The present invention relates to an optical scanning device which is equipped with a lens-holder, which is supported so as to be rotatable about an axle and on one end of which a lens is seated, which device is further equipped with two electrically conductive, elastic fastening elements which are fastened to a housing and via which at least one coil, which is arranged on the lens-holder, is supplied with current from a voltage source.

Optical scanning devices of this type are used, for example, in CD players, in order to be able to read the data of an optical compact disc, a so-called CD, by means of a light beam.

An objective lens, by means of which a light beam is focused onto the disc, is seated on a lens-holder which is supported so as to be rotatable about an axle, so that the objective lens can be moved in the radial direction with reference to the disc. In order that the objective lens can focus the light beam onto the disc, the lens-holder is movable in the direction of the optical axis of the objective lens. The lens-holder is rotatably fastened to a housing which can be moved in the radial direction with reference to the disc. It is, for example, known to place the housing on a spindle so that it can be moved over the data tracks of the disc by rotating the spindle in the radial direction. This mechanism, mostly referred to as coarse drive, is used for the purpose of being able to position the objective lens over any desired data track of the disc. By means of the already mentioned rotational movement of the lens-holder relative to the housing, the objective lens can be positioned more accurately or more finely over the data tracks. This is therefore referred to as the so-called fine drive.

The vertical movement along the optical axis of the objective lens and the rotational movement of the lens-holder are effected by means of coils which are arranged either on the housing, on the lens-holder or on both parts. As a mating piece for the coils, magnets

are mostly provided in order to achieve a magnetic force effect between the coils and the magnets.

A plurality of requirements are simultaneously placed on an optical scanning device of this type: in order that small magnetic forces already effect a lifting and a rotational movement of the objective lens, the lens-holder should have a low mass and should be easily rotatable and movable up and down.

If the coils are seated on the movable lens-holder, electrical wires must be provided as feed lines. However, these wires not only increase the weight of the lens-holder but they also increase the mechanical resistance with respect to the rotational and lifting movements of the lens-holder, since they restrict its mobility. Finally, the optical scanning device should be able to be mass-produced as cost-effectively as possible.

EP-A-0 287 235 discloses, according to the introductory part of Claim 1, an optical scanning device having a lens-holder which is fastened to a housing by means of two arms. In order to supply the coils, arranged on the lens-holder, with current, both arms are produced from electrically conductive material. The current supply to the coils is carried out via these two arms.

It is therefore the object of the invention to configure an optical scanning device having a lens-holder, which is rotatable about an axle and on one end of which a lens is seated, in such a way that it can be produced cost-effectively and that its lens-holder is distinguished by low mass and low mechanical friction.

The invention achieves this object in that the two ends of the axle are each supported in an electrically conductive manner in one of the two electrically conductive, elastic fastening elements, in that the two ends of the axle are electrically conductive but electrically insulated with respect to each other, in that the current flows from the voltage source to the coil via the upper fastening element and

the upper end of the axle and from the coil back to the voltage source via the lower end of the axle and the lower fastening element.

Figure 1 shows an exemplary embodiment of the invention in plan view

Figure 2 shows the exemplary embodiment from below

Figure 3 shows the exemplary embodiment in side view.

The invention will now be explained with reference to the exemplary embodiment shown in Figures 1, 2 and 3.

In Figure 1, the upper fastening element FO, which is designed, for example, as a leaf spring, has the shape of a bow. The limbs S of the bow-shaped upper leaf spring FO are fastened to a housing G. A conical bearing KO for a needle N, which is provided as an axis of rotation, is fitted in the centre of the handle GR of the upper leaf spring FO. Underneath the upper leaf spring FO there is located a lens-holder LH, on one end of which an objective lens L is seated. The lens-holder LH is rotatably supported, by means of the needle N, between the upper leaf spring FO and a lower leaf spring FU, which can be seen in Figure 2.

Two coils S1 and S2 are arranged at the other end of the lens-holder LH. A magnet M is fastened to the housing G, opposite the coils S1 and S2. On the upper side of the lens-holder LH, a conductor track LBO runs from the needle N to the two coils S1 and S2. A metal pin ST is arranged between the two coils S1 and S2.

Figure 2 shows the exemplary embodiment from below. The two limbs S of the lower leaf spring FU, provided as the lower fastening element, are likewise fastened to the housing G. A conical bearing KU for the needle N is provided in the centre of the handle GR of the lower leaf spring FU, just as in the case of the upper leaf spring FO. An earth connection is provided on one limb S of the lower leaf spring FU. On the

underside of the lens-holder LH, as on the upper side, an electric conductive track LBU leads from the needle N to the coils S1 and S2.

Figure 3 shows the exemplary embodiment in side view.

The upper leaf spring FO and the lower leaf spring FU are fastened to the housing G. The magnet M is arranged on the housing G between the fastening points of the two leaf springs FO and FU. The needle N, whose upper point SO is supported in the bearing KO of the upper leaf spring FO and whose lower point SU is supported in the bearing KU of the lower leaf spring FU, carries the lens-holder LH, on one end of which the objective lens L is seated and the other end of which, located opposite the magnet M, carries the coils S1 and S2.

The points SO and SU of the needle N are produced from electrically conductive material and are insulated with respect to each other by means of an insulator IS. Provided on the upper leaf spring FO or on the housing G is a connection for a voltage source U, from which the current flows to the coils S1 and S2 via the upper leaf spring FO, its bearing KO, the upper point SO of the needle N and the conductive track LBO on the upper side of the lens-holder LH. From the coils S1 and S2 the current flows to an earth connection, which is provided either on the lower leaf spring FU or at its fastening point to the housing G, via the conductive track LBU on the underside of the light-holder [sic] LH, the lower point SU of the needle N, the bearing KU of the lower leaf spring SU [sic] and of [sic] the lower leaf spring FU.

By applying current to the coils S1 and S2, the lens-holder LH can be rotated about the needle N as axis of rotation to the left or to the right, as a function of the current direction. The metal pin ST, which is arranged in the centre between the two coils S1 and S2, holds the lens-holder LH in a central position when the coils are current-free, since a force

effect occurs between the said pin and the magnet.

Since the upper and lower leaf springs FU and FO not only connect the lens-holder LH mechanically to the housing G but are simultaneously also used as an electrical line for the coil current, additional wires which increase the frictional resistance and the mass of the lens-holder LH are no longer required. The invention therefore fulfils the requirement of low mass and low friction.

Since the invention consists of only a few easily producible simple components, it can be produced easily and cost-effectively. Since the current supply of the coils is carried out via the fastening elements - the two leaf springs -, it is no longer necessary to solder wires to the movable lens-holder LH. Hence, the requirement of being easy to produce is also fulfilled.

Since elastic fastening elements - two leaf springs - are provided for fastening the lens-holder, the objective lens L can also be moved in the direction of its optical axis, in order to be able to focus the light beam onto the disc. The coils S1 and S2, arranged on one end of the lens-holder LH, can therefore be used, interacting with the magnet M, to rotate the lens-holder LH about the axle N, for track guidance, or to move the objective lens L along its optical axis, for focusing.

The arrangement shown in Figures 1, 2 and 3 is one exemplary embodiment. The shape of the elastic fastening elements is as arbitrary as the shape of the bearings. It matters only that the current for the coils flows via the bearings and the fastening elements, so that electrical feed lines are superfluous.

The invention is suitable for optical playback devices and magneto-optical recording and/or playback devices. CD players, DRAW-DISC players and videodisc players may be mentioned as examples.

* C L M S *

Patent Claims

1. Optical scanning device which is equipped with a lens-holder (LH), which is supported so as to be rotatable about an axle (N) and on one end of which a lens (L) is seated, which device is further equipped with two electrically conductive, elastic fastening elements (FO, FU) which are fastened to a housing (G) and via which at least one coil (S1, S2), which is arranged on the lens-holder (LH), is supplied with current from a voltage source (U), characterized in that the two ends (SO, SU) of the axle (N) are each supported in an electrically conductive manner in one of the two electrically conductive, elastic fastening elements (FO, FU), in that the two ends (SO, SU) of the axle (N) are electrically conductive but electrically insulated with respect to each other, in that the current flows from the voltage source (U) to the coil (S1, S2) via the upper fastening element (FO) and the upper end (SO) of the axle (N) and from the coil (S1, S2) back to the voltage source (U) via the lower end (SU) of the axle (N) and the lower fastening element (FU).

2. Optical scanning device according to Claim 1, characterized in that a needle (N) having two points (SO, SU) is provided as axle and in that a needle bearing (KO, KU) is provided in each case in the fastening elements (FO, FU), for supporting the needle (N).

3. Optical scanning device according to Claim 1 or 2, characterized in that two leaf springs (FO, FU) are provided as fastening elements.

4. Optical scanning device according to Claim 3, characterized in that the two leaf springs (FO, FU) are bow-shaped.

5. Optical scanning device according to Claim 4, characterized in that the two limbs (S) of the bow-shaped leaf springs (FO, FU) are fastened to the housing (G) and in that the bearings (KO, KU) for the axle (N) are provided in the centre of the handle (GR)

* C L M S *

of the two leaf springs (FO, FU).

6. Optical scanning device according to Claim 1, 2, 3, 4 or 5, characterized in that on the upper side of the lens-holder (LH) a first conductor track (LBO) leads from the axle (N) to a connection of the coil (S1, S2) and on the underside of the lens-holder (LH) a second conductor track (LBU) leads from the axle (N) to the other connection of the coil (S1, S2).

7. Optical scanning device according to Claim 1, 2, 3, 4, 5 or 6, characterized in that two coils (S1, S2) are arranged on that end of the lens-holder (LH) which is opposite the lens (L).

8. Optical scanning device according to Claim 1, 2, 3, 4, 5, 6 or 7, characterized in that a magnet (M) is fastened to the housing (G), opposite the coil or coils (S1, S2).

9. Optical scanning device according to Claim 8, characterized in that a pin (ST) of ferroelectric material is fastened to that end of the lens-holder (LH) which is opposite the lens (L) in such a way that, as a consequence of the magnetic force effect between the magnet (M) and the pin (ST), the lens-holder (LH) is held in a central position when the coils (S1, S2) are current-free.

10. Optical scanning device according to Claim 9, characterized in that a metal pin of circular cross-section is provided as pin (ST).

11. Optical scanning device according to Claim 9 or 10, characterized in that the pin (ST) is arranged between the two coils (S1, S2).