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OPTICAL READ/WRITE DEVICE

This invention relates to optical read/write devices.

Prior art optical read/write devices in which data is obtained from an optical recording medium by a beam are either of the reflection type using the Kerr effect or of the transmission type using the Faraday effect.

The reflection type of optical read/write device used in the Kerr effect allows reproduction of data stored in an optical recording medium by means of light reflected from the optical recording medium. However, it has the following defects:

1) An optical system is complicated and linearly polarised light is transformed into elliptically polarised light. In order to avoid this defect, many specific optical elements with little phase difference between the P component of the polarised light and the S component are required.

2) Beam generating means having a large output power are required because of the small amount of output light through an objective lens.

The transmission type of optical read/write device using the Faraday effect is designed in order to solve these problems. Figure 2 is a schematic diagram of a conventional optical read/write device using the Faraday effect. Data fed to an input terminal 120 is supplied to a laser driver 117 and

a magnetic controller 116. The magnetic controller 116 drives a coil 111 to magnetise the optical recording medium 101 to a desired direction of writing. The laser driver 117 causes the laser diode 103 to output a beam, which is directed onto the optical recording medium 101 via a collimator lens 104, a reflection prism 108, and an objective lens 109 to raise the temperature in the focused beam spot. When the temperature rises near to the Curie point, the magnetisation of the optical recording medium 101 is reversed by the magnetic field produced by the coil 111, thereby storing data.

When reading data, linearly polarised light from the laser diode 103 passes through the optical recording medium 101, the plane of polarisation of the beam being rotated depending upon the direction of magnetisation. Then, the beam is incident on a 4-part strip-type photodiode 201 after having passed through an analyser 112. The sensor 201 transforms the light signal into an electrical signal, which is amplified by a head amplifier 204 and divided into a data signal and servo signal in a signal dividing circuit 205. The data signal is outputted from a terminal 119, and the servo signal is supplied to a focusing actuator 202 and a tracking actuator 203. In addition, a terminal 122 is supplied with a track access signal which drives the tracking actuator 203. A frame 123 is driven by the focusing actuator 202 and the tracking actuator 203 in both the direction of the optical axis (normal to the optical recording medium) and at right angles with respect

to data tracks (in the plane of the optical recording medium). The frame 123 supports the laser diode 103, the collimator lens 104, the reflection prism 108, the objective lens 109, the polariser 112 and the sensor 201.

This conventional optical read/write device has the following disadvantages:

1) Access time is long because the whole frame 123 is driven in two axial directions under the control of focusing servo signals and tracking servo signals and is very heavy.

2) It is difficult to improve tracking accuracy because the tracking actuator 203 coarsely moves the frame 123 by means of the tracking access signal and simultaneously slightly moves the frame by means of the servo signal. If tracking accuracy is required then a relatively large magnetic circuit and a relatively large current are required. Therefore, the optical recording medium should be rotated at low speed, thereby reducing data transfer rate.

3) The head amplifier 204 helps to amplify the data signal as well as the servo signal. However, it is difficult to design a head amplifier which is suitable for the frequency band of each signal because both signals are different then the frequency band. For example, the data signal is of the order of several MHz, while the servo signal is of the order of several KHz. Therefore, this causes the deterioration of the C/N ratio.

The present invention seeks to provide an optical read/write device using the Faraday effect having means for obtaining

tracking servo signals and focusing servo signals from light reflected from an optical recording medium, thereby realising an increased data transfer rate, a higher C/N ratio and a higher speed of access of data.

According to the present invention, there is provided an optical read/write device comprising: light beam generating means; optical means for directing a beam from said beam generating means onto an optical recording medium; first detecting means for detecting transmitted light from said optical recording medium and reading data stored in said optical recording medium; support means carrying said beam generating means, said optical means and said first detecting means; first driving means for moving said support means parallel to the optical recording medium; second driving means for moving an objective lens of said optical means in the direction of the optical axis normal to the optical recording medium; beam moving means for moving said beam on said optical recording medium to a predetermined spot thereon; and second detecting means for detecting light reflected from said optical recording medium and generating a servo signal for said second driving means and said beam spot moving means.

Preferably said first detecting means has an analyser for detecting the angle of polarisation of a beam from said optical recording medium and magnetising means for magnetising said optical recording medium.

In one embodiment said optical means has an objective lens, said beam spot moving means, in operation, moving said objective lens in a direction perpendicular to data tracks on said optical recording medium.

In another embodiment said optical means has an objective lens, said beam moving means, in operation, moving the angle of incidence of the beam onto said objective lens.

The invention is illustration, merely by way of example, in the accompanying drawings, in which:-

Figure 1 is a schematic view of one embodiment of an optical read/write device according to the present invention;

Figure 2 is a schematic view of an embodiment of a conventional optical read/write device; and

Figure 3 is a schematic view of a tracking mechanism of another embodiment of an optical read/write device according to the present invention.

Referring first to Figure 1 there is shown an optical read/write device according to the present invention. A data signal supplied to a data input terminal 120 is fed to a magnet controller 116 and a laser driver 117. The magnet controller 116 drives a coil 111 to magnetise an optical

recording medium 101, and the laser driver 117 drives the laser diode 103 which outputs the laser beam so that the magnetisation of the optical recording medium is reversed and data is stored. This is the same as in the conventional optical read/write device.

When reading, a laser beam of 780 nm from the laser diode 103 is collimated by a collimator lens 104 and directed into a plane 121 which produces a circular beam of light. The beam is then completely, linearly polarised by a polarising beam splitter 105 having 100% of reflectance of the S component of the polarised light and 50% of transmittance of the P component of the polarised light. The linearly polarised light is deflected at right angles by a reflection prism 108 and passed to an objective lens 109. The objective lens 109 focuses light onto the optical recording medium. The optical recording medium 101 is covered with a magnetic thin film such as, for example GdTbFe, TbFeCo, DyFeCo. The focused beam, having a diameter of 1.6 μm on the optical recording medium 101, is received by an analyser 112. The detected beam is transformed into an electrical signal by a PIN diode 113 which has a diameter of 4 mm. The electric signal output of the photodiode 113 is amplified by a head amplifier 115 exclusively for data and outputted from a terminal 119.

A constant proportion of the beam is reflected by the optical recording medium 101 and then collimated by the objective lens 109. The reflected beam is directed to the

polarising beam splitter 105 via the reflection prism 108. The polarised beam splitter reflects half the beam onto a knife edge 124. The knife edge 124 produces a semicircular beam which is condensed by a condenser lens 106 onto a 4-part PIN diode 107. In Figure 1, the condenser lens 106 and photodiode 107 are disposed perpendicular to the optical recording medium but, if so desired, they can be disposed parallel to the optical recording medium.

The signal produced by the photodiode 107 is amplified by a head amplifier 118 so that a focused error signal based on the knife edge method and a tracking error signal based on the push-pull method is obtained.

The focusing error signal and tracking error signal are supplied to a two-axis lens actuator 110 for moving the beam to a predetermined spot on the optical recording medium. The actuator 110 is driven for focusing and tracking by the servo signal.

A frame 123 is moved at right angles to the tracks of the optical recording medium by a linear motor 114. The linear motor 114 is driven by the tracking access signal.

The optical recording medium 101 is a disk with a diameter of 90 mm or 130 mm and has spiral or concentric grooves having a depth of 1/8 wavelength and a track pitch of 1.6 μm. The optical recording medium 101 is rotated constantly at 180 rpm at a maximum by a motor 102. In

this embodiment, the disk has an unformatted capacity of 200 MB, the average access time is 40 ms, and the transfer rate is 6 Mbit/s with a high C/N ratio so that an error rate of 10^{-12} is achieved.

Figure 3 shows a tracking mechanism of another embodiment of an optical read/write device according to the present invention. The tracking mechanism changes the incident angle of light fed thereto by the objective lens 104. A galvanic mirror 301 is rotated by the tracking error signal and tracking is performed by changing the incident angle of light to the objective lens 109. In tracking, the photodiode 113 is large enough to receive the total amount of transmitted light without reducing signal strength.

In Figure 3 the broken line shows the path of light schematically. The objective lens 109 is focused by a focusing actuator 302 which moves solely in the direction of the optical axis. The remainder of the optical read/write device is the same as in Example 1.

The optical read/write device of Figure 1 has all the advantages of conventional optical read/write device using the Faraday effect and in addition the following advantages:

1) The whole frame 123 is moved parallel to the optical recording medium and at right angles with respect to the tracks in a short time. The optical system is controlled highly

accurately in both the direction of the optical axis and at right angles with respect to the tracks. Therefore, it is not necessary to move the whole frame by small distances in two axial directions at right angles and thereby low power, high accuracy access can be realised in a short time.

2) The actuator 110 can reply at high speed and so the optical recording medium can be rotated at high speed. Therefore, data transfer rate can be improved.

3) The photodiode 113 has a head amplifier 115 exclusively for data signals. The photodiode 107 has the head amplifier 118 exclusively for servo signals in the direction of the optical axis and at right angles with respect to the tracks. Therefore, the circuit construction of each head amplifier can be adjusted to the frequency band of data or the frequency band of servo signals, respectively. Therefore, the C/N ratio can be greatly improved.

4) The optical read/write device of Figure 1 can reproduce data stored in commonly available optical recording media in which the amount of reflected light is changed, such as DRAW type optical recording disks, compact disks and CD-ROMs. Therefore, there is excellent compatability.

C L A I M S

1. An optical read/write device comprising: light beam generating means; optical means for directing a beam from said beam generating means onto an optical recording medium; first detecting means for detecting transmitted light from said optical recording medium and reading data stored in said optical recording medium; support means carrying said beam generating means, said optical means and said first detecting means; first driving means for moving said support means parallel to the optical recording medium; second driving means for moving an objective lens of said optical means in the direction of the optical axis normal to the optical recording medium; beam moving means for moving said beam on said optical recording medium to a predetermined spot thereon; and second detecting means for detecting light reflected from said optical recording medium and generating a servo signal for said second driving means and said beam spot moving means.

2. An optical read/write device as claimed in claim 1 in which said first detecting means has an analyser for detecting the angle of polarisation of a beam from said optical recording medium and magnetising means for magnetising said optical recording medium.

3. An optical read/write device as claimed in claim 1 or 2 in which said optical means has an objective lens, said beam spot moving means, in operation, moving said objective lens in a direction perpendicular to data tracks on said optical recording medium.

4. An optical read/write device as claimed in claim 1 or 2 in which said optical means has an objective lens,

said beam moving means, in operation, moving the angle of incidence of the beam onto said objective lens.

5. An optical read/write device substantially as herein described with reference to and as shown in Figures 1 and 3 of the accompanying drawings.

* C L M S *