Description

This invention relates to an optical pickup device employed for recording/reproducing information on an optical disk.

Fig.4A is a diagrammatic perspective view illustrating an optical system extracted from a conventional optical pickup device, and Fig. 4B is an enlarged partial side elevation of the optical system shown in Fig. 4A. Referring to these figures, a laser light beam 2 emitted from an optical source 1 is split by a diffraction grating 3 into a zeroth order diffracted light beam 5a for reading signal pits on the disk 4 and for detecting focusing errors and a pair of first order diffracted light beams 5b and 5c for detecting tracking errors.

The three split laser beams 5a, 5b and 5c are passed through a holographic grating 6 and collimated by a collimator 7 into parallel beams which are focused by an object lens 8 to form three corresponding light spots 9a, 9b and 9c on an information surface of a disc 4. At this tine, the first order light spots 9b and 9c need be aligned with the tangential direction of the disc 4, that is, with the arraying direction of the signal pits, with the zeroth order light spot 9a as the center of symmetry.

The laser light beams reflected on the information surface of the disc 4 are returned on the same light path and, after passing through the collimator 7, again fall on the holographic grating 6 as they are collimated. The laser light having passed through the holographic grating 6 is separated into laser light beams 11b and 11c for detecting tracking errors and a laser light beam 11a for detecting focusing errors and radio frequency (RF) signals before they are deviated and fall on a photosensor 10.

In the photosensor 10, focusing error signals obtained by a type of wedge prism method, RF signals associated with the pits on the disk 4 and tracking error signals obtained by a three beam method, are detected.

In the conventional optical pickup device, when adjusting the direction of alignment of the light spots 9b and 9c on the disk 4 corresponding to a pair of first order light beams 5b and 5c for detecting the tracking errors, it is necessary to rotate the first order light spots 9b and 9c about the zeroth order light spot 9a as center, by rotating the diffraction grating 3 along the direction of arrow marks A and B about the optical axis as center.

Such devices are described in JP-A-62-209 733 and EP-A-0 073 066. However, in the conventional optical pickup device, it is extremely difficult to provide a mechanism for rotating the diffraction grating 3, because of the extremely narrow distance between the light source 1 and the holographic grating 6.

Also the provision of such rotating mechanism results in an increased number of component parts and an increased size and manufacturing cost of the optical pickup device.

In accordance with the present invention there is provided an optical pickup device for recording/reproducing information in a track or tracks on an optical disc, comprising a light source, means for dividing a light beam from said light source to produce a plurality of divided beams, means for focusing said divided beams as spaced beam spots on a said optical disc, photosensor means, and means for directing detection beams reflected from said beam spots toward said photosensor means, wherein said means for dividing is mounted so as to be rotatably adjustable about the axis of said light beam from said light source so as to adjust the orientation of said spaced beam spots relative to the track on the disc characterised in that said light source, said photosensor means, said means for directing and said dividing means are mounted on a common support which is mounted for said rotatable adjustment in a holder.

Thus, by rotating the holder, the means for dividing is rotated so that first order light spots on the disk for detecting the tracking errors may be rotated about a zeroth order light spot and, as a result, the first order light spots may be aligned with the arraying direction of the signal pits.

It is an advantage of the present invention that an optical pickup device which is compact and able to adjust the direction of alignment of light spots for detecting tracking errors is provided.

It is another advantage of the present invention that an optical pickup device wherein the optical axis of the optical components does not deviate when the direction of alignment of the light spots is adjusted for detecting tracking errors is provided.

The foregoing and other advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

Fig. 1 is a perspective view diagrammatically showing the optical system extracted from the optical pickup device according to a preferred embodiment of the present invention.

Fig. 2A is a longitudinal sectional view diagrammatically showing an example of the optical pickup device including the optical system of Fig. 1.

Fig. 2B is a diagrammatic bottom plan view of the device shown in Fig. 2A.

Fig. 3A is a longitudinal sectional view diagrammatically showing the optical pickup device according to a modified embodiment of the present invention.

Fig. 3B is a diagrammatic bottom plan view of the device of Fig. 3A.

Fig. 4A is a perspective view diagrammatically showing the optical system extracted from the conventional optical pickup device.

Fig. 4B is an enlarged side elevation showing a portion of the optical system of Fig. 4A.

Fig. 1 is a diagrammatic perspective view showing an optical system extracted from an optical pickup device according to an embodiment of the present invention. In this figure, a laser light beam 12 emitted from a light source 11 enters on a diffraction grating 13 and a holographic grating 16 stacked in contact with each other. As the laser light beam 12 is passed through the diffraction grating 13, it is split into a zeroth order diffracted light beam 15a for reading signal pits on an optical disk 14 and a pair of first order diffracted light beams 15b, 15c for reading tracking errors.

After passing through the holographic grating 16, the three laser light beams 15a, 15b and 15c are collimated by a collimator 17 into parallel light beams which are focused by an object lens 18 to form three corresponding light spots 19a, 19b and 19c on the disk 14. Thus the zeroth order light spot 19a is formed by the zeroth order diffracted light beam 15a, while the first order light spots 19a and 19c are formed by the first order diffracted light beams 15b and 15c.

The laser light beams reflected from the information recording surface of the disk 14 are returned on the same light path to fall on the holographic grating 16 as they are collimated by the collimator 17. These reflected laser light beams are diffracted and deviated by the holographic grating 16 to fall on a photosensor 10a.

In the photosensor 10a, focussing error signals are detected by a wedge prism method, tracking error signals by a three-beam method and RF signals correlated with signal pits on the disk 14.

Fig. 2A is a longitudinal sectional view diagrammatically showing an optical pickup device including the optical system shown in Fig. 1, and Fig. 2B is a diagrammatic bottom plan view of the device shown in Fig. 2A. A line 2A-2A in Fig. 2B represents a section line corresponding to Fig. 2A.

Referring to these figures, the light source 11 is fixed at the center on an upper surface of a substantially disk-shaped base plate 20, while the photosensor 10a is fixed on the same upper surface and slightly away from the light source 11. The lower half of the base plate 20 is formed with a projecting peripheral portion 20a. A hollow holding tube 21 has its lower half fixed to the projecting peripheral portion 20a of the base plate 20. The upper half of the holding tube 21 is formed with an inwardly projecting thickened holding section 21a on which the diffraction grating 13 and the holographic grating 16 are fixed. The diffraction grating 13 and the holographic grating 16 are arranged so that the central axes thereof coincide with an optical axis L of the laser light emitted from the light source 11. A lens barrel 22 is formed by the base plate 20, holding tube 21, diffraction grating 13 and holographic grating 16.

A lens barrel holder 23 in the form of a hollow cylinder has a projecting outer peripheral portion 23a at its upper end and a pair of screw holes 23b on its bottom surface. A lens holding section 23c is formed at the upper inner peripheral portion of the lens barrel holder 23 and holds the collimator 17. At this time, the axis of the collimator 17 coincides with the optical axis L of the laser beam.

The lower half of the lens barrel holder 23 is formed with a lens barrel holding section 23d having an inside diameter larger than the outside diameter of the holding tube 21. The lower end of lens barrel holding section 23d is formed with a fitting portion 23e having an inside diameter about equal to the outside diameter of the projecting portion 20a of the base plate 20.

The lens barrel 22 is introduced into the lens barrel holding section 23d from the lower end of the lens barrel holder 23 so that the projecting outer peripheral portion 20a of the base plate 20 fits with the fitting portion 23e. In this manner, the lens barrel 22 is supported rotatively with respect to the lens barrel holder 23 with the fitting portion 23e as a guide.

A plate spring 24 has a recess 24a for mating with the bottom section 20a of the base plate 20 and a fixing section 24b having a pair of small apertures 24c for the pair of screws 30. An opening 24d is formed at the center of the recess 24a for taking out electrical terminals. Hence, by manually gripping and rotating the bottom section 20a of the base plate 20, the lens barrel can be rotated with respect to the lens barrel holder 23 with the fitting portion 23e as a guide. At this time, the light source 11 is positioned at the center of rotation of the base plate 20, so that the center of rotation of the lens barrel 22 coincides with the optical axis L of the laser light beam.

An object lens driving section 25 has an object lens 18. The object lens driving section 25 is held on the upper surface of the lens barrel holder 23 so that the central axis of the object lens 18 coincides with the optical axis L. The object lens driving section 25 drives the object lens 18 by a well-known driving system so that the focal point of the laser light beam will be formed correctly on the disk 14.

In the optical pickup device shown in Figs. 2A and 2B, when the lens barrel 22 is rotated with the peripheral portion 20a of the base plate 20 gripped manually, the diffraction grating 13 is also rotated

in unison with the lens barrel 22, so that the pair of first order light spots 19b and 19c for detecting tracking errors may be rotated about the zeroth order light spot 19a for reading signal pits as a center. In this manner, the first order light spots 19b and 19c may be aligned with the arraying direction of the signal pits. That is, tracking error signal adjustment in the three-beam method can be made even in the case of an extremely narrow interval between the light source 11 and the holographic grating 16. It is noted that the optical pickup device shown in Figs. 2A and 2B is not increased in size because it is simple in structure and made up of a small number of components.

Fig. 3A is a sectional view showing diagrammatically another optical pickup device according to a modified embodiment of the present invention, and Fig. 3B is a diagrammatic bottom plan view of the device of Fig. 3A. The line 3A-3A in Fig. 3B represents the section line corresponding to Fig. 3A. In Figs. 3A and 3B, the same or corresponding parts are designated by the same reference symbols.

Referring to Figs. 3A and 3B, the light source 11 is fixed at the center of the upper surface of a disk-shaped base plate 26, and the photosensor 10a is also fixed thereon in proximity to the light source 11.

A hollow holding tube 27 holds the diffraction grating 13 and the holographic grating 16 at the mid portion of a hollow section thereof while holding the collimator at the upper end of the hollow section. The base plate 26 is introduced and fixed at the lower end of the hollow section of the holding tube 27. At this time, the diffraction grating 13, holographic grating 16 and the collimator 17 have their central axes coincident with the light axis L of the light source 11. A lens barrel 28 is formed by the holding tube 27 and the base plate 26.

A lens barrel holder 29 in the form of a hollow cylinder has a cylindrical lens barrel holding section 29a and a pair of screw holes 29b at its lower end. The lens barrel holding section 29a has its inside diameter substantially coincident with the outside diameter of the lens barrel 28. The lens barrel 28 is inserted and fitted inside the lens barrel holding section 29a. A plate spring 24 is fitted to the lower end of the lens barrel 28 and fixed to the lens barrel holder 29 by a pair of screws 30.

It will be understood that, in the optical pickup device shown in Figs. 3A and 3B, the tracking error signals can be adjusted by rotating lens barrel 28 with the lower end of the lens barrel 28 gripped manually.

It will also be appreciated that, in the optical pickup device shown in Fig. 3A, not only the diffraction grating 13 and the holographic grating 16 but also the collimator 17 are accommodated inside the lens barrel 28, so that the axis of the collimator 17 is not deviated from the optical axis L on rotation of the lens barrel 28.

Claims

1. An optical pickup device for recording/reproducing information in a track or tracks on an optical disc (14), comprising a light source (11), means (13) for dividing a light beam from said light source to produce a plurality of divided beams (15a, 15b, 15c), means (18) for focusing said divided beams as spaced beam spots (19a, 19b, 19c) on a said optical disc (14), photosensor means (10a), and means (16) for directing detection beams reflected from said beam spots toward said photosensor means, wherein said means (13) for dividing is mounted so as to be rotatably adjustable about the axis of said light beam from said light source so as to adjust the orientation of said spaced beam spots relative to the track on the disc characterised in that said light source (11), said photosensor means (10a), said means (16) for directing and said dividing means (13) are mounted on a common support (20, 21; 26, 27) which is mounted for said rotatable adjustment in a holder (23, 25; 29, 25).

2. An optical pick up device according to claim 1 wherein said focusing means (18) is mounted in said holder (23, 25; 29, 25).

3. An optical pickup device according to any one of the preceding claims wherein said holder (23, 25; 29, 25) comprises a substantially cylindrical hollow section (23d; 29a), and said common support (20, 21; 26, 27) comprises a substantially cylindrical outer peripheral portion mating inside said hollow section (23d; 29a).

4. The optical pickup device according to any one of the preceding claims wherein said holder (23, 25; 29, 25) also holds a collimator (17).

5. The optical pickup device according to any one of the preceding claims wherein said light source (11) comprises a semiconductor laser.

6. The optical pickup device according to any one of the preceding claims wherein said means (13) for dividing comprises a diffraction grating.

7. The optical pickup device according to any one of the preceding claims wherein said

in unison with the lens barrel 22, so that the pair of first order light spots 19b and 19c for detecting tracking errors may be rotated about the zeroth ler light spot 19a for reading signal pits as a center. In this manner, the first order light spots 19b and 19c may be aligned with the arraying direction of the signal pits. That is, tracking error signal adjustment in the three-beam method can be made even in the case of an extremely narrow interval between the light source 11 and the holographic grating 16. It is noted that the optical pickup device shown in Figs. 2A and 2B is not increased in size because it is simple in structure and made up of a small number of components.

Fig. 3A is a sectional view showing diagrammatically another optical pickup device according to a modified embodiment of the present invention, nd Fig. 3B is a diagrammatic bottom plan view of he device of Fig. 3A. The line 3A-3A in Fig. 3B represents the section line corresponding to Fig. 3A. In Figs. 3A and 3B, the same or corresponding parts are designated by the same reference symbols.

Referring to Figs. 3A and 3B, the light source 11 is fixed at the center of the upper surface of a disk-shaped base plate 26, and the photosensor 10a is also fixed thereon in proximity to the light source 11.

A hollow holding tube 27 holds the diffraction grating 13 and the holographic grating 16 at the mid portion of a hollow section thereof while holding the collimator at the upper end of the hollow section. The base plate 26 is introduced and fixed at the lower end of the hollow section of the holding tube 27. At this time, the diffraction grating 13, holographic grating 16 and the collimator 17 have heir central axes coincident with the light axis L of he light source 11. A lens barrel 28 is formed by the holding tube 27 and the base plate 26.

A lens barrel holder 29 in the form of a hollow cylinder has a cylindrical lens barrel holding section 29a and a pair of screw holes 29b at its lower end. The lens barrel holding section 29a has its inside diameter substantially coincident with the outside diameter of the lens barrel 28. The lens barrel 28 is inserted and fitted inside the lens barrel holding section 29a. A plate spring 24 is fitted to the lower end of the lens barrel 28 and fixed to the lens barrel holder 29 by a pair of screws 30.

It will be understood that, in the optical pickup device shown in Figs. 3A and 3B, the tracking error signals can be adjusted by rotating lens barrel 28 with the lower end of the lens barrel 28 gripped manually.

It will also be appreciated that, in the optical pickup device shown in Fig. 3A, not only the diffraction grating 13 and the holographic grating 16 but also the collimator 17 are accommodated inside the lens barrel 28, so that the axis of the collimator 17 is not deviated from the optical axis L on rotation of the lens barrel 28.

Claims

1. An optical pickup device for recording/reproducing information in a track or tracks on an optical disc (14), comprising a light source (11), means (13) for dividing a light beam from said light source to produce a plurality of divided beams (15a, 15b, 15c), means (18) for focusing said divided beams as spaced beam spots (19a, 19b, 19c) on a said optical disc (14), photosensor means (10a), and means (16) for directing detection beams reflected from said beam spots toward said photosensor means, wherein said means (13) for dividing is mounted so as to be rotatably adjustable about the axis of said light beam from said light source so as to adjust the orientation of said spaced beam spots relative to the track on the disc characterised in that said light source (11), said photosensor means (10a), said means (16) for directing and said dividing means (13) are mounted on a common support (20, 21; 26, 27) which is mounted for said rotatable adjustment in a holder (23, 25; 29, 25).

2. An optical pick up device according to claim 1 wherein said focusing means (18) is mounted in said holder (23, 25; 29, 25).

3. An optical pickup device according to any one of the preceding claims wherein said holder (23, 25; 29, 25) comprises a substantially cylindrical hollow section (23d; 29a), and said common support (20, 21; 26, 27) comprises a substantially cylindrical outer peripheral portion mating inside said hollow section (23d; 29a).

4. The optical pickup device according to any one of the preceding claims wherein said holder (23, 25; 29, 25) also holds a collimator (17).

5. The optical pickup device according to any one of the preceding claims wherein said light source (11) comprises a semiconductor laser.

6. The optical pickup device according to any one of the preceding claims wherein said means (13) for dividing comprises a diffraction grating.

7. The optical pickup device according to any one of the preceding claims wherein said

means (16) for directing comprises a holographic grating.

Patentansprüche

1. Optische Abtastvorrichtung zum Aufzeichnen/Wiedergeben von Informationen in einer Spur oder Spuren auf einer optischen Platte (14), mit einer Lichtquelle (11), einer Teilungseinrichtung (13) zum Teilen eines von der Lichtquelle ausgehenden Lichtstrahls, um eine Mehrzahl von geteilten Strahlen (15a, 15b, 15c) zu erzeugen, einer Fokussiereinrichtung (18) zum Fokussieren der geteilten Strahlen zu beabstandeten Strahlpunkten (19a, 19b, 19c) auf der optischen Platte (14), einer lichtempfindlichen Einrichtung (10a) und einer Lenkeinrichtung (16) zum Lenken von von den Strahlpunkten reflektierten Meßstrahlen zu der lichtempfindlichen Einrichtung, wobei die Teilungseinrichtung (13) so angebracht ist, daß sie drehbar um die Achse des von der Lichtquelle ausgehenden Lichtstrahls verstellbar ist, um die Orientierung der beabstandeten Strahlpunkte relativ zu der Spur auf der Platte einzustellen, **dadurch gekennzeichnet,** daß die Lichtquelle (11), die lichtempfindliche Einrichtung (10a), die Lenkeinrichtung (16) und die Teilungseinrichtung (13) auf einer gemeinsamen Aufnahme (20, 21; 26, 27) angebracht sind, die zur drehbaren Einstellung in einen Träger (23, 25; 29, 25) eingesetzt ist.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet,** daß die Fokussiereinrichtung (18) auf dem Träger (23, 25; 29, 25) angebracht ist.

3. Vorrichtung nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet,** daß der Träger (23, 25; 29, 25) einen im wesentlichen hohlzylindrischen Bereich (23d; 29a) aufweist, und daß die gemeinsame Aufnahme (20, 21; 26, 27) ein im wesentlichen zylindrisches Außenteil aufweist, das in dem hohlen Bereich (23d; 29a) steckt.

4. Vorrichtung nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet,** daß der Träger (23, 25; 29, 25) einen Kollimator (17) trägt.

5. Vorrichtung nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet,** daß die Lichtquelle (11) einen Halbleiter-Laser umfaßt.

6. Vorrichtung nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet,** daß die Teilungseinrichtung (13) ein Beugungsgitter aufweist.

7. Vorrichtung nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet,** daß die Lenkeinrichtung (16) ein holografisches Gitter umfaßt.

Revendications

1. Dispositif de lecture optique destiné à enregistrer/reproduire des informations sur une ou des pistes définies sur un disque optique (14), comportant une source de lumière (11), des moyens (13) pour diviser un faisceau de lumière provenant de ladite source de lumière afin de produire plusieurs faisceaux divisés (15a, 15b, 15c), des moyens (18) pour focaliser lesdits faisceaux divisés en points de faisceaux espacés (19a, 19b, 19c) sur ledit disque optique (14), des moyens photodétecteurs (10a), et des moyens (16) destinés à diriger des faisceaux de détection réfléchis à partir desdits points de faisceaux vers lesdits moyens photodétecteurs, dans lequel lesdits moyens diviseurs (13) sont montés de manière à pouvoir être ajustés d'une manière rotative autour de l'axe dudit faisceau de lumière provenant de ladite source de lumière afin d'ajuster l'orientation desdits points de faisceaux espacés par rapport à la piste définie sur le disque, caractérisé en ce que ladite source de lumière (11), lesdits moyens photodétecteurs (10a), lesdits moyens directeurs (16) et lesdits moyens diviseurs (13) sont montés sur un support commun (20, 21; 26, 27) monté dans un organe de maintien (23, 25; 29, 25) en vue dudit ajustement rotatif.

2. Dispositif de lecture optique selon la revendication 1, dans lequel lesdits moyens de focalisation (18) sont montés dans ledit organe de maintien (23, 25; 29, 25).

3. Dispositif de lecture optique selon l'une quelconque des revendications précédentes, dans lequel ledit organe de maintien (23, 25; 29, 25) comporte une section creuse sensiblement cylindrique (23d; 29a), et ledit support commun (20, 21; 26, 27) comporte une partie périphérique extérieure sensiblement cylindrique qui s'emboîte à l'intérieur de ladite section creuse (23d; 29a).

4. Dispositif de lecture optique selon l'une quelconque des revendications précédentes, dans lequel ledit organe de maintien (23, 25; 29, 25) maintient également un collimateur (17).

* C L M S *

5. Dispositif de lecture optique selon l'une quelconque des revendications précédentes, dans lequel ladite source de lumière (11) comporte un laser à semi-conducteur.

6. Dispositif de lecture optique selon l'une quelconque des revendications précédentes, dans lequel lesdits moyens diviseurs (13) comportent un réseau de diffraction.

7. Dispositif de lecture optique selon l'une quelconque des revendications précédentes, dans lequel lesdits moyens directeurs (16) comportent un réseau holographique.