Read/write arrangement for optical media

The invention relates to an arrangement for reading from or writing on a disk-shaped medium provided with tracks, comprising an optical head for projecting the beam of light on the disk-shaped medium, control means for directing the beam of light from a present track to a target track across the tracks.

Arrangements of this type are well-known and are generally used for reading from and/or writing on optical information carriers, such as CD-ROMs, videodisks or audiodisks. To this end, a laser beam is generally used to follow a track. Generally, the same laser beam is used for reading information from this same track. Before information can be read from or written to a CD-ROM track, the optical head will have to be moved to the track concerned. A customary search method is to count the tracks running past the optical head starting from a certain zero track, the optical head moving in a radius direction of the tracks. Thus, the position of the optical head can be determined in radial direction.

An object of the arrangement according to the invention is to determine the position of the optical head in case of non-operation of a position sensor. A secondary object of the arrangement according to the invention is to limit the movement of the optical head during a track search operation.

The arrangement according to the invention is thereto characterized in that there are provided first and second position sensing means for determining a position of the optical head in radial direction of the tracks.

The first position sensing means may comprise a track counter. An advantageous embodiment is thereto characterized in that the first position sensing means are designed for determining the radial position of the optical head on the basis of tracks running past the head.

In an advantageous embodiment of the invention, the second position sensing means are so designed that they operate independently of the tracks, for instance by attaching a first element, i.e. a position indicator, to the head and by attaching a second element, i.e. a reading element of the position indicator, to the housing or vice versa.

The first element may comprise a ruler designed as an encoder provided with equidistant lines and the second element may comprise a system incorporating an element for illuminating the ruler and a detector element for receiving light transmitted or reflected by the ruler.

In a second advantageous embodiment, the accuracy of the second position sensing means is far less than that of the first position sensing means, which enables them to be realised at substantially lower costs. The second position sensing means can then be used to limit the movement of the recording/reading head in case the information from the first position sensing means is not available. The second position sensing means are preferably less accurate than the first position sensing means by a factor 10 to 100.

Particularly if the reading head is set in motion by a voice coil motor, instead of by means of a spindle motor, it is essential to control the movement of the reading head. A voice coil motor can move the reading head much faster than a spindle motor. However, the position of the reading head is generally controlled in a closed loop,

whereby a tracking error signal, i.e. the difference between a measured and a desired position, is applied to a position regulator. The position regulator will apply an extremely large signal to the voice coil motor which will cause the reading head to strike a stop as a result of which damage may occur.

To prevent this, an advantageous embodiment is characterized in that there is provided a protective device for the optical head which limits the movement of the optical head on the basis of information from the second position sensing means.

The arrangement according to the invention will now be described in greater detail with reference to the following figures, of which:

Fig. 1 represents a top view of the mechanism of an embodiment of the arrangement according to the invention;

Fig. 2A schematically represents a cross-section A-A from Fig. 1;

Fig. 2B schematically represents a cross-section B-B from Fig. 1;

Fig. 3 represents an embodiment of the arrangement according to the invention which incorporates a swivelling arm.

Fig. 1 represents a preferred embodiment of the arrangement according to the invention. In this embodiment, the arrangement comprises a baseplate or frame 1, preferably made of aluminium alloy on which various components of the arrangement are mounted. An optical disk 2 provided with tracks can be placed on a drive motor 3, for instance a spindle motor. By means of bearings 5 and 6, an optical head 4 can be moved in a radial direction of the optical

disk 2 along a pair of slide rails 7 and 8 and is driven by two slide motors consisting of a voice coil 9 and 10 and a closed stator 11 and 12 of magnetic material. A laser connected to baseplate 1 transmits a beam of light 13 to the optical head 4 which, by means of a prism or mirror, projects the beam of light onto the optical disk 2 through a lens 14.

The lens 14 is suspended in a miniature frame 15 connected to the slide motors. By means of a radial fine positioning motor, for instance a miniature voice coil motor connected to the lens, the lens 14 can be moved relative to the miniature frame 15 over a limited distance in a radial direction by means of a radially operating fine positioning motor, for instance a miniature voice coil motor connected to lens 14, for fine positioning of the lens. The limited distance is in the order of several to a dozen tracks of the optical disk. The position of the lens 14 relative to the miniature frame 15 is detected by an optical transmitter 16 and receiver 17. The receiver 17 detects whether the lens 14 has passed a certain limit in radial direction relative to the miniature frame 15. Should this be the case, the miniature frame is moved by means of the slide motors in radial direction so as to enable the lens 14 to reassume a central position in the miniature frame without the track in the optical disk being lost.

It is also possible by means of a focusing motor, for instance designed as a miniature voice coil motor connected to the lens, to move the lens 14 in the direction of the optical disk 2 for focusing the laser beam onto the optical disk. The laser light reflected by the optical disk is re-reflected via the optical disk to an optical detector connected to the baseplate.

The signals output by the optical detector are decomposed into tracking error signals, focusing error signals and signals that comprise information contained in the optical disk tracks. The tracking error signals are applied to a radially operating fine positioning motor connected to the lens via a first control unit (not shown) and the focusing error signals are applied to the focusing motor via a second control unit (not shown). The slide motors 9, 10 are controlled by a third control unit.

Fig. 2A schematically represents cross-section A-A from Fig. 1. Fig. 2B schematically represents cross-section B-B from Fig. 1. Fig. 2A and 2B show a ruler 18 connected to one of the slide motors 9. The ruler comprises a number of equidistant slots 19 which are light-transmitting. The ruler is read with the aid of a light source 20 and a detector 21. A direction of movement can in a known manner be obtained by placing a second light source (not shown) with corresponding detector next to the first light source and detector. The distance, radial relative to the optical disk 2 between both light sources is equal to a quarter distance between two slots. A direction of movement can be detected by combining signals in a manner known in the prior art.

At least two operating modes can be distinguished in the arrangement according to the invention. In the first operating mode, a track is followed and read. In the second operating mode, a track is found. Finding a track should consume as little time as possible, which is of particular importance in computer applications where the information is distributed over the disk surface. During the track finding process, the optical head moves across the tracks, which tracks are subsequently counted. The distance between the initial track and the target track will be known and

can therefore always be compared with the number of tracks counted.

In an embodiment in which the ruler can provide the same accurate position information as the track counter, the information supplied by the ruler may be used in case the track counter is rendered inoperative for instance as a result of local damage to the disk.

In an exceptionally advantageous embodiment, however, the ruler provides position information which is less accurate by a factor 10 to 100, so that it can be realised far less expensively. The distance between two slots is then in the order of 10 to 100 tracks of the disk. If the arrangement is in the search mode, the slide motors are controlled on the basis of the tracks counted. Simultaneously, however, the slide's speed of traverse is updated in a microprocessor on the basis of the ruler-provided position information. If the speed of traverse exceeds a certain permissible value, a protective device is activated to limit the speed of traverse. The slide motors will subsequently be controlled on the basis of the ruler-supplied information until it has been ascertained that the track counter again provides accurate position information. In that case, the slide motors are once more driven on the basis on the track counter.

An expeditious target track search method can be obtained by first accelerating the optical head as hard as possible and by subsequently decelerating it as hard as possible such that the optical head is practically brought to a standstill at the target track. In doing so, however, account should be taken of the generation of heat and the concomitant rise of temperature in the slide motors. A second consideration is the ambient temperature. In an

advantageous embodiment of the arrangement, a temperature sensor is then mounted in the housing accommodating the arrangement. In Fig. 1 this sensor is denoted by no 26. The slide motor design data specify the generation of heat in the slide motors at a certain control current. On the basis of these design data and the ambient temperature, a maximum permissible control current or a maximum permissible period during which a certain control current is applied to the slide motors can be calculated in a microprocessor at any given moment. Thus, the control current or period, and consequently the movement of the optical head, can be limited at this value. Particularly if the arrangement is to be located in a warm environment, this embodiment serves a useful purpose and enables the search speed to be continuously maximized without the risk of a short circuit in the slide motors.

Fig. 3 represents an embodiment incorporating a swivelling arm 22 for moving the optical head 23. The swivelling arm is on one side connected to the optical head and is on the other side connected to a ruler 24, thus enabling the position of the optical head to be determined in radial direction. The swivelling arm is capable of rotation about a shaft 25 and is driven, in a manner known in the prior art, by a coil and magnet (not shown). In the standard operating mode, the position of the optical head will once more be determined by counting the tracks on the disk. The ruler-provided information will then serve to limit the movement of the optical head.

Claims

1. Arrangement for reading from or writing on a disk-shaped medium provided with tracks, comprising an optical head for projecting the beam of light on the disk-shaped medium, control means for directing the beam of light from a present track to a target track across the tracks, characterized in that there are provided first and second position sensing means for determining a position of the optical head in radial direction of the tracks.

2. Arrangement as claimed in claim 1, characterized in that the first position sensing means are designed for determining the radial position of the optical head on the basis of tracks running past the head.

3. Arrangement as claimed in claims 1 or 2, characterized in that the second position sensing means comprise a first and a second element which are capable of determining the position of the head by acting in concert.

4. Arrangement as claimed in claim 3, characterized in that the first element comprises an encoder and the second element comprises a reading device for reading the encoder.

5. Arrangement as claimed in claim 4, characterized in that the encoder is connected to the optical head and the reading device is connected to a housing.

6. Arrangement as claimed in any of the claims 1 through 5, characterized in that the second position sensing means are less accurate than the first position sensing means by a factor 10 to 100.

7. Arrangement as claimed in any of the preceding claims, characterized in that there is provided a protective device for the optical head which limits the movement of the optical head on the basis of the information provided by the second position sensing means.

8. Arrangement as claimed in any of the preceding claims, characterized in that there are furthermore provided a temperature sensor and means to limit the movement of the optical head on the basis of the information provided by the temperature sensor.