case of a "high" signal S_1 the switch 78 is closed, so that the signal CE is transferred and the radial tracking becomes operative.

For an improved control the second control signal S_2 is preferably derived not only from the high-frequency data signal HF. The requirement to be met is then that the signal S_2 goes "high" if:

a) the high-frequency data signal HF exceeds the threshold D,

b) the drop-out detector, not shown, (present in a compact-disc player) is not responsive,

c) the high-frequency DC level of the signal HF exceeds a certain other threshold D'. This ensures that the control system is more immune to drop-outs on the disc.

Legend to the blocks of Fig. 6:

Block Number	Inscription
45	start
47	focusing step
49, 55	is signal S_2 logic one?
53	falling edge in S_3 detected?
59	rising edge in S_3 detected?
61	switch on radial tracking
63	reproduction step
65	stop.

Claims

1. An apparatus for reading a disc-shaped

record carrier in which information is stored in the form of a track of optically detectable areas, which apparatus comprises:

—means for rotating the carrier

—a light source for producing a read beam,

—an objective system (8) for focussing the read beam to form a read spot on the record carrier,

—a detection system (13) for detecting the information present in the read beam after it has co-operated with the record carrier,

—radial positioning means (77) for controlling the radial position of the read spot on the information track,

—means (80) for detecting the relative radial movement between the light spot and the information track being eccentric to the axis of rotation when the radial positioning means are inoperative and the light spot is stationary, the said relative radial movement detecting means being adapted to supply a first control signal around an instant (28, 29) at which said relative radial movement changes its direction, to an output,

—a lock-in system, having an input coupled to the output of the relative radial movement detecting means, the lock-in system being adapted to switch on the radial positioning means at an instant at which the light spot substantially coincide with an information track, and if the first control signal is present,

characterized in that the relative radial movement detecting means are adapted to detect the direction of the relative radial movement between the light spot and the information track, and is adapted to supply the first control signal to the lock-in system only at an instant (28) at which the direction of said relative radial movement would change from an outward movement of the light spot over the track to an inward movement of the light spot over the track.

2. An apparatus as claimed in Claim 1, characterised in that the means for supplying the first control signal are adapted to derive the first control signal from a second control signal which indicates whether the light spot is positioned on or off the track and from a third control signal which indicates the relative radial direction of movement of the light spot over the track.

3. An apparatus as claimed in Claim 2, in which the detection system is capable of deriving a high-frequency data signal (HF) from which the information to be reproduced can be recovered, characterised in that the detection system is adapted to derive also the second control signal from the high-frequency data signal.

4. An apparatus as claimed in Claim 2 or 3, in which the detection system is capable of deriving a radial-error signal (CE), characterised in that the detection system is adapted to derive also the third control signal from the radial-error signal.

5. An apparatus as claimed in Claims 3 or 4, characterised in that the means for supplying the first control signal are adapted to detect a phase reversal of the third signal relative to the second signal and to supply the first control signal at the instant at which said phase reversal is detected.

6. An apparatus as claimed in Claim 5, characterised in that the means are adapted to detect those phase shifts for which the third control signal leads the second control signal prior to the phase reversal and the third control signal lags the second control signal after the phase reversal.

Patentansprüche

1. Gerät zum Lesen eines plattenförmigen Aufzeichnungsträgers, auf dem Information in Form einer Spur optisch detektierbarer Gebiete gespeichert ist, und dieses Gerät enthält

—Mittel zum Rotieren des Trägers,

—eine Lichtquelle zum Erzeugen eines Lesestrahls,

—ein Objektivsystem (8) zum Fokussieren des Lesestrahls zur Bildung eines Leseflecks auf dem Aufzeichnungsträger,

—ein Detektorsystem (13) zum Detektieren der nach der Zusammenarbeit mit dem Aufzeichnungsträger im Lesestrahl vorhandenen Information

—radiale Positionierungsmittel (77) zum Steuern der radialen Position des Leseflecks auf der Informationsspur,

—Mittel (80) zum Detektieren der relativen radialen Bewegung zwischen dem Lichtfleck und der Informationsspur, die in bezug auf die Drehachse exzentrisch ist, wenn die radialen Positionierungsmittel unwirksam sind und der Lichtfleck stationär ist, wobei die relativen radialen Bewegungsdetektormittel zum Liefern eines ersten Steuersignals um einen Zeitpunkt (28, 29) herum ausgelegt ist, zu dem die relative radiale Bewegung die Richtung wechselt, an einen Ausgang,

—ein Verriegelungssystem mit einem Eingang, der mit dem Ausgang der relativen radialen Bewegungsdetektormittel verbunden ist, wobei das Verriegelungssystem zum Einschalten der radialen Positionierungsmittel zu einem Zeitpunkt dient, zu dem der Lichtfleck im wesentlichen mit einer Informationsspur zusammenfällt, und wenn das erste Steuersignal vorhanden ist,

dadurch gekennzeichnet, daß die relativen radialen Bewegungsdetektormittel zum Detektieren der Richtung der relativen radialen Bewegung zwischen dem Lichtfleck und der Informationsspur ausgelegt ist, und zum Liefern des ersten Steuersignals zum Verriegelungssystem nur zu einem Zeitpunkt (28) dient, zu dem die Richtung der relativen radialen Bewegung von einer nach außen gerichteten Bewegung des Lichtflecks über die Spur nach einer nach innen gerichteten Bewegung des Lichtflecks über die Spur wechselt.

2. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß die Mittel zum Lieferen des ersten Steuersignals zum Ableiten des ersten Steuersignals aus einem zweiten Steuersignal, das angibt, ob der Lichtfleck auf oder neben der Spur positioniert ist, und aus einem dritten Steuersignal dienen, das die relative radiale Bewegungsrichtung des Lichtflecks über die Spur angibt.

3. Gerät nach Anspruch 2, in dem das Detektorsystem ein hochfrequentes Datensignal (HF)

ableiten kann, aus dem die wiederzugebende Information abgeleitet werden kann, dadurch gekennzeichnet, daß das Detektorsystem ebenfalls zum Ableiten des zweiten Steuersignals aus dem hochfrequenten Datensignal dient.

4. Gerät nach Anspruch 2 oder 3, in dem das Detektorsystem ein Radialfehlersignal (CE) ableiten kann, dadurch gekennzeichnet, daß das Detektorsystem ebenfalls zum Ableiten des dritten Steuersignals aus dem Radialfehlersignal dient.

5. Gerät nach Anspruch 3 und 4, dadurch gekennzeichnet, daß die Mittel zum Lieferen des ersten Steuersignals zum Detektieren einer Phasenumkehr des dritten Signals in bezug auf das zweite Signal und zum Lieferen des ersten Steuersignals zu dem Zeitpunkt dient, zu dem die Phasenumkehr detektiert wird.

6. Gerät nach Anspruch 5, dadurch gekennzeichnet, daß die Mittel zum Detektieren dieser Phasenverschiebungen dienen, für die das dritte Steuersignal dem zweiten Steuersignal vor der Phasenumkehr vorangeht und das dritte Steuersignal dem zweiten Steuersignal nach der Phasenumkehr folgt.

Revendications

1. Appareil de lecture d'un support d'enregistrement en forme de disque dans lequel est stockée de l'information sous la forme d'une piste de zones optiquement détectables, appareil comportant:

—des moyens de rotation du support,

—une source lumineuse pour fournir un faisceau de lecture,

—un système d'objectif (8) pour focaliser le faisceau de lecture de façon à former un spot lumineux sur le support d'enregistrement,

—un système de détection (13) pour détecter l'information qui est contenue dans le faisceau de lecture après la coopération de celui-ci avec le support d'enregistrement,

—des moyens de positionnement radial (77) pour régler la position radiale du spot lumineux sur la piste d'information,

—des moyens (80) pour détecter le mouvement radial relatif entre le spot lumineux et la piste d'information excentrique par rapport à l'axe de rotation lorsque les moyens de positionnement radial sont inactifs et le spot lumineux est stationnaire, lesdits moyens de détection du mouvement radial relatif étant conçus pour délivrer sur une sortie un premier signal de commande à peu près un instant (28, 29) où ledit mouvement radial relatif change de direction,

—un système d'accrochage muni d'une entrée couplée à la sortie des moyens de détection du mouvement radial relatif, le système d'accrochage étant conçu pour rendre actif les moyens de positionnement radial à un instant où le spot lumineux coïncide sensiblement avec une piste d'information, et en présence du premier signal de commande,

caractérisé en ce que les moyens de détection du mouvement radial relatif sont conçus pour détecter la direction du mouvement radial relatif entre le spot lumineux et la piste d'information et pour fournir le premier signal de commande au système d'accrochage uniquement à un instant (28) où ledit mouvement radial relatif change de direction de telle façon qu'un mouvement du spot lumineux sur la piste dirigé vers l'extérieur change en un mouvement du spot lumineux sur la piste dirigé vers l'intérieur.

2. Appareil selon la revendication 1, caractérisé en ce que les moyens pour fournir le premier signal de commande sont conçus pour déduire le premier signal de commande, d'une part, d'un deuxième signal de commande indiquant que le spot lumineux est positionné sur la piste ou en dehors de la piste et, d'autre part, d'un troisième signal de commande indiquant la direction radiale relative du mouvement du spot lumineux sur la piste.

3. Appareil selon la revendication 2, dans lequel le système de détection est capable de déduire un signal de données à haute fréquence (HF), d'où peut être récupérée l'information à reproduire, caractérisé en ce que le système de détection est conçu pour déduire également le deuxième signal de commande du signal de données à haute fréquence.

4. Appareil selon la revendication 2 ou 3, dans lequel le système de détection est capable de déduire un signal d'erreur radiale (CE), caractérisé en ce que le système de détection est conçu pour déduire également le troisième signal de commande du signal d'erreur radiale.

5. Appareil selon les revendications 3 et 4, caractérisé en ce que les moyens pour fournir le premier signal de commande sont conçus pour détecter une inversion de phase du troisième signal par rapport au deuxième signal et pour fournir le premier signal de commande à l'instant de détection de ladite inversion de phase.

6. Appareil selon la revendication 5, caractérisé en ce que les moyens sont conçus pour détecter les inversions de phase pour lesquelles le troisième signal de commande est en avance sur le deuxième signal de commande avant l'inversion de phase et le troisième signal de commande est en retard sur le deuxième signal de commande après l'inversion de phase.

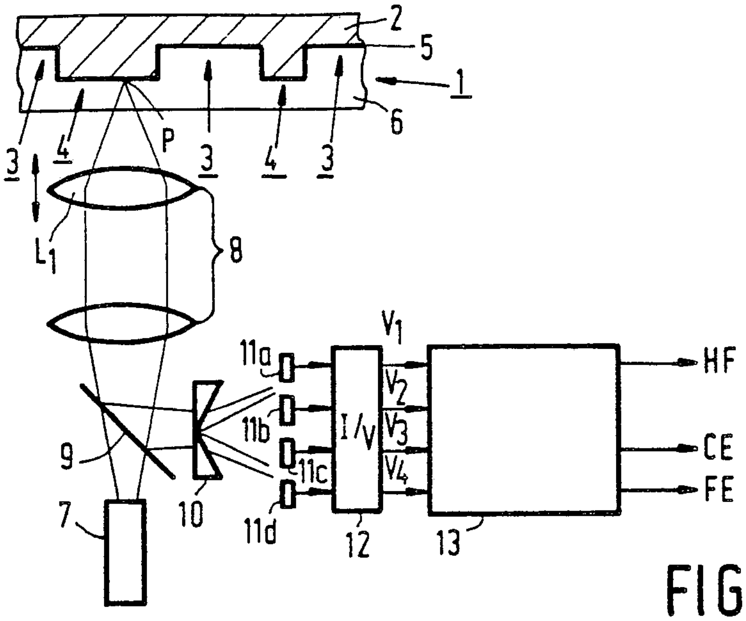
2
5
1
6
3
4
P
3
4
3
L_1
8
V_1
11a
11b
11c
11d
I/V
V_2
V_3
V_4
HF
CE
FE
9
10
7
12
13

FIG.1

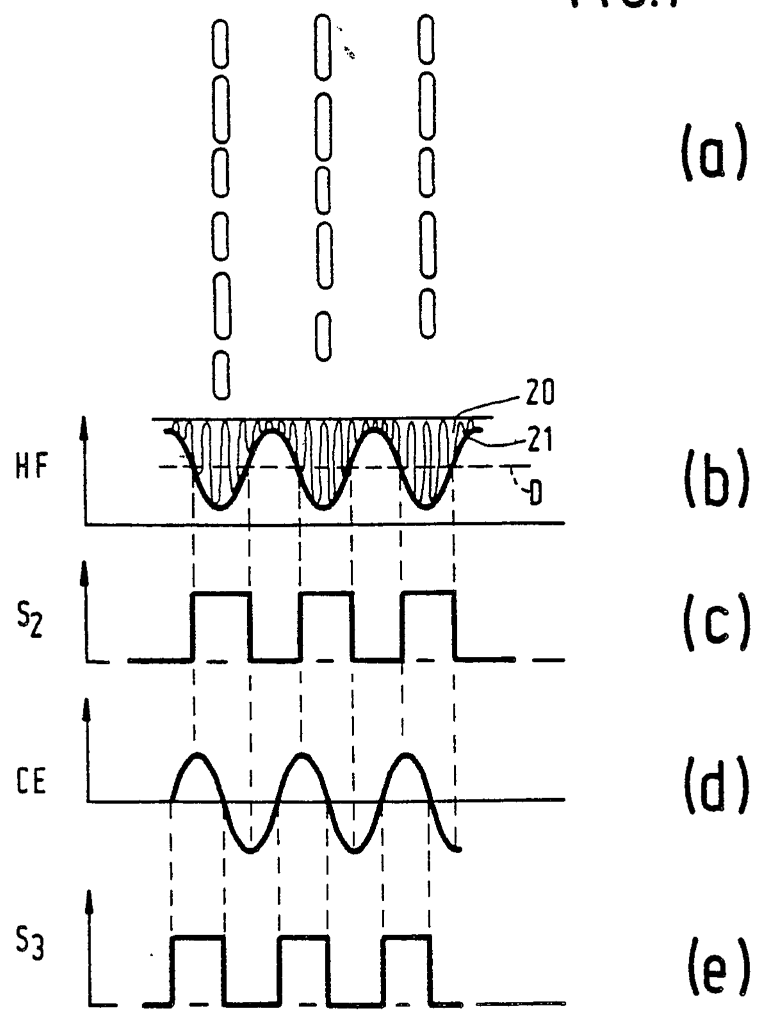
(a)
20
21
HF
D
(b)
S_2
(c)
CE
(d)
S_3
(e)

FIG.2

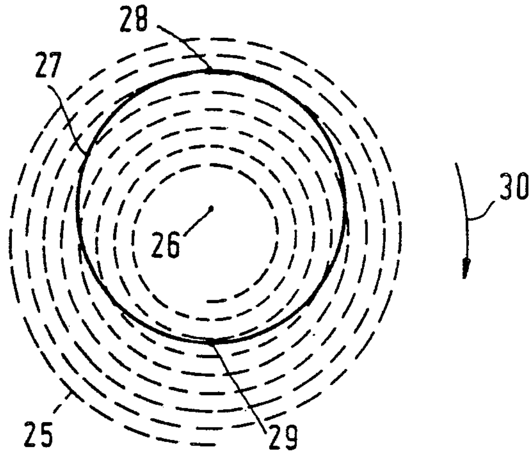

FIG. 3

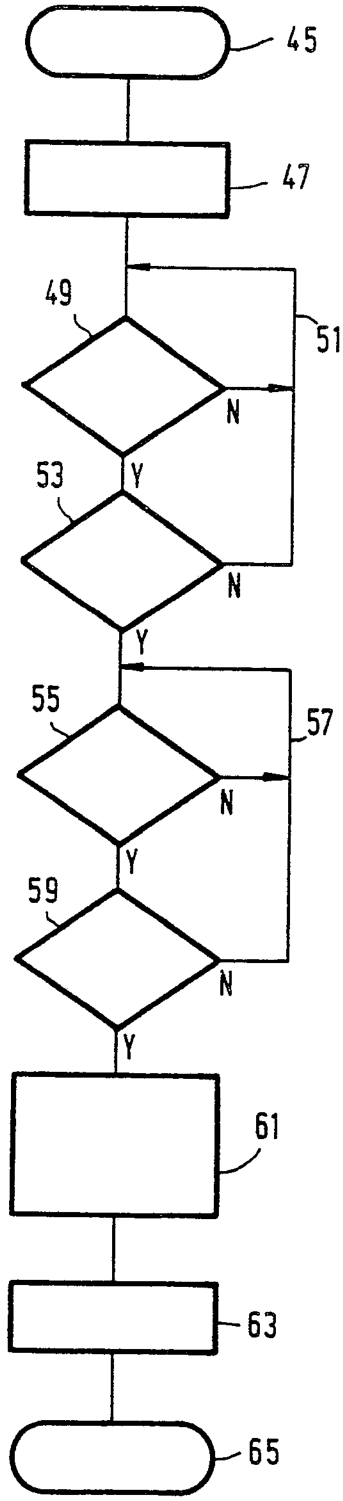

FIG. 6

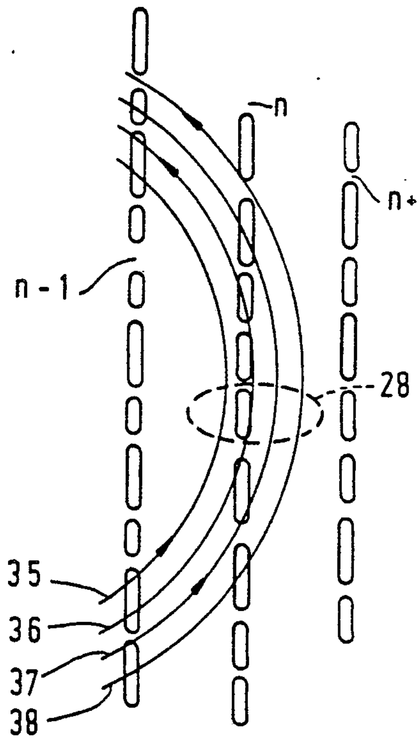

FIG. 4

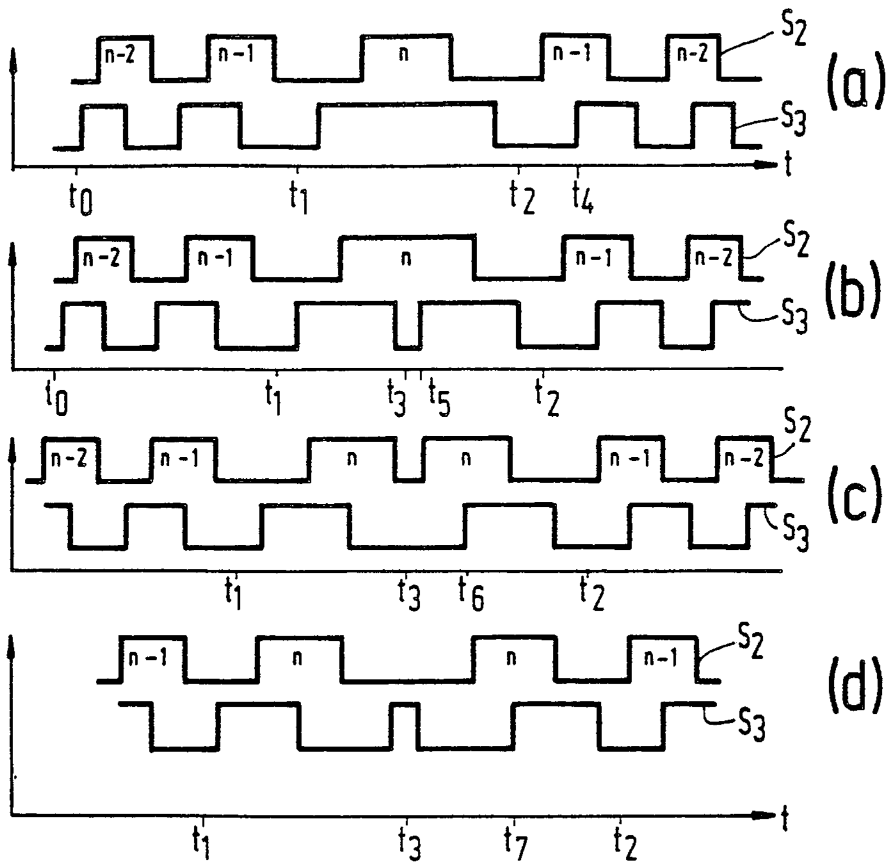
S2
S3
(a)
n-2
n-1
n
t
t0
t1
t2
t4
(b)
t3
t5
(c)
t6
(d)
t7

FIG. 5

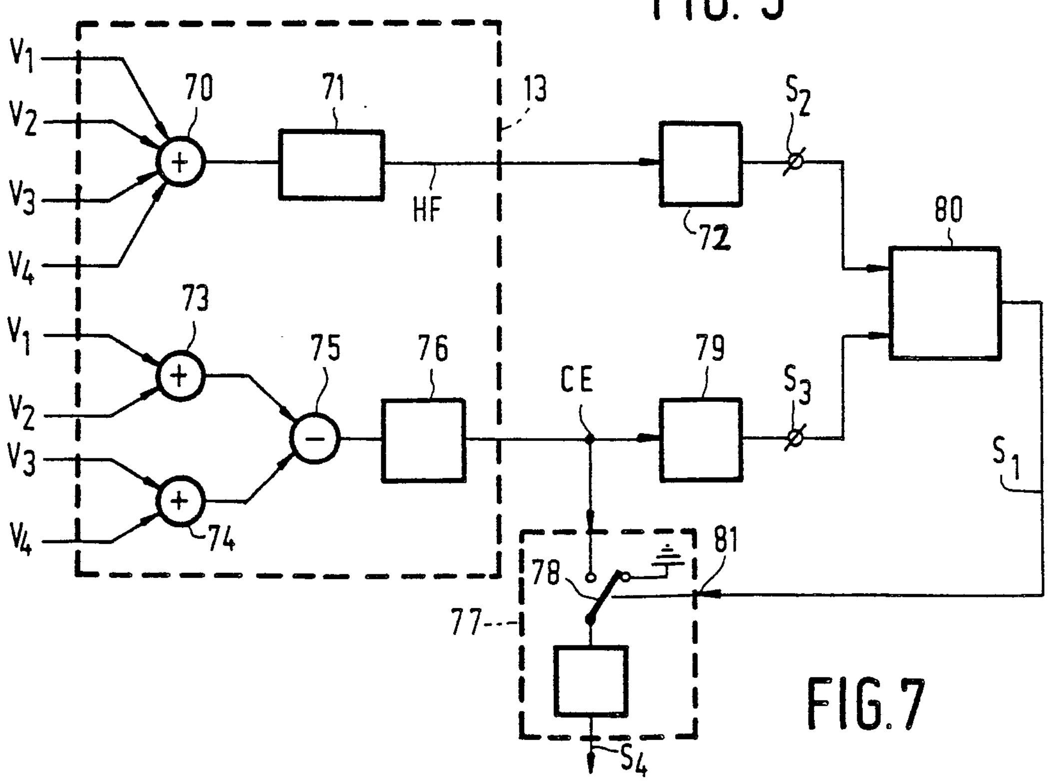
V1
V2
V3
V4
70
71
13
HF
72
S2
80
73
75
76
CE
79
S3
S1
74
78
81
77
S4

FIG.7