Description

The present invention relates to an objective lens driving device and, more particularly, to an objective lens driving device employing a permanent magnet and control coils.

Recently, optical information recording systems capable of stably recording a large amount of information at a very high recording density have diffused as optical disks, compact disks or external recording equipments for computers.

An objective lens is an essential component of such an optical recording system to focus a light beam in a spot of light on the information recording surface of an optical information recording medium to read or write information. An objective lens driving device for the positional control of the objective lens plays a very important role in correcting the tracking error and focusing error of the spot of light.

Fig. 1 is an exploded perspective view of a conventional objective lens driving device.

The objective lens driving device shown in Fig. 1 comprises a armature holder 1 and a base yoke 2.

The upper portion of the armature holder 1 is formed in the shape of an oblate hexagon or a rhombus having one end fixedly provided with an objective lens 3 and the other end fixedly provided with a counterweight 4 counter-balancing the objective lens 3. A focus control coil 5 and track control coils 6a, 6b, ... are disposed in a cylindrical arrangement on the bottom center of the armature holder 1.

The objective lens 3 and the counterweight 4 thus mounted on the armature holder 1 are fitted respectively in openings 7a and 7b formed near the opposite sides of a substantially square supporting rubber member 7. The supporting rubber member 7 is fastened to a stator base 9 with screws 8a and 8b.

The stator base 9 is provided with a central opening 9a. The control coils 5 and 6 disposed on the armature holder 1 project downward through the opening 9a. A cover 10 is attached to the upper surface of the stator base 9.

The base yoke 2 comprises a holding yoke 13 holding permanent magnets 11a and 11b and a support shaft 12, and yokes 14a and 14b attached to the upper surfaces of the permanent magnets 11a and 11b, respectively.

The armature holder 1 is mounted on the support shaft 12 so as to be axially slidable and rotatable relative to the base yoke 2.

Fig. 2 is a longitudinal sectional view of the assembly of the armature holder 1 and the base yoke 2, in which the parts corresponding to those shown in Fig. 1 are denoted by the same reference numerals and the description thereof will be omitted.

As is obvious from Fig. 2, a coil holder 15 is disposed on the bottom surface of the armature holder 1. The focus control coil 5 and track control coils 6 are fixed to the coil holder 15.

The armature holder 1 is provided on the bottom thereof with a cylindrical bearing 16, which receives the support shaft 12 therein.

The control coils 5 and 6 are fixed to the armature holder 1 as shown in Fig. 3.

The focus control coil 5 is attached to the coil holder provided on the bottom of the armature holder 1, and the track control coils 6a, 6b, 6c and 6d are fixed to the focus control coil 5. Leads 17a, 17b, ... and 17j lead out from the coils.

Motions of the conventional objective lens driving device will be described hereinafter. A light beam, such as a laser beam, is emitted through the objective lens 3 so as to be focused in a spot of light on an optical information recording medium, such as an optical disk. When the light beam is out of focus, the objective lens 3 can be focused by supplying a control current corresponding to a focal displacement to the focus control coil 5 to slide the armature holder 1 in either of directions of a double-head arrow A due to the interaction between the control current and the permanent magnets 11. Although the armature holder 1 is joined through the objective lens 3 and the counterweight 4 to the supporting rubber member 7, the objective lens 1 is slidable because the supporting rubber member 7 is bendable.

When the spot of light deviates from a track, the track control movement of the objective lens 3 can be achieved by supplying a control current corresponding to the deviation of the spot of light from the track to the track control coils 6a, 6b, ... and 6d to turn the armature holder 1 in either of directions indicated by a double-head arrow B due to the interaction between the control current and the permanent magnets 11.

The conventional objective lens driving device thus constructed has a problem that it is difficult to manufacture the objective lens driving device.

That is, the leads 17a, 17b, ... and 17j of the focus control coil 5 and the track control coils 6a, 6b, ... and 6d included in the armature unit of the objective lens driving device must be connected to the stator unit, which requires difficult wiring work. Moreover, since the armature unit and the stator unit are interconnected by the supporting rubber member 7 to set the center of a range of track control movement in which the armature unit of the objective lens driving device can be moved for track control, it is difficult to assemble the armature unit and the stator unit. Another example of a prior art lens driving device is given in GB-A-2154023

disclosing the precharacterising features of claim 1.

Furthermore, the lead wiring work and the attachment of the supporting rubber must be carried out strictly, or troubles occur in the control actions of the objective lens driving device.

DISCLOSURE OF THE INVENTION

It is an object of the present invention to provide an excellently producible and highly reliable objective lens driving device requiring no work for wiring leads from the armature unit and no work for attaching a supporting rubber member. According to the invention this is achieved by the characterising features of claim 1.

The objective lens driving device in accordance with the present invention comprises the foregoing components. Accordingly, the permanent magnet is provided on the armature holder, the control coils are arranged on the yoke, and hence the armature unit need not be provided with leads. Furthermore, since the gaps are formed in the yoke, magnetic flux density in the gaps is reduced and a tendency of low-magnetic-flux-density portions of the annular permanent magnet coming opposite to the gaps is enhanced, and hence it is possible to set the center of a range of track control movement of the armature unit in the driving device even if the driving device is not provided with any supporting rubber member.

Thus, the objective lens driving device in accordance with the present invention eliminates work for wiring the leads and work for attaching the supporting rubber member, thereby, having excellent producibility and higher reliability.

In the objective lens driving device in accordance with the present invention, the permanent magnet is arranged in the armature unit, while the control coils are arranged in the stator unit, and hence there is no lead extended from the armature unit and, hence, no work for wiring leads is necessary.

Furthermore, since the interactions of the gaps formed in the yoke and the permanent magnet enables the retention of the center of a range of track control movement of the armature unit, and hence the armature unit need not be provided with any supporting rubber member.

Thus, the objective lens driving device eliminates the delicate work for interconnecting the armature unit and the stator unit, and hence the objective lens driving device has excellent producibility and high reliability.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1 to 3 are illustrations explaining a conventional objective lens driving device;

Figs. 4 to 6 are illustrations explaining the construction of an objective lens driving device in a first embodiment according to the present invention;

Figs. 7 and 8 are illustrations explaining the retaining function of the center of track control movement of the objective lens driving device in the first embodiment;

Figs. 9 to 11 are illustrations explaining the retaining function of the center of focus control movement of the objective lens driving device in the first embodiment;

Figs. 12 to 16 are illustrations explaining a modification of the retaining function of the center of focus control movement of the objective lens driving device in the first embodiment;

Figs. 17 to 19 are illustrations explaining the construction of another objective lens driving device in a second embodiment according to the present invention; and

Fig. 20 is an illustration explaining the retaining function of the center of track control movement of the objective lens driving device in the second embodiment.

BEST MODE FOR CARRYING OUT THE INVENTION

Fig. 4 is an exploded perspective view of an objective lens driving device in a first embodiment according to the present invention, in which parts corresponding to those of the foregoing conventional objective lens driving device are denoted by reference numerals obtained by adding 100 to those of corresponding parts and the description thereof will be omitted to avoid duplication.

The present invention is characterized in that a permanent magnet is arranged on an armature holder, and control coils are arranged on a yoke of a stator unit, and gaps are formed in a base yoke at positions facing the permanent magnet.

Accordingly, an armature holder 101 employed in an objective lens driving device in the first embodiment is provided with a cylindrical bearing 116 near the central portion thereof. An objective lens 103 is fixed to the armature holder 101 at an eccentric position at a predetermined distance from the bearing 116. An annular skirt 130 extends downward from the bottom of the movable holder 101, and an annular permanent magnet 111 magnetized radially symmetrically in four magnetic poles is fixedly held on the annular skirt 130. The polarity of the poles 111a and 111b of the annular permanent magnet 111 on the same circumference is the same, and the polarity of the poles 111c and 111d of the annular permanent magnet 111 on the same circumference is the same.

On the other hand, the circumferential wall of a substantially cylindrical base yoke 102 is divided into two portions forming outer projections 132a and 132b. A support shaft 112 extends upright from the substantially central portion of the base yoke 102. An inner projection 134 is formed concentrically with the outer projections 132a and 132b between the outer projections 132a and 132b, and the support shaft 112.

Gaps 136a and 136b formed between the outer projections 132a and 132b are formed symmetrically so as to coincide respectively with the boundary between the poles 111a and 111c of the annular permanent magnet 111 and the boundary between the poles 116b and 116d of the annular permanent magnet 111.

A focus control coil 105 is disposed around and fixed to the outer circumference of the inner projection 134. Track control coils 106a and 106b respectively wound on back yokes 138a and 138b are fixedly disposed respectively in the gaps 136a and 136b. The track control coils 106a and 106b have each a rectangular shape and are disposed so that the directions of vectors of magnetic flux intersecting with each other on one of sides substantially parallel with the axis of the support shaft 112 and the other side are substantially opposite to each other.

In assembling the objective lens driving device having the aforesaid construction, the support shaft 112 fixed to the base yoke 102 is inserted in the bearing 116 of the armature holder 101 as shown in Figs. 5 and 6.

Fig. 5 is a top plan view of the objective lens driving device in the first embodiment according to the present invention, and Fig. 6 is a longitudinal sectional view taken on line VI-VI in Fig. 5.

The operation of the objective lens driving device in the first embodiment thus constructed will be described hereinafter.

Similarly to the operation of the foregoing conventional objective lens driving device, a laser beam is emitted through the objective lens 103 and focused in a spot of light on the information recording surface of an optical information recording medium, such as an optical disk. When the spot of light is out of focus, a control current corresponding to a focal displacement is supplied to the focus control coil 105 to slide the armature holder 101 through the permanent magnet 111 in either of directions indicated by a double-head arrow A for the focus control movement of the objective lens 103.

When the spot of light deviates from a track, a control current corresponding to the deviation of the spot of light from the track is supplied to the track control coils 106a and 106b to turn the armature holder 101 through the permanent magnet 111 in either of directions indicated by a double-head arrow B for the track control movement of the objective lens 103.

Since the focus control coil 105 and the track control coils 106a and 106b are provided on the base yoke 102, namely, a stator unit, and any current need not be supplied to the armature holder 101, namely, an armature unit, wiring work for the leads can be achieved very easily.

Moreover, since the annular permanent magnet 111 is disposed so that the boundaries between the poles 111a and 111c and between the poles 111b and 111d of the annular permanent magnet 111, coincide respectively with the gaps 136a and 136b formed in the base yoke 102, the magnetic flux gradient on the circumference of the permanent magnet 111 changes when the movable holder 101 is turned in either of the directions of the double-head arrow B and a restorative force tending to restore the armature holder 101 to the original position acts on the permanent magnet 111, so that the center of track control movement of the armature holder 101 can be retained.

Accordingly, any supporting rubber member, which is necessary for the conventional objective lens driving device, is not necessary, and hence the assembling work is facilitated and no problem occurs in the control operation of the objective lens driving device.

Incidentally, when the permanent magnet 111 is disposed so that the boundaries between the pole faces thereof coincide respectively with the gaps 136a and 136b, as shown in Fig. 7 showing the disposition of the base yoke and the permanent magnet, it is preferable for the stable retention of the center of track control movement that the central angle θ_m of each of the poles 111c and 111d of the annular permanent magnet 111 and the central angle θ_y of each of the gaps 136a and 136b of the base yoke 102 meet an inequality: $\theta_m \geq \theta_y$.

It is also possible to retain the center of track control movement when the poles 111c and 111d of the annular permanent magnets 111 are disposed opposite to the gaps 136a and 136b, respectively, as shown in Fig. 8. In this case, the central angles θ_m and θ_y must meet an inequality: $\theta_m < \theta_y$.

Improvement of the performance in retaining center of track control movement of the armature holder will be described hereinafter with reference to Figs. 9 through 16.

Figs. 9 to 11 are illustrations explaining the objective lens driving device in the first embodiment, and Figs. 12 to 16 are illustrations explaining an objective lens driving device in a modification, in which parts corresponding to those shown in Fig. 4 are denoted by the same reference numerals and the description thereof will be omitted.

First, the modification will be described with reference to Figs. 12 through 16. As shown in Fig. 12, coil seats 150 are disposed fixedly on the inner circumference of a base yoke 102 between outer projections 132a and 132b, and an inner projection 134. Track control coils 106a, 106b, 106c and 106d are positioned respectively in recesses 151a, 151b, 151c and 151d formed in the inner surfaces of the coil seats 150.

The track control coils 106a, 106b, 106c and 106d have each a rectangular shape. The track control coils 106a and 106b are disposed adjacently, while the track control coils 106c and 106d are disposed adjacently. A permanent magnet 111 is disposed so that a predetermined gap is formed between the permanent magnet 111 and a focus control coil 105 and a predetermined gap is formed between the permanent magnet 111 and the track control coils 106a, 106b, 106c and 106d. The permanent magnet 111 is magnetized so that the magnetic polarity of a surface facing a portion adjacent to the sides of the track control coils 106a, 106b, 106c and 106d is different from that of another surface on the same circumference.

Since this objective lens driving device is thus constructed, the distribution of the magnetic flux density (magnetic flux gradient) on the surface of the permanent magnet 111 changes and a restorative force F acts on the permanent magnet 111 when the permanent magnet 111 is moved in the directions of the arrow A (Fig. 12) as shown in Figs. 15(A), 15 (B) and 15(C) for focus control.

The restorative force F acts downward (leftward in Fig. 15) in the objective lens driving device. The restorative force F varies gradually as the permanent magnet 111 moves toward the upper open end of the base yoke 102, and increases sharply after the permanent magnet 111 has moved outward beyond the upper end of the base yoke 102, namely, a position shown in Fig. 15(B).

As is obvious from Fig. 16, even when the permanent magnet 111 is at a position shown in Fig. 15(A), namely, even within the base yoke, a little restorative force F acts on the permanent magnet 111.

This restorative force F acting on the permanent magnet 111 makes the movement of the objective lens driving device nonlinear as shown in Fig. 16, which may cause inconvenience to control the movement of the objective lens driving device.

In the first embodiment, i.e., a basic embodiment, back yokes 138a and 138b are disposed opposite to the poles of the permanent magnet 111 as shown in Fig. 9 in an enlarged view. Accordingly, when the permanent magnet 111 is moved in the direction of an arrow X1 for focus control, the restorative force F tending to pull back the permanent magnet 111 acts on the permanent magnet 111 in the direction of an arrow X2 as shown in Fig. 10.

On the other hand, as shown in Fig. 10(C), when the permanent magnet 111 is moved in the direction of the arrow X2, the restorative force F acts on the permanent magnet 111 in the direction of the arrow X1. The restorative force F, as obviously shown in Fig. 11, act in the opposite direction to that of movement of the permanent magnet 111.

Thus, in the configuration shown in Fig. 9, the back yokes 138a and 138b having a height H_y, and the permanent magnet 111 having a height H_m are disposed opposite to each other to retain the permanent magnet 111 at the center corresponding to the center of the height of the back yokes 138a and 138b.

Such central position retention is possible because a magnetic gradient produced by the permanent magnet 111 and the back yokes 138a and 138b when the permanent magnet 111 is moved in the direction of the arrow X1 by a fixed distance δx, and a magnetic gradient produced by the permanent magnet 111 and the back yokes 138a and 138b when the permanent magnet 111 is moved in the direction of the arrow X2 by the fixed distance δx are symmetrical.

In retaining the center of focus control movement with the permanent magnet 111 and the back yokes 138a and 138b, it is appropriate to determine the values of the heights H_m and H_y so that an inequality $H_m \leq H_y$ is satisfied.

An objective lens driving device in a second embodiment according to the present invention will be described hereinafter with reference to Figs. 17 through 20, in which parts corresponding to those of the first embodiment will be denoted by the same reference numerals and the description thereof will be omitted to avoid duplication.

The second embodiment is characterized in that recesses are formed in the permanent magnet 111. Referring to Fig. 17, the nnular permanent magnet 111 has S-poles on the outer circumference thereof, N-poles on the inner circumference thereof, and recesses 140a and 140b formed diametrically in the outer circumference thereof. The permanent magnet 111 is disposed with the recesses 140a and 140b thereof positioned respectively opposite the gaps 136a and 136b of the outer projection 132.

In the second embodiment, the track control coils 106 are wound respectively on the back yokes 138 and are disposed fixedly respectively in the gaps 136a and 136b of the outer projection 132 of the base yoke 102 opposite to the permanent magnet 111.

The operation of the objective lens driving device in the second embodiment thus constructed will be described hereinafter.

Similarly to the operation of the first embodiment, a desired control current is supplied to the focus control coil 105 to slide the armature holder 1 in either of directions of a double-head arrow A (Fig. 19) for the focus control movement of the objective lens 3.

A desired current is supplied to the track control coils 106a and 106b to turn the armature holder 1 in either of directions of a double-head arrow B (Fig. 18) for the track control movement of the objective lens 103.

In the second embodiment, since the permanent magnet 111 is disposed with the recesses 140a and 140b thereof respectively opposite the gaps 136a and 136b of the base yoke 102, the magnetic flux gradient on the circumference of the permanent magnet 111 changes when the armature unit represented by the armature holder 101 is turned in either of the directions of the arrow B, and then a restorative force tending to restore the armature unit to its original position acts on the permanent magnet 111, which enables the retention of the center of track control movement of the armature holder 101.

In retaining the center of track control movement of the armature holder 101 with the recesses 140a and 140b of the permanent magnet 111, and the gaps 136a and 136b in the base yoke 102, it is preferable for the stabilization of the driving efficiency and the retention of the center to determine the values of the central angle θ_m of the recesses 140a and 140b of the permanent magnet 111 and the central angle θ_y of the gaps 136a and 136b shown in Fig. 20 so that an inequality $\theta_y \geq \theta_m$ is satisfied.

Capability of Exploitation in Industry

As is apparent from the foregoing description, the objective lens driving device in accordance with the present invention is useful as a lens positioning mechanism for controlling the objective lens of an optical information recording system to correct the focusing and tracking errors of the objective lens. Particularly, the objective lens driving device eliminates unnecessary members to facilitate the assembling work, is improved in reliability, and is suitable for the highly accurate positioning of the lens.

Claims

1. An objective lens driving device comprising:

a armature holder (101) rotatably and slidably supported by a support shaft (112);

an objective lens (103) mounted on said armature holder (10) at an eccentric position with respect to the support shaft (112); and

a driving mechanism for driving said holder (101) in turning and sliding motions to control focusing and tracking a light beam emitted through the objective lens (103) in a spot of light focused on an optical information recording medium;

said driving mechanism comprising

a permanent magnet (111) provided on said holder;

a base yoke (102) comprising a stator unit (132 a, b) opposite to the pole surfaces of said permanent magnet (111) and having gaps (136 a, b) formed in the circumference thereof so as to extend in parallel with the support shaft (112);

track control coils (106 a, b) for tracking the spot of light on an information recording track formed in the optical information recording medium by turning said holder (101);

a focus control coil (105) for sliding said holder (101) along the support shaft (112) to focus the light beam in a spot of light on the information recording surface of the medium,disposed in the space, and fixed to said base yoke (102);

said track control coils (106 a, b) being disposed in a space including the gaps formed between said permanent magnet (111) and said base yoke (102), and being fixed to said base yoke (102);

characterized in that

said permanent magnet (111) is magnetized in directions substantially perpendicular to the axis of the support shaft (112) with a plurality of pairs of magnetic poles (111 a - d); and

the gaps (136 a, b) formed in the circumference of said base yoke (102) confront at least one of boundaries between the magnetic poles (111 a - d) of said permanent magnet (111).

2. An objective lens driving device according to Claim 1, wherein the boundaries between the magnetic poles of said annular permanent magnet and the gaps formed in said base yoke are arranged symmetrically with respect to the axis of the support shaft, and said annular permanent magnet has at least four boundaries.

3. An objective lens driving device according to Claim 1, wherein said annular permanent magnet is disposed with one of the boundaries between the magnetic poles opposite one of the gap formed in said base yoke.

Similarly to the operation of the first embodiment, a desired control current is supplied to the focus control coil 105 to slide the armature holder 1 in either of directions of a double-head arrow A (Fig. 19) for the focus control movement of the objective lens 3.

A desired current is supplied to the track control coils 106a and 106b to turn the armature holder 1 in either of directions of a double-head arrow B (Fig. 18) for the track control movement of the objective lens 103.

In the second embodiment, since the permanent magnet 111 is disposed with the recesses 140a and 140b thereof respectively opposite the gaps 136a and 136b of the base yoke 102, the magnetic flux gradient on the circumference of the permanent magnet 111 changes when the armature unit represented by the armature holder 101 is turned in either of the directions of the arrow B, and then a restorative force tending to restore the armature unit to its original position acts on the permanent magnet 111, which enables the retention of the center of track control movement of the armature holder 101.

In retaining the center of track control movement of the armature holder 101 with the recesses 140a and 140b of the permanent magnet 111, and the gaps 136a and 136b in the base yoke 102, it is preferable for the stabilization of the driving efficiency and the retention of the center to determine the values of the central angle θ_m of the recesses 140a and 140b of the permanent magnet 111 and the central angle θ_y of the gaps 136a and 136b shown in Fig. 20 so that an inequality $\theta_y \geq \theta_m$ is satisfied.

Capability of Exploitation in Industry

As is apparent from the foregoing description, the objective lens driving device in accordance with the present invention is useful as a lens positioning mechanism for controlling the objective lens of an optical information recording system to correct the focusing and tracking errors of the objective lens. Particularly, the objective lens driving device eliminates unnecessary members to facilitate the assembling work, is improved in reliability, and is suitable for the highly accurate positioning of the lens.

Claims

1. An objective lens driving device comprising:

a armature holder (101) rotatably and slidably supported by a support shaft (112);

an objective lens (103) mounted on said armature holder (10) at an eccentric position with respect to the support shaft (112); and

a driving mechanism for driving said holder (101) in turning and sliding motions to control focusing and tracking a light beam emitted through the objective lens (103) in a spot of light focused on an optical information recording medium;

said driving mechanism comprising

a permanent magnet (111) provided on said holder;

a base yoke (102) comprising a stator unit (132 a, b) opposite to the pole surfaces of said permanent magnet (111) and having gaps (136 a, b) formed in the circumference thereof so as to extend in parallel with the support shaft (112);

track control coils (106 a, b) for tracking the spot of light on an information recording track formed in the optical information recording medium by turning said holder (101);

a focus control coil (105) for sliding said holder (101) along the support shaft (112) to focus the light beam in a spot of light on the information recording surface of the medium,disposed in the space, and fixed to said base yoke (102);

said track control coils (106 a, b) being disposed in a space including the gaps formed between said permanent magnet (111) and said base yoke (102), and being fixed to said base yoke (102);

characterized in that

said permanent magnet (111) is magnetized in directions substantially perpendicular to the axis of the support shaft (112) with a plurality of pairs of magnetic poles (111 a - d); and

the gaps (136 a, b) formed in the circumference of said base yoke (102) confront at least one of boundaries between the magnetic poles (111 a - d) of said permanent magnet (111).

2. An objective lens driving device according to Claim 1, wherein the boundaries between the magnetic poles of said annular permanent magnet and the gaps formed in said base yoke are arranged symmetrically with respect to the axis of the support shaft, and said annular permanent magnet has at least four boundaries.

3. An objective lens driving device according to Claim 1, wherein said annular permanent magnet is disposed with one of the boundaries between the magnetic poles opposite one of the gap formed in said base yoke.

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4. An objective lens driving device according to Claim 1 or 2, wherein said annular permanent magnet is disposed with the two of the boundaries between the magnetic poles thereof opposite one of the gaps formed in said base yoke.

5. An objective lens driving device according to each of claims 1-4, wherein said focus control coil and said track control coils are disposed within the space between said permanent magnet and said base yoke so that effective magnetic fluxes intersect with each other.

6. An objective lens driving device according to Claim 1, wherein said permanent magnet has an annular shape, the yoke surface of said base yoke facing said permanent magnet is concentric with said permanent magnet, the gaps are provided in the direction of the outer circumference of said permanent magnet, and plate-shaped yokes are fixedly arranged on the outer circumference of said base yoke at the gaps opposite said permanent magnet.

7. An objective lens driving device according to Claim 6, wherein said focus control coil is formed in the shape of a ring and is disposed fixedly so that a current flows therethrough in the direction of the inner circumference of said permanent magnet and perpendicularly to the axis of the support shaft, and said track control coils are formed in a rectangular shape and are mounted on the plate-shaped yokes opposite to said permanent magnet so that some sides thereof are substantially parallel with the axis of the support shaft.

8. An objective lens driving device according to Claim 6 or 7, wherein the gaps are fixedly and symmetically arranged on said base yoke, and the plate-shaped yokes are fixedly and symmetrically arranged on said base yoke.

9. An objective lens driving device according to Claim 6, wherein said focus control coil is formed in the shape of a ring and is disposed fixedly so that a current flows therethrough in the direction of the inner circumference of said permanent magnet and perpendicularly to the axis of the support shaft, said track control coils are formed in a rectangular shape, and the plate-shaped yokes are fixed to said base yoke opposite to said permanent magnet with some of the sides thereof substantially in parallel with the axis of the support shaft.

10. An objective lens driving device according to Claim 9, wherein the gaps are formed symmetrically in said base yoke, and the plate-shaped yoke is fixedly and symmetrically arranged on said base yoke opposite to said permanent magnet.

11. An objective lens driving device according to Claim 1, wherein said permanent magnet is formed in the shape of a ring, provided in the circumference thereof with recesses, and is disposed with the recesses opposite the gaps formed in the yoke surface of said base yoke.

12. An objective lens driving device according to Claim 11, wherein the recesses formed in said annular permanent magnet are arranged symmetrically with respect to the axis of the support shaft, and the gaps formed in said base yoke are symmetrical with respect to the axis of the support shaft.

13. An objective lens driving device according to Claim 11 or 12, wherein said annular permanent magnet is magnetized radially substantially perpendicularly to the axis of the support shaft.

14. An objective lens driving device according to Claim 11 or 12, wherein said track control coils are wound on said plate-shaped yokes, and the plate-shaped yokes are provided fixedly in the gaps in said base yoke so that a current flows through said track control coils in the direction of the axis of the support shaft.

15. An objective lens driving device according to Claim 11 or 12, wherein said annular permanent magnet is magnetized radially substantially perpendicularly to the axis of the support shaft, said track control coils are wound on the plate-shaped yokes, and the plate-shaped yokes are provided fixedly in the gaps in said base yoke so that a current flows through said track control coils in the direction of the axis of the support shaft.

Patentansprüche

1. Antriebsvorrichtung einer Objektivlinse mit:
einem Ankerhalter (101), der drehbar und verschiebbar von einer Tragwelle (112) gehalten ist;
einer Objektivlinse (103), die am Ankerhalter (10) in einer exzentrischen Position gegenüber der Tragwelle (112) befestigt ist; und
einem Antriebsmechanismus zum Antrieb des Halters (101) in Dreh- und Schiebebewegun-

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gen, um die Brennweiteneinstellung und die Führung eines durch die Objektivlinse (103) ausgesandten Lichtstrahls in einem auf ein optisches Informationsaufzeichnungsmedium fokussierten Lichtpunkt zu steuern;
wobei die Antriebseinrichtung umfaßt
einen am Halter vorgesehenen Permanentmagneten (111);
ein Basisjoch (102) mit einer Statoreinheit (132a, b), die gegenüber den Polflächen des Permanentmagneten (11) angeordnet ist, und mit Spalten (136a, b), die in dessen Mantel derart ausgebildet sind, daß sie parallel zur Tragwelle (112) verlaufen;
Spursteuerungsspulen (106a, b) zur Führung des Lichtpunktes auf einer im optischen Informationsaufzeichnungsmedium ausgebildeten Informationsaufzeichnungsspur durch Drehen des Halters (101);
eine Brennweitensteuerungsspule (105) zum Verschieben des Halters (101) entlang der Tragwelle (112), um den Lichtstrahl in einem Lichtpunkt auf der Informationsaufzeichnungsoberfläche des Mediums, im Raum angeordnet und am Basisjoch (102) fixiert, zu fokussieren;
wobei die Spursteuerungsspulen (106a, b) in einem Raum angeordnet sind, der die Spalte einschließt, die zwischen dem Permanentmagneten (111) und dem Basisjoch (102) ausgebildet sind, und am Basisjoch (102) fixiert sind;
dadurch gekennzeichnet, daß
der Permanentmagnet (111) in Richtungen im wesentlichen rechtwinklig zur Achse der Tragwelle (112) bei einer Vielzahl von Paaren von Magnetpolen (111a bis d) magnetisiert ist; und
die im Umfang des Basisjochs (102) ausgebildeten Spalte (136a, b) mindestens einer der Grenzen zwischen den Magnetpolen (111a bis d) des Permanentmagneten (111) gegenüberliegen.

2. Antriebsvorrichtung einer Objektivlinse nach Anspruch 1, bei welcher die Grenzen zwischen den Magnetpolen des ringförmigen Permanentmagneten und die im Basisjoch ausgebildeten Spalte symmetrisch gegenüber der Achse der Tragwelle angeordnet sind und der ringförmige Permanentmagnet mindestens vier Grenzen besitzt.

3. Antriebsvorrichtung einer Objektivlinse nach Anspruch 1, bei welcher der ringförmige Permanentmagnet so angeordnet ist, daß eine der Grenzen zwischen den Magnetpolen einem der im Basisjoch ausgebildeten Spalte gegenüberliegt.

4. Antriebsvorrichtung einer Objektivlinse nach Anspruch 1 oder 2, bei welcher der ringförmige Permanentmagnet so angeordnet ist, daß zwei der Grenzen zwischen den Magnetpolen einer der im Basisjoch ausgebildeten Spalte gegenüberliegen.

5. Antriebsvorrichtung einer Objektivlinse nach jedem der Ansprüche 1 bis 4, bei welcher die Brennweitensteuerungsspule und die Spursteuerungsspulen innerhalb des Raumes zwischen dem Permanentmagneten und dem Basisjoch angeordnet sind, so daß sich effektive Magnetflüsse gegenseitig schneiden.

6. Antriebsvorrichtung einer Objektivlinse nach Anspruch 1, bei welcher der Permanentmagnet eine Ringform besitzt, die Jochoberfläche des dem Permanentmagneten gegenüberliegenden Basisjochs gegenüber dem Permanentmagneten konzentrisch verläuft, die Spalte in der Richtung des Außenumfanges des Permanentmagneten vorgesehen sind und plattenförmige Jochs am Außenumfang des Basisjochs an den gegenüber dem Permanentmagneten liegenden Spalten fest angeordnet sind.

7. Antriebsvorrichtung einer Objektivlinse nach Anspruch 6, bei welcher die Brennweitensteuerungsspule in der Form eines Ringes ausgebildet und fest angeordnet ist, so daß ein Strom durch diese in Richtung des inneren Umfanges des Permanentmagneten und rechtwinklig zur Achse der Tragwelle fließt, und die Spursteuerungsspulen rechtwinklig ausgebildet und an den plattenförmigen Jochs gegenüber dem Permanentmagneten befestigt sind, so daß deren einige Seiten im wesentlichen parallel zur Achse der Tragwelle verlaufen.

8. Antriebsvorrichtung einer Objektivlinse nach Anspruch 6 oder 7, bei welcher die Spalte fest und symmetrisch am Basisjoch angeordnet und die plattenförmigen Jochs fest und symmetrisch am Basisjoch angeordnet sind.

9. Antriebsvorrichtung einer Objektivlinse nach Anspruch 6, bei welcher die Brennweitensteuerungsspule die Form eines Rings besitzt und fixiert angeordnet ist, so daß ein Strom durch diese in Richtung des inneren Umfangs des Permanentmagneten und rechtwinklig zur Achse der Tragwelle fließt, die Spursteuerungsspulen rechtwinklig geformt sind und die plattenförmigen Jochs am Basisjoch gegenüber dem Permanentmagneten fixiert sind, wobei einige von deren Seiten im wesentlichen parallel zur Achse der Tragwelle verlaufen.

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10. Antriebsvorrichtung einer Objektivlinse nach Anspruch 9, bei welcher die Spalte symmetrisch im Basisjoch ausgebildet sind und das plattenförmige Joch fest und symmetrisch am Basisjoch gegenüber dem Permanentmagneten angeordnet ist.

11. Antriebsvorrichtung einer Objektivlinse nach Anspruch 1, bei welcher der Permanentmagnet in der Form eines Ringes ausgebildet ist, der in seinem Umfang mit Aussparungen versehen ist, und so angeordnet ist, daß die Aussparungen gegenüber den in der Jochoberfläche des Basisjochs ausgebildeten Spalten liegen.

12. Antriebsvorrichtung einer Objektivlinse nach Anspruch 11, bei welcher die im ringförmigen Permanentmagneten ausgebildeten Aussparungen symmetrisch zur Achse der Tragwelle angeordnet sind und die im Basisjoch ausgebildeten Spalte symmetrisch zur Achse der Tragwelle verlaufen.

13. Antriebsvorrichtung einer Objektivlinse nach Anspruch 11 oder 12, bei welcher der ringförmige Permanentmagnet im wesentlichen rechtwinklig zur Achse der Tragwelle radial magnetisiert ist.

14. Antriebsvorrichtung einer Objektivlinse nach Anspruch 11 oder 12, bei welcher die Spursteuerungsspulen auf plattenförmigen Jochs gewickelt sind und die plattenförmigen Jochs in den Spalten im Basisjoch so befestigt sind, daß ein Strom durch die Spursteuerungsspulen in Richtung der Achse der Tragwelle fließt.

15. Antriebsvorrichtung einer Objektivlinse nach Anspruch 11 oder 12, bei welcher der ringförmige Permanentmagnet im wesentlichen rechtwinklig zur Achse der Tragwelle radial magnetisiert ist, die Spursteuerungsspulen auf die plattenförmigen Jochs gewickelt sind und die plattenförmigen Jochs in den Spalten im Basisjoch befestigt sind, so daß ein Strom durch die Spursteuerungsspulen in Richtung der Achse der Tragwelle fließt.

Revendications

1. Dispositif d'entraînement d'objectif comprenant :

une armature support (101) supportée de façon mobile en rotation et de façon coulissante par un arbre support (112) ;

un objectif (103) monté sur ladite armature support (10) dans une position excentrée par rapport à l'arbre support (112) ; et

un mécanisme d'entraînement pour entraîner ledit support (101) en des mouvements de rotation et de coulissement afin de commander la mise au point et l'alignement d'un faisceau lumineux émis à travers l'objectif (103) en un point lumineux focalisé sur un support d'enregistrement d'information optique ;

ledit mécanisme d'entraînement comprenant :

un aimant permanent (111) disposé sur ledit support ;

une culasse support (102) comprenant une unité stator (132 a, b) à l'opposé des surfaces polaires dudit aimant permanent (111) et pourvue de fentes (136 a, b) situées sur sa circonférence de façon à s'étendre parallèlement à l'arbre support (112) ;

des bobines de commande d'alignement (106 a, b) pour aligner le point lumineux sur une piste d'enregistrement d'information située sur ledit support d'enregistrement d'information optique par rotation dudit support (101) ;

une bobine de commande de focalisation (105) pour faire coulisser ledit support (101) le long de l'arbre support (112) afin de focaliser le rayon lumineux sous la forme d'un point lumineux sur la surface d'enregistrement d'information du support, situé dans la cavité, et fixé sur ladite culasse support (102) ;

lesdites bobines de commande d'alignement (106a,b) étant disposées dans une cavité comprenant les fentes formées entre ledit aimant permanent (111) et ladite culasse support (102), et étant fixées sur ladite culasse support (102) ;

caractérisé en ce que

ledit aimant permanent (111) est magnétisé dans des directions pratiquement perpendiculaires à l'axe de l'arbre support (112) avec une pluralité de paires de pôles magnétiques (111 a à d) ; et

les fentes (136 a, b) réalisées sur la circonférence de ladite culasse support (102) sont situées en face d'au moins une des frontières entre les pôles magnétiques (111 a à d) dudit aimant permanent (111).

2. Dispositif d'entraînement d'objectif selon la revendication 1, dans lequel les frontières entre les pôles magnétiques dudit aimant permanent annulaire et les fentes formées sur ladite culasse support sont disposées symétriquement par rapport à l'axe de l'arbre support, et ledit aimant permanent annulaire présente au moins quatre frontières.

3. Dispositif d'entraînement d'objectif selon la revendication 1, dans lequel ledit aimant perma-

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nent annulaire est disposé de telle façon que l'une des frontières séparant les pôles magnétiques soit à l'opposé de l'une des fentes formée sur ladite culasse support.

4. Dispositif d'entraînement d'objectif selon la revendication 1 ou 2, dans lequel ledit aimant permanent annulaire est disposé de telle façon que deux frontières séparant ses pôles magnétiques soient à l'opposé de l'une des fentes formée sur ladite culasse support.

5. Dispositif d'entraînement d'objectif selon chacune des revendications 1 à 4, dans lequel ladite bobine de commande de focalisation et ladite bobine d'alignement sont situées à l'intérieur de la cavité entre ledit aimant permanent et ladite culasse support de telle façon que leurs flux magnétiques efficaces se coupent l'un l'autre.

6. Dispositif d'entraînement d'objectif selon la revendication 1, dans lequel ledit aimant permanent est de forme annulaire, la face de la culasse de ladite culasse support située face audit aimant permanent est concentrique avec ledit aimant permanent, les fentes sont disposées dans le sens de la périphérie externe dudit aimant permanent, et des culasses en forme de plaques sont disposées à demeure sur la périphérie externe de ladite culasse support sur les fentes opposées audit aimant permanent.

7. Dispositif d'entraînement d'objectif selon la revendication 6, dans lequel ladite bobine de commande de focalisation est de forme annulaire et est disposée à demeure afin qu'un courant y circule dans le sens de la périphérie interne dudit aimant permanent et perpendiculairement à l'axe de l'arbre support, et lesdites bobines de commande d'alignement sont de forme rectangulaire et sont montées sur les culasses en forme de plaques à l'opposé dudit aimant permanent de façon à ce que plusieurs de leurs côtés soient pratiquement parallèles à l'axe de l'arbre support.

8. Dispositif d'entraînement d'objectif selon la revendication 6 ou 7, dans lequel les fentes sont disposées à demeure et de façon symétrique sur ladite culasse support, et les culasses en forme de plaques sont fixées à demeure et de façon symétrique sur ladite culasse support.

9. Dispositif d'entraînement d'objectif selon la revendication 6, dans lequel ladite bobine de commande de focalisation est de forme annulaire et est disposée à demeure afin qu'un courant la traverse dans le sens de la périphérie interne dudit aimant permanent et perpendiculairement à l'axe de l'arbre support, lesdites bobines de commande d'alignement sont de forme rectangulaires, et les culasses en forme de plaques sont fixées sur ladite culasse support à l'opposé dudit aimant permanent, plusieurs de leurs côtés étant pratiquement parallèles à l'axe de l'arbre support.

10. Dispositif d'entraînement d'objectif selon la revendication 9, dans lequel les fentes sont réalisées symétriquement dans ladite culasse support, et les culasses en forme de plaques sont disposées à demeure et de façon symétrique sur ladite culasse support à l'opposé dudit aimant permanent.

11. Dispositif d'entraînement d'objectif selon la revendication 1, dans lequel ledit aimant permanent est de forme annulaire, pourvu de cavités sur sa circonférence, et est disposé de telle façon que les cavités soient à l'opposé des fentes situées sur la face de la culasse de ladite culasse support.

12. Dispositif d'entraînement d'objectif selon la revendication 11, dans lequel les cavités réalisées sur ledit aimant permanent annulaire sont situées symétriquement par rapport à l'axe de l'arbre support, et les fentes réalisées sur ladite culasse support sont symétriques par rapport à l'axe de l'arbre support.

13. Dispositif d'entraînement d'objectif selon la revendication 11 ou 12, dans lequel ledit aimant permanent est magnétisé dans le sens radial pratiquement perpendiculairement à l'axe de l'arbre support.

14. Dispositif d'entraînement d'objectif selon la revendication 11 ou 12, dans lequel lesdites bobines de commande d'alignement sont enroulées autour desdites culasses en forme de plaques, et les culasses en forme de plaques sont montées à demeure dans les fentes de ladite culasse support de telle façon qu'un courant traverse lesdites bobines de commande d'alignement dans le sens de l'axe de l'arbre support.

15. Dispositif d'entraînement d'objectif selon la revendication 11 ou 12, dans lequel ledit aimant permanent est magnétisé dans le sens radial pratiquement perpendiculairement à l'axe de l'arbre support, lesdites bobines de commande d'alignement sont enroulées autour desdites

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culasses en forme de plaques, et les culasses en forme de plaques sont montées à demeure dans les fentes de ladite culasse support de telle façon qu'un courant traverse lesdites bobines de commande d'alignement dans le sens de l'axe de l'arbre support.

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