

Description

The invention relates to the field of information carrier disks which can be written and read optically, the information being written in the form of a disturbance of a layer sensitive to a radiation, for example a heat-sensitive layer.

An optical head may comprise:

- an AsGa type semiconductor laser;
- a lens for setting to infinity;
- one or two anamorphic prisms;
- a polarization separator cube;
- a quarter wave plate;
- a reflecting mirror;

- a set of servomotors for the focusing on the disk and for the tracking.

Write-read devices are described in the documents DE-A-3,131,212 and DE-A-2,630,381. In Figure 7 of the document DE-A-2,630,381, it is possible to see that the rotation axis of a reflecting mirror is disposed in such a manner that the rays which emerge therefrom in the direction of the lens pass through the rear focus of the latter.

The light beam emitted by the laser source after reflection on the reflecting mirror is focused by the focusing lens on a predetermined track of the information carrier. This reflecting mirror permits a radial feedback control of the optical head. However, on account of the rotation of this reflecting mirror about its axis, this beam undergoes pupil effects. In fact, it is stopped down by the input pupil of the focusing lens.

The device of the invention permits the alleviation of this disadvantage of the prior art.

The subject of the device of the invention is an optical head in a write-read device for an information carrier comprising adjacent track elements, comprising a semiconductor laser source emitting a collimated beam along a determined direction and illuminating, via a reflection mirror pivoting about an axis, the input pupil of a lens projecting a light spot into a reference

surface containing said track, this spot being forced by radial feedback control means to follow any one of said track elements during the passage of said information carrier under said optical head; said radial feedback control means comprising photodetector means for detecting the radiation received through this lens from this information carrier; said optical head being mobile in a direction which is orthogonal to the track elements in order to reach with said spot any one of said track elements disposed in said reference surface, characterized in that said axis is situated in the plane of said pupil; said pupil being imaged in the focal plane of said lens, and said mirror cooperating with blocking means.

Other features and advantages of the invention will become evident in the description given hereinbelow, with reference to the accompanying figures in which:

- Figure 1 illustrates a device of the prior art;
- Figures 2 to 5 illustrate the operation of the reflecting mirror in devices of the prior art;
- Figures 6 and 7 illustrate the operation of a mirror in the optical head according to the invention;
- Figure 8 illustrates an optical head implementing the invention.

Figure 1 represents a device of the prior art. In this Figure 1, the semiconductor laser is polarized linearly along the plane of the junction; this permits the use of a polarization beam separator 16. The latter perhaps (sic), for example a cube consisting of two cemented prisms. The surface of separation 3 constituted by the hypotenuse of the two cubes is treated in such a manner as to be polarization-separating: it transmits in totality radiations which have a given polarization and it reflects in totality radiations which have a polarization at $\pi/2$ from the preceding one.

Thus, in Figure 1, the radiation F_A originating from the laser source is entirely transmitted towards the disc 4. A lens 6 of optical axis coincident with the axis A_x is placed between the laser 1 and the polarization beam

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separator 16. At its output, the radiation is made almost parallel in order to reach in its totality the face 17 of the beam separator 16. This lens is designed in such a manner as not to exhibit spherical aberrations for the maximum apertures of the beam F_A which are formed by the laser 1.

The beam F_C transmitted by this polarization separator 16 then reaches the parallel quarter wave plate 5. This plate is oriented at $\pi/4$ from the polarization of the incident beam F_C .

This quarter wave plate permits the performance of an optical decoupling. In fact, the radiation emanating from the source 1 and reflected by the surface of the information carrier 4 will no longer have a same polarity and will therefore not be able to interfere.

Furthermore, the linearly polarized incident wave emerges from this parallel quarter wave plate 5 polarized circularly and, for example, in the levorotatory sense. This wave will be transmitted to the elements of the write-read head and reflected by the disc. It is then returned towards the quarter wave ... (sic) 5 still circularly polarized but in the dextrorotatory sense. It follows from this that this wave is returned towards the beam separator 16, after traversing the quarter wave plate 5, linearly polarized but at $\pi/2$ radians from the original polarization. It follows from this that on traversing the beam separator 16 there is reflection on the face 3.

Thus, the beam reflected by the surface of the disk 4 of Figure 1 is separated from the beam emitted by the laser by virtue of the quarter wave plate 5 and at the separating surface 3 of a polarization separator cube 16. When the beam F is perfectly focused on the disc, forming an almost point spot T , after traversing the converging lens 10 which may be, for example, a plano-convex lens, the return beam F_B is focused at a point. In the course of the reading, the power of the beam F_B which may be detected in the vicinity of this point by detection means 11, is a function of the surface condition of

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the disk 4 at the point T. The presence of a hollow engraved imprint implies an absence or a diminution of the reflecting power of the disk 4. On the other hand, in the non-engraved zones, the beam is totally reflected.

5 Thus, the power of the beam F_B is modulated progressively according to the rotation of the disc and the radial advance of the head, in the rhythm of the relief modulation previously inscribed on the disk. Moreover, both in the course of the writing and in the course of the
10 reading, it is desirable that the detection means 11 should be able to detect the focusing errors (the point T is not exactly in the plane of the disk) expressed in the form of a Z shift. The signals representing the detection of these errors are then used by means of the
15 circuit 19 in order to control by feedback the position of the lens 8. These detecting means may likewise permit the detection of the radial tracking errors (the point T is not situated on the engraved track, in the case of the reading, or on the track which it is desired to trace,
20 generally substantively represented in the form of a pre-engraved track in the case of the writing), expressed in the form of a shift on the radial axis of the disk 4.

On the path of the beam F_C there is positioned a galvanized mirror 2, the pivoting of which about an axis
25 ensures the radial feedback control. This reflecting mirror 2 is inserted in front of the lens 8 in such a manner as to deflect according to an axis Δz the beam F_C along the axis x. The lens 8 then focuses the beam F on the information carrier disk 4. This disk is driven to
30 execute a rotary movement symbolized by the arrow 7.

In Figures 2, 3 and 4, a description will be given of a preferred embodiment of the reflecting mirror 2 used in the devices of the prior art and certain elements of which are taken up again on a non-limiting
35 basis in the invention.

As represented diagrammatically in cross-section in Figure 2, the mobile plane with which the mirror 2 is solid and which, in one embodiment, is the mirror itself, rests on a plane 20 of the fixed base by means of a

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prismatic resilient element 21, the axis of which is the direction about which this mirror 2 pivots. The element 21 is a prism, for example of rubber, possessing two parallel lateral bearing faces 22 and 23. The face 22 is cemented on the lower face of the mirror 2; the face 23 of this prism is cemented on the plane 20 of the fixed base. The mirror 2 is disposed substantially symmetrically on the element 21 in such a manner as to be in equilibrium parallel to the plane 20 in the absence of electrodynamic force.

The electrodynamic motor means with which this deflector is equipped and which are not represented on this diagram produce on the mirror 2 a force couple represented by the arrows 24 in Figure 2. Under the effect of this couple, the mirror 2 flips as represented in Figure 2, giving rise to the deformation inflection of the element 21 which remains attached to it and which exerts, on the mirror 2, a restoring force which tends to return it into its initial position.

In order to increase the definition of the rotary movement, it is possible to use an element 21 possessing a longitudinal constriction parallel to the bearing faces under the effect of the force couple causing the mirror to flip; this element is preferentially deformed in the zone of less mechanical resistance, that is to say in the constricted part. If it is sufficiently narrow, it may be assimilated to a rotation axis. An illustrative embodiment of such an element is represented in Figure 3. It is a prism with an X-shaped cross-section. This prism possesses two parallel faces 22 and 23, which are intended to be connected, for example by cementing, to the mirror and to the plane of the fixed base respectively.

The cross-section of this prism is an X, the constricted part of which, delimited arbitrarily by the broken lines, constitutes the section of "the axis" of rotation of the system.

An optical deflector utilizing such an element with X-shaped cross-section is represented in Figure 4. This deflector consists of a set of mobile elements

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resting on a set of fixed elements by means of the resilient element with an X-shaped cross-section. On the interior face of the mirror 2 there is cemented a frame supporting the coil 25. The mirror 2 is rectangular, and the coil is a frame of rectangular cross-section, of dimensions slightly less than those of the mirror. The set of the fixed elements comprises a base per se 26, on which there are disposed three ferrite blocks 27, 28, 29 in such a manner as to form two spaces 30 and 31, parallel to two sides of the mirror, in which spaces there prevail two identical magnetic fields directed along the direction of the arrows H. The mirror 2 is connected to the ferrite block 27 serving as a fixed plane by means of the rubber prismatic element 21, the upper lateral face of which 22 is cemented to the lower face of the mirror 2 and the lower lateral face 23 of which is cemented to the upper face of the ferrite element 27. Two opposite sides 32 and 33 of the coil 25 extend into the spaces 30 and 31 in which the permanent magnetic field H prevails. When the coil is supplied with an electric current I, the two opposite sides 32 and 33 are subjected to two forces of the same intensity and of opposite sense; this causes the mirror 2 to pivot about "the axis" of rotation constituted by the constriction of the resilient element 21. As this element exerts a restoring couple on the mirror, the latter is placed in a position which is a function of the intensity of the electric current I; this makes possible the remote control of the orientation of the mirror. In an application to the optical disk, such a deflector is used for the radial feedback control of the optical beam on the track engraved on the disk.

In the devices of the prior art, the mirror 2 turns about an axis 36 which is situated at its centre of symmetry, as represented in Figure 5. However, the incident beam, which is then represented in broken lines, is then stopped down by the input pupil 35 of the focusing lens.

In the optical head according to the invention,

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the axis of rotation 36 of the galvanometer mirror has been offset in order to place it in the plane of the input pupil 35 of the focusing lens on the disc, this being done in order to avoid the pupil effect associated with the rotation of the mirror 2 about its axis 36. On the other hand, to avoid a pupil effect on the return, the plane of the pupil is situated at the focus of the lens. For reasons of convenience (to avoid ... (sic) an excessively large lever arm which would run the risk of disturbing the system), the input pupil 35 of the focusing lens is situated as far as possible in front of the lens.

Thus, as represented in Figure 6, when the reflecting mirror 2 turns about its axis 36, it always passes through the two points A and B, and all its energy thus reaches the disk 4. In the optical head of the invention, the input pupil 35 is considered preferably as being a virtual pupil brought into the input space.

Figure 7 shows the non-limiting example of an optical device 37 comprising three elements, the aperture diaphragms of which have respectively π_1 , π_2 and π_3 . P_1 , P_2 and P_3 are the conjugates in the object space of these diaphragms π_1 , π_2 and π_3 . The beam incident ... (sic) the mirror 2 being collimated, P_2 which is the smallest-diameter aperture is thus the input pupil 35, and π_2 is thus the aperture diaphragm.

Consideration is then given to the optical head of the invention comprising the reflecting mirror 2 as described previously and which is illustrated in particular, on a non-limiting basis, in Figure 4, taking into account the modification illustrated in Figure 6. This leads to the obtaining of an integrated optical head 40 according to the invention. The latter is illustrated in Figure 8. The elements described previously in Figures 1 and 4 have maintained the same numbers. The general operation of this head 40 has been described previously in illustration in Figure 1.

In the optical head of the invention, the axis of pivoting of the galvanometer mirror 2 is therefore not

coincident with the centre of gravity of 2 (sic) the pivoting structure; thus, in the course of a fast displacement of the optical head, the acceleration imposed on the mirror gives rise to a reverse couple which disorients this mirror 2. This galvanometer mirror 2 can turn about the axis substantively represented by the constricted section of the support having an X-shaped cross-section. The untimely pivoting due to the acceleration undergone in the course of a fast displacement of the optical head disturbs the radial feedback control. The document US-A-3,772,464 describes an optical scanning device in which the orientation of a pivoting mirror is evaluated by means of a reflected auxiliary beam which illuminates a linear photodetector. In this device, the command for orientation of the mirror is dependent upon the comparison of a scanning signal with the signal produced by the linear photodetector.

Figure 8 illustrates an optical head which can be subjected to a fast displacement capable of causing a pivoting of the reflecting mirror. In order to reduce this imbalance of the mirror 2 during the fast displacement of the optical head, an emitting source 38 which may be, for example, an emitting diode, passes a light beam which is reflected, for example, on the edge of the mirror which is made reflective in order to reach photodetector means 39. These photodetector means 39 then permit the blocking of the mirror 2 in a predetermined position during the fast displacement of the optical head.

These photodetector means may be constructed with a two-quadrant cell, for example.

It is also possible to cement a light diode on the edge of the mirror at the location of its rotation axis without disturbing the proper operation of the mirror. It is insufficient to bring up, having regard to the divergence of the diode, a fixed two-quadrant cell, the separation axis of which is parallel to the rotation axis, until the sufficient loop gain is obtained.

In the variant represented in Figure 8, the

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polarization separator device is constructed with a prism 18.

5 This prism also performs the function of polarization beam separator; for this reason, its input face 13 has undergone a polarization separator treatment which completely transmits the incident light and completely reflects the light polarized at 90° which returns after reflection on the surface of the disk 4.

10 The quarter wave plate 5 which permits the rotation of the polarization of the light reflected by the disc through 90° in relation to that of the incident light, cut oriented in a square, of which the neutral lines are the diagonals, has been cemented on one of the sides of the prism 18.

15 The lens 10 may be constructed with a plano-convex lens which may be, for example, cemented on the other side of a prism 18, as represented in Figure 8. This permits the focusing on the detection means 11.

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Claims

1. An optical head (40) in a write-read device for an information carrier disk comprising adjacent track elements, comprising a semiconductor laser source (1) emitting a collimated beam along a determined direction and illuminating, via a reflection mirror (2) pivoting about an axis (26), the input pupil (35) of a lens (8) projecting a light spot into a reference surface containing said track, this spot being forced by radial feedback control means to follow any one of said track elements during the passage of said information carrier under said optical head; said radial feedback control means comprising photodetector means (11) for detecting the radiation received through this lens (8), from this information carrier (4); said optical head being mobile in a direction which is orthogonal to the track elements in order to reach with said spot any one of said track elements disposed in said reference surface, characterized in that said axis is situated in the plane of said pupil (35); said pupil (35) being imaged in the focal plane of said lens (8) and said mirror (2) cooperating with blocking means.
2. An optical head according to Claim 1, characterized in that said blocking means comprise optical means associated with said mirror (2) in order to show an untimely pivoting of said mirror with respect to a predetermined equilibrium position, in order to produce an electrical control signal; said signal reacting on the motor element of said mirror for reducing its disequilibrium during the fast movement of said optical head.
3. An optical head according to Claim 2, characterized in that the optical means associated with the mirror (2) comprise a second light source (38) emitting a radiation which is reflected on the mirror (2) in order to reach second photodetector means (35).
4. An optical head according to Claim 2, characterized in that the radiation emitted by this second light source (38) is reflected on the edge of the mirror in order to reach the second photodetector means (39).



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5. An optical head according to Claim 2, characterized in that the optical means associated with the mirror (2) comprise a light diode disposed on the edge of the mirror at the level of its rotation axis.

5 6. An optical head according to either one of Claims 1 and 2, characterized in that the reflecting mirror (2) is fixed to a coiled frame (25) of rectangular form traversed by a variable electric current and inserted into fixed magnetic fields supplied by fixed inductor
10 means constituted by three aligned parallelepipedic ferrite blocks (27, 28, 28 (sic)) in order to create two magnet gaps (30, 31) traversed by magnetic fields of the same direction, a resilient element (21) with an X-shaped cross-section having two parallel bearing sides, one of
15 the faces (23) being fixed to one of the outer parallelepipedic blocks (28), the other face (22) being fixed to the rear side of the reflecting mirror (2), this element serving as rotation axis for the reflecting mirror (2).



As printed

Informationsträgerscheibe, die nebeneinanderliegende Spurelemente aufweist, mit einer Halbleiterlaserquelle (1), die ein kollimatiertes Bündel entlang einer bestimmten Richtung aussendet und über einen um eine Achse (26) schwenkenden Umlenkspiegel (2) die Eingangsöffnung (35) eines Objektivs (8) beleuchtet, das auf eine die genannte Spur enthaltende Bezugsoberfläche einen Lichtpunkt projiziert, der von Radial-Regelmitteln dazu gezwungen wird, einem beliebigen der genannten Spurelemente während des Durchlaufs des Informationsträgers unter dem optischen Kopf zu folgen, wobei die Radial-Regelmittel Lichtdetektormittel (11) für die von dem Objektiv (8) aufgefangene und von dem Informationsträger (4) kommende Strahlung aufweisen, wobei der optische Kopf in einer zu den Spurelementen senkrechten Richtung beweglich ist, um mit dem Fleck zu irgendeinem der in der Bezugsebene angeordneten Spurelemente zu gelangen, dadurch gekennzeichnet, daß die Achse sich in der Ebene der Eingangsöffnung (35) befindet, wobei die Eingangsöffnung (35) in der Brennebene des Objektivs (8) abgebildet wird und der Spiegel (2) mit Blockiermitteln zusammenwirkt.

2. Optischer Kopf nach Anspruch 1, dadurch gekennzeichnet, das die Blockiermittel mit dem Spiegel (2) verbundene optische Mittel aufweisen, um ein unzeitiges Schwenken des Spiegels in bezug auf eine vorbestimmte Gleichgewichtsposition aufzuzeigen, so daß ein elektrisches Kontrollsignal erzeugt wird, das auf das Antriebselement des Spiegels reagiert, um sein Ungleichgewicht während der schnellen Bewegung des optischen Kopfs einzugrenzen.

3. Optischer Kopf nach Anspruch 2, dadurch gekennzeichnet, daß die zum Spiegel (2) gehörenden optischen Mittel eine zweite Lichtquelle (38) aufweisen, die eine Strahlung aussendet, welche im Spiegel (2) reflektiert wird, um zweite Lichtdetektormittel (39) zu erreichen.

4. Optischer Kopf nach Anspruch 3, dadurch gekennzeichnet, daß die von dieser zweiten Lichtquelle (38) ausgesandte Strahlung auf der Spiegelkante reflektiert wird, um die zweiten Lichtdetektormittel (39) zu erreichen.

5. Optischer Kopf nach Anspruch 2, dadurch gekennzeichnet, daß die zum Spiegel (2) gehörenden optischen Mittel eine Leuchtdiode aufweisen, die auf dem Rand des Spiegels in Höhe seiner Rotationsachse angeordnet ist.

6. Optischer Kopf nach einem beliebigen der Ansprüche 1 und 2, dadurch gekennzeichnet, daß der Umlenkspiegel (2) fest mit einem Spulenrahmen (25) rechteckiger Form verbunden ist, der von einem variablen elektrischen Strom durchflossen wird und in feste Magnetfelder eintaucht, die von festen Induktormitteln geliefert werden, welche aus drei fluchtenden parallelepipedischen Ferritblöcken (27, 28, 29) bestehen, um zwei Magnetpolen (30, 31) zu bilden, die von Magnetfeldern gleicher Richtung durchquert werden, wobei ein elastisches

Patentansprüche

1. Optischer Kopf (40) in einer Schreib-Lesevorrichtung für eine



... in der Ebene des Querschnitts zwischengleich und abwechselnd mit einer Längsachse (23) und einer Querschnittsachse (24) in einer Reihe von parallelepipedischen Blöcken (27, 28, 29) befestigt und die andere (22) an der Längsachse (23) befestigt ist, wobei das Element (21) als Rotationsachse des Resonanzspiegels (2) dient.

Claims

1. An optical head (40) in a write-read device for an information carrier disk comprising adjacent track elements, the head including a semiconductor laser source (1) emitting a collimated bundle along a predetermined direction and illuminating, via a reflection mirror (2) pivoting about an axis (26), the input pupil (35) of a lens (8) projecting a light spot into a reference surface containing said track, this spot being forced by radial feedback control means to follow any one of said track elements during the passage of said information carrier under said optical head, said radial feedback control means comprising photodetector means (11) for detecting the radiation received through this lens (8) from the information carrier (4), said optical head being mobile in a direction which is orthogonal to the track elements in order to reach with said spot any one of said track elements disposed in said reference surface, characterized in that said axis is situated in the plane of said pupil (35); said pupil (35) being imaged in the focal plane of said lens (8) and said mirror (2) cooperating with blocking means.

2. An optical head according to claim 1, characterized in that said blocking means comprise optical means associated to said mirror (2) in order to show an untimely pivoting of said mirror with respect to a predetermined equilibrium position, in order to produce an electrical control signal reacting on the motor element of said mirror for reducing its disequilibrium during the fast movement of the optical head.

3. An optical head according to claim 2, characterized in that the optical means associated to the mirror (2) comprise a second light source (38) emitting a radiation which is reflected on the mirror (2) in order to reach second photodetector means (39).

4. An optical head according to claim 3, characterized in that the radiation emitted by this second light source (38) is reflected on the edge of the mirror in order to reach the second photodetector means (39).

5. An optical head according to claim 2, characterized in that the optical means associated to the mirror (2) comprise a light diode disposed on the edge of the mirror at the level of its rotation axis.

6. An optical head according to any one of claims 1 and 2, characterized in that the reflecting mirror (2) is fixed to a coiled frame (25) of

rectangular form traversed by a variable electrical current and inserted into fixed magnetic fields supplied by fixed inductor means constituted by three aligned parallelepipedic ferrite blocks (27, 28, 29) in order to create two magnetic gaps (30, 31) traversed by magnetic fields of the same direction, a resilient element (21) with an X-shaped cross section having two parallel bearing sides, one of the faces (22) being fixed to one of the outer parallelepipedic blocks (28), the other face (22) being fixed to the rear side of the reflecting mirror (2), this element serving as rotation axis of the reflection mirror (2).

