Description

The invention relates to a device for inscribing and/or reading a magneto-optical information carrier, as defined in the preamble of the independent claims 1 to 3.

Such a device is known from German Offenlegungsschrift DE 37 23 134. The prior art device for magneto-optically inscribing a magneto-optical disc comprises a housing having a cover which can be opened and closed to insert or remove a magneto-optical disc. During operation the magneto-optical disc loaded into the housing is held on a turntable by a disc-pressure member and is rotated by a drive motor. The drive motor is secured to a frame accommodated in the housing. The housing further accommodates a slide which is movable over rectilinear guide means in a radial direction relative to the axis of rotation of the turntable. The slide is constructed as a tilted U-shaped part having two mutually parallel radial limbs. One of the limbs carries an objective for concentrating a radiation beam to form a radiation spot and the other limb carries a permanent magnet for producing a magnetic bias field. The objective and the magnet are arranged opposite one another and are each situated at one side of the disc which is supported by the turntable.

The information carrier to be used for magneto-optical recording is provided with a thin film of a ferromagnetic or ferrimagnetic material having a direction of easy magnetisation perpendicular to the surface of the thin film. During recording it is necessary that the thin film is heated to a temperature above the Curie temperature, or in the case of ferrimagnetic materials to a temperature above the so-called compensation point. When the prior-art device is used the magneto-optical disc is inscribed by applying a magnetic bias field by means of the permanent magnet and by heating the thin film by means of a pulsed laser beam.

It is an object of the invention to provide a device of the type defined in the opening paragraph, enabling a magneto-optical information carrier to be inscribed with the aid of a pulsating magnetic field in such a way that a comparatively large amount of information can be recorded per unit of time.

To this end the device in accordance with the invention is characterized as defined in the respective second portion of independent claims 1 to 3.

During operation of the device in accordance with the invention the ferromagnetic or ferrimagnetic film of the information carrier is heated locally with the aid of a continuous-wave or a pulsed laser beam. By driving the coil in conformity with the information to be recorded a desired pulsating magnetic field is produced at the location of the information carrier heated by the laser beam. Since the invention in particular aims at recording a large amount of information per unit of time, for example 6 kbytes/s, the magnetic flux produced by the coil is required to have only a comparatively small maximum value, so that the generated magnetic field is comparatively small. However, owing the presence of the further actuator, it is possible for the coil, even in the case of a rapidly rotating information carrier, for example 300 r.p.m., to be kept accurately at a predetermined distance from the information-carrier side which faces the magnetic unit. This ensures that the pulsating magnetic field produced by the coil is sufficiently strong at the location of the radiation spot formed by the objective. The information recorded by means of the device in accordance with the invention is read optically utilising the Kerr effect.

It is to be noted that it is known per se from European Patent Application EP 0,242,837 (herewith incorporated by reference) to use a coil secured to a support as a magnetic unit in a magneto-optical apparatus.

An embodiment of the device in accordance with the invention is characterized in that the measurement and control system comprises two optical detectors for cooperation with a reflecting surface of the information carrier, which detectors comprise a light source and at least one photocell. An advantage of the use of the optical detectors is that the measurement process is without mechanical contact, whilst in addition no magnetic or electric fields are produced which may adversely affect the magneto-optical recording process.

Another embodiment is characterized in that the measurement and control system comprises a capacitive detector for cooperation with an electrically conductive layer of the information carrier, which detector comprises at least one electrode. An advantage of this embodiment is that said distance can be determined without mechanical contact and independently of the reflection coefficient of the information-carrier side facing the magnetic unit. The electrically conductive layer may be situated on or in the information carrier. Magneto-optical information carriers, in particular discs, which have an internal electrically conductive layer of aluminium are known per se. In this respect reference is made to the article "Digital magneto-optic disk drive", T. Deguchi c.s., Applied Optics, Vol. 23, No. 22, 15 November 1984, pp. 3972-3978.

An embodiment, in which the distance between the reference surface of the magnetic unit and the of the information-carrier surface is determined mechanically, is characterized in that the measurement control system comprises a mechanical detector for cooperation with an information-carrier surface, which detector comprises a slip contact. This enables the position of the coil to be controlled in a purely mechanical way during operation of the device. A further advantage of the use of the mechanical detector is that no requirements have to be imposed on the re-

flectivity or the electrical conductivity of the information carrier.

Detection of the distance between coil and surface of the recording medium is known from JP-A-1-55 766. But there is no disclosure of details of the detectors as they are claimed in the independent claims of this application.

Another embodiment, employing a mechanical detector, is characterized in that the measurement and control system comprises an optical sensor for determining the excursion of the slip contact. This has the advantage that only a low contact pressure is required between the slip contact and the cooperating surface of the information carrier.

A further embodiment is characterized in that the measurement and control system comprises a sensor for determining the position of the objective relative to the frame. An advantage of this embodiment is that by means of the servo-system thus formed the position of the coil during operation is controlled completely independently of the properties of the rotating information carrier.

An embodiment which counteracts the influence of undesired magnetic fields is characterized in that the magnetic unit is provided with a magnetically shielding plate which extends between the further actuator and the coil. Suitably, a plate made of μ-metal can be used for this purpose.

The invention will now be described in more detail, by way of example, with reference to the accompanying drawings in which:

Fig. 1 is a diagrammatic side view of a first embodiment of the device in accordance with the invention,

Fig. 2 is a plan view of the embodiment shown in Fig. 1,

Fig. 3 is a sectional view taken on the line III-III in Fig. 1,

Fig. 4 is a diagrammatic side view showing a part of a second embodiment of the device in accordance with the invention,

Fig. 4A is a side view showing a part of the second embodiment,

Fig. 4B is a plan view of the part shown in Fig.4A,

Fig. 5 is a diagrammatic side view showing a part of a third embodiment of the device in accordance with the invention,

Fig. 6 is a diagrammatic side view of a fourth embodiment of the device in accordance with the invention,

Fig. 7 is a plan view of the embodiment shown in Fig. 6,

Fig. 8 shows diagrammatically the measurement and control system employed in the fourth embodiment,

Fig. 9 is a diagrammatic cross-sectional view showing a part of a fifth embodiment of the device in accordance with the invention,

Fig. 10 shows diagrammatically the measurement and control system used in the fifth embodiment,

Fig. 11 is a diagrammatic longitudinal sectional view showing a part of a sixth embodiment of the device in accordance with the invention,

Fig. 12 shows diagrammatically the measurement and control system used in the sixth embodiment,

Fig. 13 is a diagrammatic longitudinal sectional view of a part of a seventh embodiment of the device in accordance with the invention,

Fig. 14 shows diagrammatically the measurement and control system employed in the seventh embodiment,

Fig. 15 shows diagrammatically a part of an eighth embodiment of the device in accordance with the invention,

Fig. 16 shows diagrammatically a part of a ninth embodiment of the device in accordance with the invention,

Fig. 17 is a diagrammatic longitudinal sectional view showing a part of a tenth embodiment of the device in accordance with the invention, and

Fig. 18 shows diagrammatically the measurement and control system employed in the tenth embodiment.

The device in accordance with the invention shown in Figs. 1, 2 and 3 comprises a frame 1 and a pivotable sub-frame 3. A turntable 5 for supporting and centring a disc-shaped magneto-optical information carrier 7 is arranged in the frame 1. For this purpose the turntable 5 comprises a supporting surface 5a and a centring cone, not shown. An electric motor 9 secured in the frame 1 serves to rotate the turntable 5 about an axis of rotation 11, a speed of for example 2400 revolutions per minute being attainable. Two guide spindles 13 and 5 are arranged on the frame 1 to form rectilinear guide means for a slide 17. The guide spindles 13 and 15 extend parallel to one another and are oriented in such a way that the slide 17 can perform a radial movement relative to the axis of rotation 11 between a position near the turntable and a position remoter from the turntable. The slide 17 carries an optical unit 19, comprising an optical lens or objective 21 having an optical axis 23 and an electromagnetic actuator for driving the objective 21. The electromagnetic actuator may be of a type as is disclosed in European Patent Application 0,268,311 (PHN 11.896). The objective 21 serves for focusing a radiation beam from a radiation source, not shown, for example a laser, to form a radiation spot in the information plane of the information carrier 7. The radiation source may be situated on the slide 17 or elsewhere, for example on the frame 1. During operation the slide 17 is driven by a linear motor 25, comprising a stator 27 and a movable armature 29. The stator 27 comprises central stator plates 31 and end plates 32

with magnets 33 and is secured to the frame 1. The armature 29 comprises armature coils 35 and is secured to the slide 17. The linear motor 25 may be constructed as a stepping motor. If the motor is not constructed as a stepping motor, as in the present embodiment, the device may comprise an optical ruler 37 secured to the stator 27 and a set of optical emitters and receivers 39 cooperating with said rulers and secured to the armature 29 to detect the position of the slide 17.

The sub-frame 3 is pivotable about a pivotal axis 43 defined by a shaft 45 having two journals 47 and 49 which are supported in the frame 1. The shaft 45 is secured to the sub-frame 3, which comprises two guide spindles 53 and 55 which extend parallel to one another and which are secured to a connecting member 51 of the sub-frame 3. The guide spindles 53 and 55, which extend parallel to the guide spindles 13 and 15 of the frame 1 in the position shown, which corresponds to the operating position, provide the rectilinear guidance for a slide 57. The slide 57 carries a magnetic unit 59, comprising means for generating a magnetic field which extends into the information plane of the information carrier 7. Such means may comprise a permanent magnet or an induction coil. The magnetic unit may further comprise an electromagnetic actuator for moving said means in a direction perpendicular to the information carrier 7. The magnetic unit 59, to which a magnetic axis 63 can be assigned, is situated opposite to and is spaced from the optical unit 19. The information carrier 7 is situated between the optical unit 19 and the magnetic unit 59, and at least during operation it is important that the optical axis 23 and the magnetic axis 63 are disposed in line with one another. In order to achieve this, the device comprises coupling means for coupling the slides 17 and 57 to one another. In the present embodiment the coupling means comprise a banana-shaped member 61 secured to the slide 17 and a stop 65 arranged on the slide 57 to cooperate with said member. The member 61 is secured to the slide via a slide portion 57 which extends in a radial direction. The stop 65 is constituted by the inner bounding wall of an opening 69 formed in a slide member 71 which extends in a radial direction and which is secured to the slide 57. Relative to the member 61 the opening 69 is dimensioned so as to allow pivotal movements of the sub-frame 3 in directions indicated by the double arrow A.

At the location of the connecting member 51 the sub-frame carries a disc-pressure member 73 for pressing the information carrier 7 onto the turntable 5. To enable the information carrier 7 to be placed on or removed from the turntable the disc-pressure member can be moved away from the turntable 5 by pivoting the sub-frame 3.

In the embodiments to be described hereinafter parts corresponding to those in the first embodiment bear the same reference numerals.

The part of the second embodiment shown in Fig. 4 comprises a slide 17 carrying an optical unit 19 and a slide 57 carrying a magnetic unit 59. The slides 17 and 57 each comprise separate rectilinear guide means, whose respective guide spindles 15 and 55 are shown. The construction of the optical unit 19 and the magnetic unit 59 may correspond to the construction of the relevant units of the device shown in Figs. 1, 2 and 3. The slide 17 can be driven by a stepping motor or otherwise. The slides 17 and 57 are coupled to each other by means of a hinge construction 75, which has one side connected to a slide member 67 of the slide 17 and its other side to the slide 57. The hinge construction 75 comprises a central elongate portion 77, two end portions 79 and 81, and two pairs of elastic hinges 83A, 83B and 85A, 85B, extending between the parts 77 and 79 and between the parts 77 and 81 respectively. The hinges 83A and 85A have a hinge axis which is oriented transversely of the optical axis of the optical unit 19 and transversely of the direction of movement X of the two slides. The hinges 83B and 85B each have a hinge axis parallel to said optical axis 23. The hinge construction 75 allows a pivotal movement of the slide 57 relative to the slide 17 and is sufficiently rigid in the X direction to guarantee an accurately defined coupling between the two slides 17 and 57.

The part of the third embodiment of the device in accordance with the invention shown in Fig. 5, like the preceding embodiments, comprises a frame and a sub-frame which is secured to the relevant frame so as to be translatable or pivotable. The device comprises a slide 17 carrying an optical unit 19 and a slide 57 carrying a magnetic unit 59. Both slides are moved over rectilinear guide means, bearing the reference numerals 13, 15 and 53, 55, parallel to an information carrier 7 which extends between the two units 19 and 59. An electric motor 87 secured to the frame provides the drive for the two slides 17 and 57. The motor 87 comprises a motor shaft 88, which cooperates with a transmission mechanism 59, for example a worm wheel and gear wheel transmission which cooperates with a drive shaft 91. At each end the drive shaft 91, which extends parallel to the optical axis 23 of the optical unit 19, carries a pinion 93 and 95 respectively. The slide 17 is provided with a gear rack 97 which extends in the driving direction X and the slide 57 is provided with a gear rack 99 which extends parallel thereto. Since the gear rack 97 cooperates with the pinion 93 and the gear rack 99 cooperates with the pinion 95, the slides 17 and 57 can be moved concurrently and synchronously by one motor, so that the desired radial position of the optical unit 19 and the magnetic unit 59 relative to one another is guaranteed during operation.

The fourth embodiment of the device in accordance with the invention shown in Figs. 6 and 7 com-

prises a frame 1 comprising two parallel guide spindles, of which only one spindle, bearing the reference numeral 15, is shown, and a pivotable sub-frame 3 comprising two guide spindles 53 and 55, which engage against a stop element 56 of the frame 1 during operation. The guide spindles of the frame 1 serve for guiding and supporting a slide 17 and the guide spindles 53 and 55 serve for guiding and supporting a slide 57. The slide 17 carries an optical unit 19 comprising an objective 21 having an optical axis 23 and an electro-magnetic actuator for moving the objective along the optical axis 23. A magnetic unit 59 having a magnetic axis 63 is suspended from the slide 57. A turntable 5, which is supported in the frame 1, carries a magneto-optical information carrier 7 at least during operation. The slides 17 and 57 are driven in radial directions independently of one another. For this purpose each slide is coupled to a linear motor 101 and 103 respectively. Both motors 101 and 103 each comprise a stator, having a magnet 105 and a stator yoke 107, and an armature, having one or more coils 109. For the purpose of position detection one of the two motors, for example the linear motor 101 is provided with an incremental measurement ruler 111 and an optical sensor which cooperates therewith. In order to guarantee an optimum cooperation between the optical unit 19 and the magnetic unit 59 during recording on the magneto-optical information carrier 7 the device comprises a measurement and control system for positioning the optical unit and the magnetic unit relative to one another at least during operation. The measurement and control system comprises an optical distance meter (opto-coupler) 113 arranged on a slide member 67 of the slide 17 and a reflecting surface 117 arranged on a slide member 71 of the slide 57. The optical distance meter 113 is arranged opposite the reflecting surface 117 and is connected to an electronic control unit.

The measurement and control system employed in the device shown in Figs. 6 and 7 will be described in more detail with reference to Fig. 8. A signal $\underline{a}$ from a player control system is applied to a controller I to establish the correct initial conditions such as bringing the reflecting surface within the measurement range of the opto-coupler after the device has been switched on. Moreover, a signal $\underline{b}$ corresponding to the desired slide position (set-point) is applied to the controller I. The optical distance meter 113 supplies a signal $\underline{c}$ to the controller I, the value of this signal being dependent on the distance from the reflecting surface 117. In the controller I the signal $\underline{c}$ is compared with the signal $\underline{b}$ the controller ensuring that the system has the desired stability and that the slides 17 and 57 are accurately in track with one another. The controller I supplies an output voltage Vu1 to an output amplifier II, which drives the coil 109 of the linear motor 117.

The part of the fifth embodiment of the device in accordance with the invention shown in Fig. 9 comprises a slide 17 carrying an optical unit 19 and a slide 57 carrying a magnetic unit 59. The two slides are guided similarly to those in the embodiments already described hereinbefore. Each slide is driven by a separate linear motor, 101 and 103 respectively, each motor being provided with an incremental measurement ruler 119 and 121 respectively and an optical detector 123 and 125 cooperating therewith. The optical detectors 123 and 125 each have two emitters at one side of the relevant optical incremental ruler and two receivers at the other side of the relevant ruler and are electronically coupled to one another by a microprocessor.

The measurement and control system of the device shown in Fig. 9 will be described in greater detail with reference to Fig. 10. The measurement and control system comprises two controllers III and IV, a player control system supplying a signal $\underline{d}$ related to the desired slide position to each of said controllers. A position-measurement unit represented by V and VI, is coupled to the controllers III and IV respectively. From the position-measurement unit V the controller III receives a signal $\underline{e}$ which is related to the actual position of the slide 17 and from the position-measurement unit VI the controller IV receives a signal $\underline{f}$ which is related to the actual position of the slide 57. The controllers III and IV provide the desired stability of the two parallel sub-systems and the desired tracking accuracy, the signals $\underline{d}$ and $\underline{e}$ being compared with one another in the controller III and the signals $\underline{d}$ and $\underline{f}$ being compared with one another in the controller IV. The controllers III and IV apply an output voltage Vu3 and Vu4 respectively to an output amplifier VII and VIII respectively. The output amplifier VIII energises the coil 102 of the linear motor 101 and the output amplifier VIII energises the coil 104 of the linear motor 103.

The embodiment of the device in accordance with the invention which, is shown in part in Fig. 11, is a modification of the device as shown in Figs. 1, 2 and 3 and, similarly to that described with reference to Figs. 1, 2 and 3, it comprises a frame, a sub-frame, a slide carrying an optical unit 19, and a slide 57 carrying a magnetic unit 59. For a comprehensive description of these parts of the device reference is therefore made to the paragraphs relating to Figs. 1, 2 and 3. Fig. 11 shows the objective 21 of the optical unit 19, which objective has an optical axis 23. The object 21 is arranged at the transparent side 7a of a magneto-optical disc 7, which is rotatable about an axis of rotation 11. The magneto-optical disc 7 comprises a composite information layer 7b. By means of the objective a radiation beam 127, which is directed to the objective, can be converged to form a radiation spot 128 in the information layer 7b. A magnetic unit 59 is arranged opposite the objective 21 at the other side of the optical information carrier 7. In the present

embodiment the magnetic unit comprises a coil 131, arranged on a support 129, and an electro-magnetic actuator 24 for moving the coil 131 in a direction parallel to the axis of rotation 11 of the turntable 5 (Fig. 1). The support 129 is suitably made of a ferrite and has a central portion 129a which is directed towards the objective 21 and which carries the coil 131. When the coil 131 is energised a magnetic field is produced such that the lines of field emerge from the central portion 129a and intersect the information layer 7b substantially perpendicularly. The actuator 24 comprises an axially magnetised magnet 139 arranged between magnetically conductive portions 135 and 137. The actuator 128 further comprises an actuator coil 141, which is secured to a coil holder 143 and which is axially movable in an annular air gap 145 bounded by the portions 135 and 137. The coil holder 143 is secured to an actuator spindle 147 whose end which is remote from the coil holder 143 is provided with a supporting element 149 to which the support 129 is secured. The actuator portions 135, 137 and 139 are secured directly to the slide 57 and the portions 141, 143, and 147 are together supported by two leaf springs 151 and 153 secured to the slide 57.

The device shown in Fig. 11 further comprises a measurement and control system for determining, during operation of the device, the distance between a reference plane of the magnetic unit 59, for example the side of the coil 131 or the central portion 129a facing the objective and bearing the reference R in the Figure, and the side 7c of the information carrier 7 facing the magnetic unit. The measurement and control system also serves for adjusting the desired position of the coil 131. The measurement and control system which is used comprises two juxtaposed optical detectors 155 and 157 which are secured to the supporting element 149 and together are situated adjacent the coil 131. The two optical detectors 155 and 157 together form an omitter for emitting an optical beam and two receivers for receiving the radiation reflected from the side 7c of the information carrier 7.

The measurement and control system used in the device shown in Fig. 11 will be described in greater detail with reference to the block diagram shown in Fig. 12. The emitter mentioned in the preceding paragraph bears the reference numeral 161 and the two receivers bear the reference numerals 163 and 165. The receiver 163 is a reference diode and the receiver 165 is a measurement diode. The magneto-optical information carrier bears the reference numeral 7. A reference current g from the reference diode 163 and a measurement current h from the measurement diode 165 are applied to a unit IX. The unit IX supplies a normalised signal $\underline{i}$, which is applied to a controller X. A signal $\underline{j}$ which is related to the desired position of the coil 131, is applied to the controller X by a player control system. The controller X provides the desired stability of the system and controls the desired distance from the optical disc 7, the signals $\underline{i}$ and $\underline{j}$ being compared with one another in the controller X. The controller X supplies an output voltage Vu10 to an output amplifier XI. The coil 141 of the actuator 24 is energised by the output amplifier XI.

The embodiment of the device in accordance with the invention, which is shown in part in Fig. 13, is also a modification of the device as shown in Figs. 1, 2 and 3. The principal difference with the embodiment shown in Fig. 11 is that the present embodiment comprises a capacitive detector 171 instead of the optical detectors 155 and 157. The capacitive detector 171 comprises an electrically conductive ring, for example made of phosphor-bronze, and cooperates with a conductive layer 7b1, which may be one of the constituent layers of the information layer 7b. For the remainder the construction and mechanical operation of this embodiment may be similar to that shown in Fig. 11. For a more detailed description of this embodiment reference is made to the paragraphs relating to Fig. 11. The capacitive detector 171 forms part of a measurement and control system for determining, during operation of the device, the distance between a reference surface of the magnetic unit 59, for example the side of the coil 131 facing the objective 21 and bearing the reference R in the Figure, and the side 7c of the information carrier 7 facing the magnetic unit, the system also serving to control the desired position of the coil 131. The capacitive detector 171 is secured to the supporting element 149 of the actuator 24.

Fig. 14 shows the block diagram of the measurement and control system employed in the device shown in Fig. 13. In said Figure the capacitive detector has the reference numeral 171 and the conductive layer of the information carrier bears the numeral 7b1. The detector 171 supplies a measurement signal which is related to the actual position of the coil 131 and which is applied to a buffer amplifier 172 and subsequently rectified by a rectifier 174. The rectified measurement signal $\underline{k}$ is applied to a controller XII and in the controller XII it is compared with a signal $\underline{l}$ related to the desired position. The controller XII supplies an output voltage Vu12 and is electrically connected to an output amplifier XIII. The output amplifier XIII energises the coil 141 of the actuator 24.

Fig. 15 shows a part of a further embodiment of the invention. This embodiment is again a modification of the device as shown in Figs. 1, 2 and 3. The measurement and control system in the present embodiment comprises a mechanical detector 181 for cooperation with a peripheral surface 183 of the information carrier 7. The mechanical detector comprises a supporting arm 185 which is pivotally secured to the slide 57 and which carries a slip contact 187 which bears on the information carrier during operation. The supporting arm 185 carries the magnetic unit 59, which comprises a coil 131. During operation the slip

contact 187 follows the peripheral surface 183 of the rotating information carrier 7, to detect irregularities in this peripheral surface, which cause a pivotal movement of the supporting arm 185. The coil 131 of the magnetic unit 59, which coil is arranged on the supporting arm 185, follows the movements of the pivotal arm, thereby guaranteeing a predetermined distance between the coil 131 and the peripheral surface 7c of the information carrier 7.

The part of the ninth embodiment of the device in accordance with the invention shown in Fig. 16 is a modification of the part shown in Fig. 11. The present embodiment comprises an actuator 24, which may be of a construction similar to that of the actuator shown in Fig. 11. The actuator 24 is connected partly directly to the slide 57 and partly via two blade springs 151 and 153 and comprises an axially movable actuator shaft 157 with a supporting element 149. The supporting element carries a coil former 129, made of for example a ferrite, with a coil 131 for producing a magnetic field. The embodiment further comprises a mechanical detector 181, which is pivotally connected to the supporting element 149 and which is provided with a slip contact 187 which in operation engages with a peripheral surface 183 of a rotating information carrier 7. The mechanical detector 181 further comprises a supporting arm 185 having a reflecting surface 189. An optical sensor 191 secured to the supporting element 149 is arranged opposite the reflecting surface 189 to detect excursions of the slip contact 187. The optical sensor 191 forms part of a measurement and control system for controlling the desired position of the coil 131. The measurement and control system is comparable to the system shown in Fig. 12. Since the reflecting surface 181 can be uniquely defined it is not necessary to provide a reference diode.

Fig. 17 shows a part of the tenth embodiment of the device in accordance with the invention. This embodiment is another modification of the device as shown in Figs. 1, 2 and 3. The embodiment comprises a slide 17 carrying an optical unit 19 and a slide 57 carrying a magnetic unit 19. The slide 17 is supported in a frame corresponding to the frame of the device shown in Figs. 1, 2 and 3, and the slide 57 is supported in a pivotable sub-frame corresponding to the subframe 3 in the device shown in Figs. 1, 2 and 3. The magnetic unit 19 comprises an actuator which is similar to the actuator 24 of the device shown in Fig. 11. The actuator comprises a stationary section, which is secured directly to the slide 57, and a movable section, which is connected to the slide 57 by blade springs 151 and 153. The actuator 24 comprises an actuator spindle 157 which is movable along its longitudinal axis and which carries a magnetically shielding plate 193, suitably made of a μ-metal. The actuator spindle 147 further carries a ferrite coil former 129 with a coil 131 for generating a fluctuating magnetic field.

The optical unit 19 comprises an actuator 195, which comprises a stationary section, comprising with a permanent magnet 197 and a magnetic yoke 199, and a movable section, comprising with a focusing coil 201 and tracking coils 203. The movable section of the actuator 195 further comprises a supporting member 205, in which an objective 21 having an optical axis 23 is mounted. At its side which faces the magnetic unit 59 the optical unit 19 may be magnetically shielded by means of a μ-metal plate 207, which is for example disc-shaped or annular.

The device shown in Fig. 17 comprises a measurement and control system comprising a sensor 211 for detecting the position of the objective 21 relative to the frame 1. The sensor 211, which in the present example is an optical distance detector, is secured to the stationary section of the actuator 195 and cooperates with a reflecting surface 213 provided on the supporting member 205 of the movable part of the actuator 195, which member is movable along the optical axis 23. The stationary section of the actuator 24 or the directly adjoining part of the slide 57 carries a further sensor 215, in the present embodiment also an optical distance detector, which cooperates with a reflecting surface 217, which in the present example is provided on the blade spring 153, which is coupled to the movable part of the actuator 24.

The measurement and control system of the device shown in Fig. 17 will now be described in greater detail with reference to the block diagram shown in Fig. 18 and the part shown in Fig. 17. By means of a player control system, not shown, a specific routine is carried out during starting of the device. This routine may include inter alia that the objective 21 is set to a suitable focusing position and the magnetic unit 59 is briefly pressed against the information carrier 7 to be inscribed or to be read. The signal m from the player control system activates a memory XIV. Said sensors 211 and 215, which convert the distance from the reflecting surfaces 213 and 217 respectively into voltage signals n1 and n2, are connected to a controller XV and analog-to-digital converter XVI, which is coupled to the memory XIV, via adders A1, A2 and A3, in a manner as shown in the block diagram. The memory XIV is coupled to the controller XV as shown via the adders A1 and A2 and a digital-to-analog converter XVII. Moreover, a signal p, which is related to the desired value of the distance between the magnetic unit 51, in particular its reference surface R, and the magneto-optical information carrier 7, in particular its information surface 7b, is applied to the adder A1. The signal g from the adder A2 is applied to the controller XV, the controller XV ensuring that the system has the desired stability and said desired value is maintained accurately. The controller XV is connected to an output amplifier XVIII and has an output voltage Vu15. The output amplifier XVIII

drives the coil 141 (see Fig. 11) of the actuator 24 of the magnetic unit 59. This enables a measurement and control system to be realised which does not make use of the rotating information carrier 7.

Claims

1. A device for inscribing and/or reading a magneto-optical information carrier, comprising
   - a frame (1) carrying a turntable (5), which is rotatable about an axis of rotation (11), for supporting the information carrier,
   - an optical unit (19), comprising an objective (21) for concentrating a radiation beam to form at least one radiation spot in a focusing plane, and a first actuator (195) for moving the objective in a direction parallel to said axis of rotation,
   - a magnetic unit (59) which, viewed according to said axis of rotation, is arranged opposite to and spaced from the optical unit, the optical unit and the magnetic unit being arranged to be movable in a plane transverse to said axis of rotation, which magnetic unit is provided with means for generating a magnetic field which extends into said focusing plane, characterised in that said means comprise a coil (131) arranged on a support (129), the magnetic unit being further provided with a second actuator (24) for moving the coil in a direction parallel to the axis of rotation of the turntable,
   - a measurement and control system for determining, during operation of the device, the distance between a reference plane (R) of the magnetic unit and a peripheral surface of the information carrier and for controlling the position of the coil, which measurement and control system is electrically connected to the second actuator and comprises two optical detectors (155, 157) for cooperation with a reflecting surface of the information carrier, which detectors are secured to a support member (149) of the magnetic unit and form together an emitter for emitting an optical beam and two receivers for receiving radiation of the optical beam after reflecting by the reflecting surface.

2. A device for inscribing and/or reading a magneto-optical information carrier, comprising
   - a frame (1) carrying a turntable (5), which is rotatable about an axis of rotation (11), for supporting the information carrier,
   - an optical unit (19), comprising an objective (21) for concentrating a radiation beam to form at least one radiation spot in a focusing plane, and a first actuator (195) for moving the objective in a direction parallel to said axis of rotation,
   - a magnetic unit (59) which, viewed according to said axis of rotation, is arranged opposite to and spaced from the optical unit, the optical unit and the magnetic unit being arranged to be movable in a plane transverse to said axis of rotation, which magnetic unit is provided with means for generating a magnetic field which extends into said focusing plane, characterised in that said means comprise a coil (131) arranged on a support (129), the magnetic unit being further provided with a second actuator (24) for moving the coil in a direction parallel to the axis of rotation of the turntable,
   - a measurement and control system for determining, during operation of the device, the distance between a reference plane (R) of the magnetic unit and a peripheral surface of the information carrier and for controlling the position of the coil, which measurement and control system is electrically connected to the second actuator and comprises a capacitive detector (171) for cooperation with a conductive layer of the information carrier, which detector comprises at least one electrode secured to a supporting element (149) of the magnetic unit.

3. A device for inscribing and/or reading a magneto-optical information carrier, comprising
   - a frame (1) carrying a turntable (5), which is rotatable about an axis of rotation (11), for supporting the information carrier,
   - an optical unit (19), comprising an objective (21) for concentrating a radiation beam to form at least one radiation spot in a focusing plane, and a first actuator (195) for moving the objective in a direction parallel to said axis of rotation,
   - a magnetic unit (59) which, viewed according to said axis of rotation, is arranged opposite to and spaced from the optical unit, the optical unit and the magnetic unit being arranged to be movable in a plane transverse to said axis of rotation, which magnetic unit is provided with means for generating a magnetic field which extends into said focusing plane, characterised in that said means comprise a coil (131) arranged on a support (129), the magnetic unit being further provided with a second actuator (24) for moving the coil in a direction parallel to the axis of rotation of the turntable,
   - a measurement and control system for de-

* C L M S *

drives the coil 141 (see Fig. 11) of the actuator 24 of the magnetic unit 59. This enables a measurement and control system to be realised which does not make use of the rotating information carrier 7.

Claims

1. A device for inscribing and/or reading a magneto-optical information carrier, comprising
   - a frame (1) carrying a turntable (5), which is rotatable about an axis of rotation (11), for supporting the information carrier,
   - an optical unit (19), comprising an objective (21) for concentrating a radiation beam to form at least one radiation spot in a focusing plane, and a first actuator (195) for moving the objective in a direction parallel to said axis of rotation,
   - a magnetic unit (59) which, viewed according to said axis of rotation, is arranged opposite to and spaced from the optical unit, the optical unit and the magnetic unit being arranged to be movable in a plane transverse to said axis of rotation, which magnetic unit is provided with means for generating a magnetic field which extends into said focusing plane, characterised in that said means comprise a coil (131) arranged on a support (129), the magnetic unit being further provided with a second actuator (24) for moving the coil in a direction parallel to the axis of rotation of the turntable,
   - a measurement and control system for determining, during operation of the device, the distance between a reference plane (R) of the magnetic unit and a peripheral surface of the information carrier and for controlling the position of the coil, which measurement and control system is electrically connected to the second actuator and comprises two optical detectors (155, 157) for cooperation with a reflecting surface of the information carrier, which detectors are secured to a support member (149) of the magnetic unit and form together an emitter for emitting an optical beam and two receivers for receiving radiation of the optical beam after reflecting by the reflecting surface.

2. A device for inscribing and/or reading a magneto-optical information carrier, comprising
   - a frame (1) carrying a turntable (5), which is rotatable about an axis of rotation (11), for supporting the information carrier,
   - an optical unit (19), comprising an objective (21) for concentrating a radiation beam to form at least one radiation spot in a focusing plane, and a first actuator (195) for moving the objective in a direction parallel to said axis of rotation,
   - a magnetic unit (59) which, viewed according to said axis of rotation, is arranged opposite to and spaced from the optical unit, the optical unit and the magnetic unit being arranged to be movable in a plane transverse to said axis of rotation, which magnetic unit is provided with means for generating a magnetic field which extends into said focusing plane, characterised in that said means comprise a coil (131) arranged on a support (129), the magnetic unit being further provided with a second actuator (24) for moving the coil in a direction parallel to the axis of rotation of the turntable,
   - a measurement and control system for determining, during operation of the device, the distance between a reference plane (R) of the magnetic unit and a peripheral surface of the information carrier and for controlling the position of the coil, which measurement and control system is electrically connected to the second actuator and comprises a capacitive detector (171) for cooperation with a conductive layer of the information carrier, which detector comprises at least one electrode secured to a supporting element (149) of the magnetic unit.

3. A device for inscribing and/or reading a magneto-optical information carrier, comprising
   - a frame (1) carrying a turntable (5), which is rotatable about an axis of rotation (11), for supporting the information carrier,
   - an optical unit (19), comprising an objective (21) for concentrating a radiation beam to form at least one radiation spot in a focusing plane, and a first actuator (195) for moving the objective in a direction parallel to said axis of rotation,
   - a magnetic unit (59) which, viewed according to said axis of rotation, is arranged opposite to and spaced from the optical unit, the optical unit and the magnetic unit being arranged to be movable in a plane transverse to said axis of rotation, which magnetic unit is provided with means for generating a magnetic field which extends into said focusing plane, characterised in that said means comprise a coil (131) arranged on a support (129), the magnetic unit being further provided with a second actuator (24) for moving the coil in a direction parallel to the axis of rotation of the turntable,
   - a measurement and control system for de-

* C L M S *

termining, during operation of the device, the distance between a reference plane (R) of the magnetic unit and a peripheral surface of the information carrier and for controlling the position of the coil, which measurement and control system is electrically connected to the second actuator and comprises a mechanical detector (181) for cooperation with an information-carrier surface, which detector comprises a slip contact (187).

4. A device as claimed in Claim 3, wherein the mechanical detector (181) comprises a supporting arm (185) which carries the slip contact.

5. A device as claimed in Claim 4, wherein the supporting arm is pivotally secured to a supporting element and carries the magnetic unit.

6. A device as claimed in Claim 3, 4 of 5, wherein the measurement and control system comprises an optical sensor (191) for determining the excursion of the slip contact.

7. A device as claimed in any one of the preceding claims, characterized in that the measurement and control system comprises a sensor for determining the position of the objective relative to the frame.

8. A device as claimed in any one of the preceding Claims, wherein the magnetic unit is provided with a magnetically shielding plate which extends between the further actuator and the coil.

9. A device as claimed in Claim 8, wherein the magnetically shielding plate is made of a μ-metal.

Patentansprüche

1. Einrichtung zum Einschreiben und/oder Auslesen eines magnetooptischen Informationsträgers, mit
   - einem Gestell (1) mit einem um eine Drehungsachse (11) drehbaren Plattenteller (5) zum Auflegen des Informationstragers,
   - einer optischen Einheit (19), die mit einem Objektiv (21) zum Konzentrieren eines Strahlungsbündels zu mindestens einem Strahlungsflecken in einer Fokussierebene versehen ist, und mit einem ersten Betätigungselement (195) zum in einer Richtung parallel zu der Drehungsachse Verschieben des Objektivs und mit
   - einer, gemäß der genannten Drehungsachse gesehen, gegenüber und in einem Abstand von der optischen Einheit angeordneten magnetischen Einheit (59), wobei die optische Einheit und die magnetische Einheit derart vorgesehen sind, daß sie in einer Ebene quer zu der genannten Drehungsachse beweglich sind, wobei die magnetische Einheit mit Mitteln versehen ist zum Erzeugen eines sich bis in die genannte Fokussierebene erstreckenden Magnetfeldes, **dadurch gekennzeichnet**, daß die genannten Mittel eine auf einem Träger (129) angeordnete Spule (131) aufweisen, wobei die magnetische Einheit weiterhin mit einem zweiten Betätigungselement (24) versehen ist zum in einer Richtung parallel zu der Drehungsachse des Plattentellers Verschieben der Spule,
   - wobei ferner ein Meß- und Steuersystem vorgesehen ist zum im Betrieb der Einrichtung Ermitteln des Abstandes zwischen einer Bezugsebene (R) der magnetischen Einheit und einer Seitenfläche des Informationsträgers und zum Regeln der Lage der Spule, wobei dieses Meß- und Steuersystem mit dem zweiten Betätigungselement elektrisch verbunden ist und zwei optische Detekto ren (155, 157) aufweist zum Zusammenarbeiten mit einer reflektierenden Fläche des Informationsträgers, wobei diese Detektoren auf einem Träger (149) der magnetischen Einheit angeordnet sind undzusammen einen Sender bilden zum Senden eines optischen Strahles und zwei Empfänger vorgesehen sind zum Empfangen von Strahlung des optischen Strahles nach Reflexion an der reflektierenden Oberfläche.

2. Einrichtung zum Einschreiben und/oder Auslesen eines magnetooptischen Informationsträgers, mit
   - einem Gestell (1) mit einem um eine Drehungsachse (11) drehbaren Plattenteller (5) zum Auflegen des Informationsträgers,
   - einer optischen Einheit (19), die mit einem Objektiv (21) zum Konzentrieren eines Strahlungsbündels zu mindestens einem Strahlungsflecken in einer Fokussierebene versehen ist, und mit einem ersten Betätigungselement (195) zum in einer Richtung parallel zu der Drehungsachse Verschieben des Objektivs und mit
   - einer, gemäß der genannten Drehungsachse gesehen, gegenüber und in einem Abstand von der optischen Einheit angeordneten magnetischen Einheit (59), wobei die optische Einheit und die magnetische Einheit derart vorgesehen sind, daß sie in einer

* C L M S *

Ebene quer zu der genannten Drehungsachse beweglich sind, wobei die magnetische Einheit mit Mitteln versehen ist zum Erzeugen eines sich bis in die genannte Fokussierebene erstreckenden Magnetfeldes, dadurch gekennzeichnet, daß die genannten Mittel eine auf einem Träger (129) angeordnete Spule (131) aufweisen, wobei die magnetische Einheit weiterhin mit einem zweiten Betätigungselement (24) versehen ist zum in einer Richtung parallel zu der Drehungsachse des Plattentellers Verschieben der Spule,

- wobei ferner ein Meß- und Steuersystem vorgesehen ist zum im Betrieb der Einrichtung Ermitteln des Abstandes zwischen einer Bezugsebene (R) der magnetischen Einheit und einer Seitenfläche des Informationsträgers und zum Regeln der Lage der Spule, wobei dieses Meß- und Steuersystem mit dem zweiten Betätigungselement elektrisch verbunden ist und einen kapazitiven Detektor (171) aufweist zum Zusammenarbeiten mit einer leitenden Schicht des Informationsträgers, wobei dieser Detektor wenigstens eine Elektrode aufweist, die auf dem Träger (149) der magnetischen Einheit angeordnet ist.

3. Einrichtung zum Einschreiben und/oder Auslesen eines magnetooptischen Informationsträgers, mit
   - einem Gestell (1) mit einem um eine Drehungsachse (11) drehbaren Plattenteller (5) zum Auflegen des Informationsträgers,
   - einer optischen Einheit (19), die mit einem Objektiv (21) zum Konzentrieren eines Strahlungsbündels zu mindestens einem Strahlungsflecken in einer Fokussierebene versehen ist, und mit einem ersten Betätigungselement (195) zum in einer Richtung parallel zu der Drehungsachse Verschieben des Objektivs und mit
   - einer, gemäß der genannten Drehungsachse gesehen, gegenüber und in einem Abstand von der optischen Einheit angeordneten magnetischen Einheit (59), wobei die optische Einheit und die magnetische Einheit derart vorgesehen sind, daß sie in einer Ebene quer zu der genannten Drehungsachse beweglich sind, wobei die magnetische Einheit mit Mitteln versehen ist zum Erzeugen eines sich bis in die genannte Fokussierebene erstreckenden Magnetfeldes, dadurch gekennzeichnet, daß die genannten Mittel eine auf einem Träger (129) angeordnete Spule (131) aufweisen, wobei die magnetische Einheit weiterhin mit einem zweiten Betätigungselement (24) versehen ist zum in einer Richtung parallel zu der Drehungsachse des Plattentellers Verschieben der Spule,
   - wobei ferner ein Meß- und Steuersystem vorgesehen ist zum im Betrieb der Einrichtung Ermitteln des Abstandes zwischen einer Bezugsebene (R) der magnetischen Einheit und einer Seitenfläche des Informationsträgers und zum Regeln der Lage der Spule, wobei dieses Meß- und Steuersystem mit dem zweiten Betätigungselement elektrisch verbunden ist und einen mechanischen Detektor (181) aufweist zum Zusammenarbeiten mit einer Informationsträgerfläche, wobei dieser Detektor einen Schleifkontakt (187) aufweist.

4. Einrichtung nach Anspruch 3, wobei der mechanische Detektor (181) einen Tragarm (185) mit dem Schleifkontakt aufweist.

5. Einrichtung nach Anspruch 4, wobei der Tragarm schwenkbar auf einbem Tragelement vorgesehen ist und die magnetische Einheit trägt.

6. Einrichtung nach Anspruch 3, 4 oder 5, wobei das Meß- und Steuersystem einen optischen Sensor (191) aufweist zum Bestimmen der Verschiebung des Schleifkontaktes.

7. Einrichtung nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß das Meß- und Steuersystem einen Sensor aufweist zum Ermitteln der Lage des Objektivs gegenüber dem Gestell.

8. Einrichtung nach einem der vorstehenden Ansprüche, wobei die magnetische Einheit mit einer sich zwischen dem weiteren Betätigungselement und der Spule erstreckenden magnetisch abschirmenden Platte versehen ist.

9. Einrichtung nach Anspruch 8, wobei die magnetisch abschirmende Platte aus einem µ-Metall besteht.

Revendications

1. Dispositif pour l'enregistrement et/ou la lecture d'un support d'information magnéto-optique comprenant
   - un châssis (1) supportant une plaque rotative (5), qui peut tourner autour d'un axe de rotation (11) pour supporter le support d'information,
   - une unité optique (19) comprenant un ob-

* C L M S *

jectif (21) pour concentrer un faisceau de rayonnement afin de former au moins un spot de rayonnement dans un plan de focalisation, et un premier actionneur (195) pour déplacer l'objectif dans une direction parallèle audit axe de rotation,

- une unité magnétique (59) qui, vue selon ledit axe de rotation, est disposée vis-à-vis et de façon espacée de l'unité optique, l'unité optique et l'unité magnétique étant disposées de façon mobile dans un plan transversal audit axe de rotation, laquelle unité magnétique est munie de moyens pour engendrer un champ magnétique qui s'étend dans ledit plan de focalisation, caractérisée en ce que lesdits moyens comprennent une bobine (131) disposée sur un support (129), l'unité magnétique étant en outre munie d'un deuxième actionneur (24) pour déplacer la bobine dans une direction parallèle à l'axe de rotation de la plaque rotative,
- un système de commande et de mesure pour déterminer, lors du fonctionnement du dispositif, la distance comprise entre un plan de référence (R) de l'unité magnétique et une surface périphérique du support d'information et pour commander la position de la bobine, lequel système de commande et de mesure est connecté électriquement au deuxième actionneur et est muni de deux détecteurs optiques (155, 157) pour la coopération avec une surface réflectrice du support d'information, lesquels détecteurs sont fixés à un élément de support (149) de l'unité magnétique et constituent ensemble un émetteur pour émettre un faisceau optique et deux récepteurs pour recevoir le rayonnement du faisceau optique après réflexion par les surfaces réflectrices.

2. Dispositif pour l'enregistrement et/ou la lecture d'un support d'information magnéto-optique, comprenant

- un châssis (1) supportant une plaque rotative (5), qui peut tourner autour d'un axe de rotation (11) pour supporter le support d'information,
- une unité optique (19) comprenant un objectif (21) pour concentrer un faisceau de rayonnement afin de former au moins un spot de rayonnement dans un plan de focalisation, et un premier actionneur (195) pour déplacer l'objectif dans une direction parallèle audit axe de rotation,
- une unité magnétique (59) qui, vue selon ledit axe de rotation, est disposée vis-à-vis et de façon espacée de l'unité optique, l'unité optique et l'unité magnétique étant disposées de façon mobile dans un plan transversal audit axe de rotation, laquelle unité magnétique est munie de moyens pour engendrer un champ magnétique qui s'étend dans ledit plan de focalisation, caractérisé en ce que lesdits moyens comprennent une bobine (131) disposée sur un support (129), l'unité magnétique étant en outre munie d'un deuxième actionneur (24) pour déplacer la bobine dans une direction parallèle à l'axe de rotation de la plaque rotative,
- un système de commande et de mesure pour déterminer, lors du fonctionnement du dispositif, la distance comprise entre un plan de référence (R) de l'unité magnétique et une surface périphérique du support d'information et pour commander la position de la bobine, lequel système de commande et de mesure est connecté électriquement au deuxième actionneur et est muni d'un détecteur capacitif (171) pour la coopération avec une couche conductrice du support d'information, lequel détecteur est muni d'au moins une électrode fixée à un élément de support (149) de l'unité magnétique.

3. Dispositif pour l'enregistrement et/ou la lecture d'un support d'information magnéto-optique comprenant

- un châssis (1) supportant une plaque rotative (5), qui peut tourner autour d'un axe de rotation (11) pour supporter le support d'information,
- une unité optique (19) comprenant un objectif (21) pour concentrer un faisceau de rayonnement afin de former au moins un spot de rayonnement dans un plan de focalisation et un premier actionneur (195) pour déplacer l'objectif dans une direction parallèle audit axe de rotation,
- une unité magnétique (59) qui, vue selon ledit axe de rotation, est disposée vis-à-vis et de façon espacée de l'unité optique, l'unité optique et l'unité magnétique étant disposées de façon mobile dans un plan transversal audit axe de rotation, laquelle unité magnétique est munie de moyens pour engendrer un champ magnétique qui s'étend dans ledit plan de focalisation, caractérisée en ce que lesdits moyens comprennent une bobine (131) disposée sur un support (129), l'unité magnétique étant en outre munie d'un deuxième actionneur (24) pour déplacer la bobine dans une direction parallèle à l'axe de rotation de la plaque rotative,
- un système de commande et de mesure pour déterminer, lors du fonctionnement du

* C L M S *

dispositif, la distance comprise entre un plan de référence (R) de l'unité magnétique et une surface périphérique du support d'information et pour commander la position de la bobine, lequel système de commande et de mesure est connecté électriquement au deuxième actionneur et est muni d'un détecteur mécanique (181) pour la coopération avec une surface de support d'information, lequel détecteur est muni d'un contact glissant (187).

4. Dispositif selon la revendication 3, dans lequel le détecteur mécanique (181) est muni d'un bras de support (185) qui supporte le contact glissant.

5. Dispositif selon la revendication 4, dans lequel le bras de support est fixé de façon à pouvoir pivoter à un élément de support et supporte l'unité magnétique.

6. Dispositif selon la revendication 3, 4 ou 5, dans lequel le système de commande et de mesure comprend un détecteur optique (191) pour déterminer l'excursion du contact glissant.

7. Dispositif selon l'une des revendications précédentes, caractérisé en ce que le système de commande et de mesure est muni d'un détecteur pour déterminer la position de l'objectif par rapport au châssis.

8. Dispositif selon l'une des revendications précédentes, dans lequel l'unité magnétique est munie d'une plaque de blindage magnétique qui s'étend entre l'autre actionneur et la bobine.

9. Dispositif selon la revendication 8, dans lequel la plaque de blindage magnétique est réalisée en métal μ.