Description

The invention relates to an apparatus for recording and/or reading recording tracks in a recording surface of a disc by means of a scanning unit provided with an objective with an optical axis, which disc rotates about an axis of rotation during operation, the apparatus comprising a frame with a disc-supporting member which is rotatable about the axis of rotation, and a pivotal arm which supports the scanning unit and which is pivotable relative to the frame between two extreme pivotal positions about a pivotal axis parallel to the axis of rotation by means of electro-magnetic driving means comprising a coil having a coil axis parallel to the pivotal axis, and a magnetic body having magnetic poles, one of the driving means being carried by the pivotal arm and another driving means being supported by the frame.

Such an apparatus is disclosed in US-A-4,408,311 (herewith incorporated by reference). US-A-4,408,311 discloses an optical tracking device comprising a coil secured to a pivotal arm and two spaced-apart magnetic yokes each comprising a magnet. The coil which is movable in two air gaps formed by the yokes comprises two active coil sections which extend radially of the pivotal axis of the pivotal arm and make an angle of about 90° with each other. The magnetic field in one of said air gaps is oppositely directed with regard to the field in the other air gap. When the coil is energized the radial coil sections are subjected to two mutually perpendicular forces, producing a resultant force which exerts a moment of force on the pivotal arm so that this arm is pivoted. A drawback of this construction is that a transverse force is exerted on the supporting means of the pivotal arm, whereby the pivotal arm is subjected to a reactive force which may give rise to parasitic resonances in the frame, which may lead to instabilities in the tracking control system. Moreover, when the energising current is reversed, the coil may give rise to hysteresis effects in the control system, which inter alia lead to a bandwidth reduction.

In EP-A 0,074,131 (herewith incorporated by reference) an apparatus is shown which employs two coils which are arranged at opposite sides of and spaced from the pivotal axis and which cooperate with permanent magnets arranged opposite these coils. In principle, this apparatus performs satisfactorily but in view of the tendency to reduce the dimensions of such an apparatus it may be a drawback that such an arrangement of magnets and coils occupies a comparatively large amount of space. A further drawback is the requirement that the spindle about which the pivotal arm is pivoted should be robust enough to take up the obtaining transverse forces, which may also be in conflict with the miniaturisation of such a construction.

It is an object of the invention to provide an apparatus which does not have said drawbacks.

A first apparatus in accordance with the invention is characterized in that the coil is a substantially semi-circle coil provided with a straight or at least substantially straight active coil section substantially transversing the pivotal axis of the pivotal arm, which active coil section extends at least substantially transversely of and symmetrically relative to a connecting line between the optical axis of the objective and the pivotal axis, and which active coil section has ends interconnected by an inactive coil section which is disposed around and spaced from the pivotal axis and which is situated at that side of the pivotal axis which is remote from the objective, the active coil section facing at least one pair of permanent magnets of opposite polarities, one magnet of the pair of magnets being situated on a side of said connecting line, when the pivotal arm is in a central position midway between the two extreme positions, and also being directed towards said active coil section with a north pole and the other magnet being situated on another side of said connecting line with a south pole, whereby a torque is exerted on the pivotal arm when the active coil sections is energised.

The construction in accordance with the invention can be very compact, enabling an effective torque to be exerted on the pivotal arm over a comparatively large pivoting angle in such a way that transverse forces on the parts supporting the pivotal arm are at least substantially precluded.

It is to be noted that DE-A 27 44 223 (herewith incorporated by reference) discloses an apparatus which utilises a triangular coil arranged in such a way that one of the legs of this triangular coil is at least substantially concentric with the pivotal spindle of the pivotal arm and the two other legs extend at least substantially radially towards the pivotal axis from this concentric limb, however, when such a construction is utilised the supporting means of the pivotal arm will also be subjected to undesirable transverse forces. US-A 4,150,407 (herewith incorporated by reference) discloses a drive arrangement for a pivotal arm carrying magnetic heads. This known device, whose bandwidth need only be limited, comprises two stationary metal plates with magnets between which a coil is interposed, which coil is secured to the pivotal arm and comprises two substantially parallel active coil sections. This known arrangement enables a large resultant force for pivoting the pivotal arm to be obtained, but the arrangement has drawbacks similar to those of the known tracking device described above. JP-A 59-68846 (herewith incorporated by reference) discloses a pivotal-arm construction for

an optical player. In this known construction the pivotal arm is driven at a comparatively large distance from the pivotal axis by means of a drive arrangement comprising a stationary magnetic yoke and a coil, which is secured to the pivotal arm. As a result of the comparatively large distance between the coil and the pivotal axis this known construction exhibits hardly any relationship with the apparatus in accordance with the invention. Forest K. Harris Ph. D. "Electrical Measurements", John Wiley & Sons, Inc., page 45, 1952, New York, U.S. discloses a moving-magnet galvanometer and a moving-coil galvanometer.

Embodiments of the construction in accordance with the invention will now be described in more detail, by way of example, with reference to the accompanying diagrammatic drawings.

Fig. 1 is a diagrammatic plan view of an apparatus in accordance with the invention,

Fig. 2 is a diagrammatic cross-sectional view of a part of a pivotal arm with the coil supported by this arm and the parts supporting the pivotal arm.

Fig. 3 is a diagrammatic plan view of the arrangement of the magnets and the pivotal arm shown in Fig. 2.

Fig. 4 is a diagrammatic perspective view of the coil and magnet arrangement.

Fig. 5 is a partly sectional view of a second arrangement of a pivotal arm with magnets and coils.

Fig. 6 is a diagrammatic plan view of the pivotal arm with magnets and coils shown in Fig. 5.

As is shown diagrammatically the apparatus in accordance with the invention, which in the present example constitutes an optical audio disc player, comprises a frame 1 in which a supporting member 3 for an optical audio disc 4, in particular a Compact Disc, is journalled, which member is rotatable about a vertical axis of rotation 2. During operation the supporting member 3 can be rotated about its axis of rotation in known manner by drive means, not shown.

In operation the disc 4 can be read in a manner known per se by an optical scanning unit 5, wich is shown diagrammatically and which is arranged on an end portion of a pivotal arm 6. The scanning unit comprises an objective 55 having an optical axis 55A. During operation the pivotal arm 6 is pivotable about a pivotal axis 8 which coincides with the central axis of a spindle 7 which supports the arm. During operation the scanning unit is pivoted in the customary manner along an arc of circle A between two extreme pivotal positions B_1 and B_2 for recording and/or reading the recording tracks on the disc 4.

This pivotal movement of the pivotal arm is performed in a customary manner by means of pivoting elements comprising one or more coils, through which during operation a current is fed by suitable control means, and one or more permanent magnets. In the embodiment shown in Figs. 2 and 3 two journals 7' and 7" constituting the spindle 7 and two bearings 9 support the arm 6 in two mutually parallel supporting plates 10 which form part of the frame 1 and which comprise edge portions 11 bent towards each other and flanges 12 secured to each other.

A coil 13 is connected to the pivotal arm 6 and comprises a straight active first coil section 14 and an arcuate second coil section 15 interconnecting the ends of this straight coil section. The coil section 14 extends perpendicularly to the central axis of the pivotal arm 6,i.e. the connecting line between the pivotal axis 8 and the optical axis 55A of the objective 55. For this purpose, as is shown diagrammatically in Fig. 2, the coil 13 is arranged in a recess formed in the arm 6. At the side of the pivotal axis 8 which is remote from the optical scanning unit 5. the coil section 15 extends between the ends of the coil section 14 in such a way that it is at least substantially concentric with this pivotal axis 8. The coil section 15 may serve to a counterpoise the scanning unit 5.

Above and underneath the coil flat permanent magnets 16 and 17 are secured to the facing bounding surfaces of the supporting plates 10. with opposite polarities. As is shown in Figs. 2 and 3, the magnet plates 16 and 17 can be square or rectangular. Rectangular magnets have the advantage that a variable torque can be exerted on the arm, so that the loop gain in the control loop can be maintained constant. The magnets are arranged in such a way that the bounding line between these two magnets 16 and 17 at least substantially coincides with the longitudinal axis 6A of the pivotal arm in the central position of the pivotal arm, i.e. in the position midway between the two extreme pivotal positions B_1 and B_2.

Fig. 4 shows diagrammatically and in perspective the arrangement of the magnets and the coil described above, the magnets shown here not being rectangular to indicate that it is also possible to use magnets of different shape in the apparatus in accordance with the invention. As is further shown in this Figure, the metal supporting plates 10 serve as flux-linkage plates for the magnetic field, of each magnet pair, resulting in a short flux path, which promotes the magnet action and hence the efficiency of the apparatus. The path of the magnetic flux, is as indicated by the arrows in Fig 4.

It will be appreciated that when the coil 13 is energised a torque about the pivotal axis 8, as is indicated by means of the arrows K, will be exerted on the coil and consequently on the pivotal arm 6 connected to the coil, undesirable transverse forces

being substantially precluded.

Further to what has been stated above about the use of the rectangular magnets 16 and 17 in the apparatus in accordance with the invention, it is to be noted that in the centre position of the pivotal arm 6 the coil 13, which is connected to the pivotal arm 6, is less susceptible to the forces exerted on the coil by the magnetic field than, for example, in one extreme pivotal positions. This is advantageous for a correct control of the pivotal movement of the arm, because in the centre position of the pivotal arm the scanning unit moves between the tracks at least substantially perpendicularly to the longitudinal directions of the successive tracks, whilst in the extreme pivotal position the scanning unit moves between the tracks at an angle which differs from 90° relative to these tracks.

In the embodiment described with reference to Figs. 2 to 4 a magnet coil is secured to the pivotal arm 6 and permanent magnets are arranged at opposite sides of this magnet coil.

However, as is shown in Figs. 5 and 6, alternatively two flats permanent magnets 18 and 19 which are concentric with the pivotal axis 8 can be secured to the pivotal arm 6. As is evident in particular from Fig. 6, these permanent magnets 18 and 19 extend concentrically around the pivotal axis 8 over an angle slightly larger than 90°, at opposite sides of the longitudinal axis of the arm 6. Above and underneath the end of the arm 6 carrying the magnet plates 18 and 19 corresponding coils 20 and 21 are secured to the supporting plates 10. As is shown in Fig. 6, each coil comprises a first coil section 22, which extends transversely of the longitudinal axis of the pivotal arm 6, in such a way that this coil section 20 is diposed symmetrically relative to the longitudinal axis of the pivotal arm 6, in the central position of the pivotal arm. The ends of the coil section 22 are interconnected by a coil section 23 which is substantially concentric with the pivotal axis 8 and which is arranged at that side of the pivotal axis 8 which is remote from the optical scanning unit 5.

For reasons of constructional engineering it may be difficult to achieve that the coil section 22 which extends transversely of the longitudinal axis of the pivotal arm, viewed in the longitudinal direction of the pivotal axis 8, coincides with this axis, but the effect pursued by the invention is also obtained to a satisfactory extent if this coil section 22 is arranged at a small distance from the pivotal axis 8.

If will be evident that in the embodiment shown in Figs. 5 and 6 it is also possible to obtain a torque which effectively acts on the pivotal arm 6 substantially about the pivotal axis 8 if a current is fed through the coils 20 and 21. Another advantage of this embodiment is that no electrical conductors have to be coupled to the pivotal arm, because the coils are arranged on a supporting plate 10 which is stationary relative to the frame.

Claims

1. An apparatus for recording and/or reading recording tracks in a recording surface of a disc by means of a scanning unit (5) provided with an objective (55) with an optical axis (55A), which disc rotates about an axis of rotation (2) during operation, the apparatus comprising a frame (1) with a disc-supporting member (3) which is rotatable about the axis of rotation, and a pivotal arm (6) which supports the scanning unit and which is pivotable relative to the frame between two extreme pivotal positions (B1, B2) about a pivotal axis (8) parallel to the axis of rotation by means of electro-magnetic driving means comprising a coil (13) having a coil axis parallel to the pivotal axis, and a magnetic body having magnetic poles, one of the driving means being carried by the pivotal arm and another driving means being supported by the frame, characterized in that the coil is a substantially semi-circle coil provided with a straight or at least substantially straight active coil section (14) substantially transversing the pivotal axis of the pivotal arm, which active coil section extends at least substantially transversely of and symmetrically relative to a connecting line between the optical axis of the objective and the pivotal axis, and which active coil section (14) has ends interconnected by an inactive oil section (15) which is disposed around and spaced from the pivotal axis and which is situated at that side of the pivotal axis which is remote from the objective, the active coil section (14) facing at least one pair of permanent magnets (16, 17) of opposite polarities, one magnet of the pair of magnets being situated on a side of said connecting line, when the pivotal arm is in a central position midway between the two extreme positions, and also being directed towards said active coil section (14) with a north pole and the other magnet being situated on another side of said connecting line with a south pole, whereby a torque is exerted on the pivotal arm when the active coil sections (14) is energised.

2. An apparatus as claimed in Claim 1, characterized in that the magnetic body is provided with a further pair of permanent magnets, the active coil section being interposed between the two pairs of magnets, facing poles having opposite polarities.

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being substantially precluded.

Further to what has been stated above about the use of the rectangular magnets 16 and 17 in the apparatus in accordance with the invention, it is to be noted that in the centre position of the pivotal arm 6 the coil 13, which is connected to the pivotal arm 6, is less susceptible to the forces exerted on the coil by the magnetic field than. for example, in one extreme pivotal positions. This is advantageous for a correct control of the pivotal movement of the arm, because in the centre position of the pivotal arm the scanning unit moves between the tracks at least substantially perpendicularly to the longitudinal directions of the successive tracks, whilst in the extreme pivotal position the scanning unit moves between the tracks at an angle which differs from 90° relative to these tracks.

In the embodiment described with reference to Figs. 2 to 4 a magnet coil is secured to the pivotal arm 6 and permanent magnets are arranged at opposite sides of this magnet coil.

However, as is shown in Figs. 5 and 6, alternatively two flats permanent magnets 18 and 19 which are concentric with the pivotal axis 8 can be secured to the pivotal arm 6. As is evident in particular from Fig. 6, these permanent magnets 18 and 19 extend concentrically around the pivotal axis 8 over an angle slightly larger than 90° at opposite sides of the longitudinal axis of the arm 6. Above and underneath the end of the arm 6 carrying the magnet plates 18 and 19 corresponding coils 20 and 21 are secured to the supporting plates 10. As is shown in Fig. 6, each coil comprises a first coil section 22, which extends transversely of the longitudinal axis of the pivotal arm 6, in such a way that this coil section 20 is diposed symmetrically relative to the longitudinal axis of the pivotal arm 6, in the central position of the pivotal arm. The ends of the coil section 22 are interconnected by a coil section 23 which is substantially concentric with the pivotal axis 8 and which is arranged at that side of the pivotal axis 8 which is remote from the optical scanning unit 5.

For reasons of constructional engineering it may be difficult to achieve that the coil section 22 which extends transversely of the longitudinal axis of the pivotal arm, viewed in the longitudinal direction of the pivotal axis 8, coincides with this axis, but the effect pursued by the invention is also obtained to a satisfactory extent if this coil section 22 is arranged at a small distance from the pivotal axis 8.

If will be evident that in the embodiment shown in Figs. 5 and 6 it is also possible to obtain a torque which effectively acts on the pivotal arm 6 substantially about the pivotal axis 8 if a current is fed through the coils 20 and 21. Another advantage of this embodiment is that no electrical conductors have to be coupled to the pivotal arm, because the coils are arranged on a supporting plate 10 which is stationary relative to the frame.

Claims

1. An apparatus for recording and/or reading recording tracks in a recording surface of a disc by means of a scanning unit (5) provided with an objective (55) with an optical axis (55A), which disc rotates about an axis of rotation (2) during operation, the apparatus comprising a frame (1) with a disc-supporting member (3) which is rotatable about the axis of rotation, and a pivotal arm (6) which supports the scanning unit and which is pivotable relative to the frame between two extreme pivotal positions (B1, B2) about a pivotal axis (8) parallel to the axis of rotation by means of electro-magnetic driving means comprising a coil (13) having a coil axis parallel to the pivotal axis, and a magnetic body having magnetic poles, one of the driving means being carried by the pivotal arm and another driving means being supported by the frame, characterized in that the coil is a substantially semi-circle coil provided with a straight or at least substantially straight active coil section (14) substantially transversing the pivotal axis of the pivotal arm, which active coil section extends at least substantially transversely of and symmetrically relative to a connecting line between the optical axis of the objective and the pivotal axis, and which active coil section (14) has ends interconnected by an inactive oil section (15) which is disposed around and spaced from the pivotal axis and which is situated at that side of the pivotal axis which is remote from the objective, the active coil section (14) facing at least one pair of permanent magnets (16, 17) of opposite polarities, one magnet of the pair of magnets being situated on a side of said connecting line, when the pivotal arm is in a central position midway between the two extreme positions, and also being directed towards said active coil section (14) with a north pole and the other magnet being situated on another side of said connecting line with a south pole, whereby a torque is exerted on the pivotal arm when the active coil sections (14) is energised.

2. An apparatus as claimed in Claim 1, characterized in that the magnetic body is provided with a further pair of permanent magnets, the active coil section being interposed between the two pairs of magnets, facing poles having opposite polarities.

3. An apparatus as claimed in Claim 1 or 2, characterized in that the magnets (16, 17) are pairwise secured to plates (10) made of a magnetisable material.

4. An apparatus as claimed in Claim 3, characterized in that said plates (10) form part of the frame (1).

5. An apparatus as claimed in Claim 1, 2, 3 or 4, characterized in that the permanent magnets are rectangular.

6. An apparatus as claimed in Claim 1, characterized in that the magnets are secured to the pivotal arm, and are disposed concentrically around the pivotal axis and symmetrically relative to a longitudinal axis of the pivotal arm, and in that, viewed along the pivotal axis, a stationarily arranged active coil section is disposed at opposite sides of the pivotal arm.

7. An apparatus as claimed in Claim 6, characterized in that the magnets (18, 19) each extend over an angle of substantially 90°.

Patentansprüche

1. Gerät zum Aufzeichnen und/oder Auslesen von Aufzeichnungsspuren in einer Aufzeichnungsfläche einer scheibenförmigen Platte mittels einer Abtasteinheit (5) mit einem Objektiv (55) mit einer optischen Achse (55A), wobei diese scheibenförmige Platte sich im Betrieb um eine Drehungsachse (2) dreht, wobei dieses Gerät einen Rahmen (1) mit einem um die Drehungsachse drehbaren Plattenträgerelement (3) aufweist sowie einen Schwenkarm (6), der die Abtasteinheit trägt und gegenüber dem Rahmen zwischen zwei äußersten Schwenklagen (B1, B2) um eine Schwenkachse (8) parallel zu der Drehungsachse schwenkbar ist und zwar mittels elektromagnetischer Antriebsmittel mit einer Spule (13), deren Achse sich parallel zu der Schwenkachse erstreckt, und mit einem Magnetkörper mit Magnetpolen, wobei eines der Antriebsmittel von dem Schwenkarm getragen wird und ein anderes Antriebsmittel vom Rahmen unterstützt wird, dadurch gekennzeichnet, daß die Spule eine nahezu halbkreisförmige Spule ist mit einem geraden oder wenigstens nahezu geraden, die Schwenkachse des Schwenkarms im wesentlichen durchquerenden aktiven Spulenteil (14), der sich wenigstens im wesentlichen quer zu und symmetrisch zu einer Verbindungslinie zwischen der optischen Achse des Objektivs und der Schwenkachse erstreckt, und dessen Enden durch einen, um und in einem Abstand von der Schwenkachse vorgesehenen nicht aktiven Spulenteil (15) miteinander verbunden sind und an derjenigen Seite der Schwenkachse liegt, die von dem Objektiv abgewandt ist, wobei der aktive Spulenteil (14) wenigstens einem Paar Dauermagneten (16, 17) entgegengesetzter Polarität zugewandt ist, wobei der eine Magnet des Magnetpaares an einer Seite der genannten Verbindungslinie vorgesehen ist, wenn der Schwenkarm sich in einer zentralen Lage halbwegs zwischen den beiden äußersten Lagen befindet, und ebenfalls mit einem Nordpol dem genannten aktiven Spulenteil (14) zugewandt ist, und wobei der andere Magnet mit einem Südpol an einer anderen Seite der genannten Verbindungslinie liegt, wodurch auf den Schwenkarm ein Moment ausgeübt wird, wenn der aktive Spulenteil (14) erregt wird.

2. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß der Magnetkörper mit einem weiteren Paar Dauermagneten versehen ist, wobei der aktive Spulenteil zwischen den beiden Magnetpaaren liegt, wobei einander zugewandte Pole entgegengesetzter Polarität sind.

3. Gerät nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Magneten (16, 17) paarweise auf Platten (10) aus magnetisierbarem Material angeordnet sind.

4. Gerät nach Anspruch 3, dadurch gekennzeichnet, daß die genannten Platten (10) einen Teil des Rahmens (1) bilden.

5. Gerät nach Anspruch 1, 2, 3 oder 4, dadurch gekennzeichnet, daß die Dauermagneten rechtwinklig sind.

6. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß die Magneten auf dem Schwenkarm angeordnet und konzentrisch um die Schwenkachse und symmetrisch zu einer Längsachse des Schwenkarms vorgesehen sind, und daß, längs der Schwenkachse gesehen, auf je einer Seite da Schwenkarms ein ortsfest angeordneter aktiver Spulenteil vorgesehen ist.

7. Gerät nach Anspruch 6, dadurch gekennzeichnet, daß die Magneten (18, 19) sich über je einen Winkel von nahezu 90° erstrecken.

Revendications

1. Appareil pour enregistrer et/ou lire, au moyen d'une unité d'exploration (5) munie d'un objectif (55) ayant un axe optique (55A), des pistes

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dans une surface d'enregistrement d'un disque qui, en fonctionnement, tourne autour d'un axe de rotation (2), appareil comportant un châssis (1) muni d'un organe de support de disque (3) pouvant tourner autour de l'axe de rotation, et un bras pivotant (6) supportant l'unité d'exploration et qui, par rapport au châssis, peut être animé d'un mouvement pivotant autour d'un axe de pivotement (8) parallèle à l'axe de rotation, entre deux positions de pivotement extrême (B1, B2), par des moyens d'entraînement électromagnétiques comportant une bobine (13) ayant un axe de bobine parallèle à l'axe de pivotement et un corps magnétique ayant des pôles magnétiques, l'un des moyens d'entraînement étant supporté par le bras pivotant et l'autre moyen de pivotement étant supporté par le châssis, caractérisé en ce que la bobine est une bobine sensiblement semicirculaire comportant une partie de bobine active rectiligne (14) ou au moins pratiquement rectiligne située sensiblement en travers de l'axe de pivotement du bras pivotant, partie de bobine active qui s'étend au moins sensiblement transversalement et symétriquement par rapport à une ligne de jonction entre l'axe optique de l'objectif et l'axe de pivotement et qui a des extrémités reliées entre elles par une partie inactive de bobine (15) entourant l'axe de pivotement tout en étant séparée par une distance de celui-ci et qui est disposée du côté de l'axe de pivotement situé à l'opposé de l'objectif, la partie active de bobine (14) faisant face à au moins une paire d'aimants permanents (16, 17) de polarités opposées, l'un des aimants de la paire étant situé d'un côté de cette ligne de jonction lorsque le bras pivotant se trouve dans une position centrale, à mi-distance entre les deux positions extrêmes, et étant dirigé en outre par un pôle nord vers ladite partie active de bobine (14), tandis que l'autre aimant de la paire est situé par un pôle sud de l'autre côté de ladite ligne de jonction, de sorte que, lors de l'excitation des parties actives de bobine (14) un couple est exercé sur le bras pivotant.

2. Appareil selon la revendication 1, caractérisé en ce que le corps magnétique est pourvu d'une autre paire d'aimants permanents, la partie active de bobine étant interposée entre les deux paires d'aimants de façon que des pôles opposés ont des polarités opposées.

3. Appareil selon la revendication 1 ou 2, caractérisé en ce que les aimants (16, 17) sont fixés paire par paire à des plaques (10) en matériau aimantable.

4. Appareil selon la revendication 3, caractérisé en ce que lesdites plaques (10) font partie du châssis (1).

5. Appareil selon la revendication 1 2, 3 ou 4, caractérisé en ce que les aimants permanents sont rectangulaires.

6. Appareil selon la revendication 1, caractérisé en ce que les aimants sont fixés au bras pivotant et sont disposés concentriquement autour de l'axe de pivotement et symétriquement par rapport à un axe longitudinal du bras pivotant, et en ce que, vu suivant l'axe de pivotement, une partie active de bobine placée à demeure est disposée de part et d'autre du bras pivotant.

7. Appareil selon la revendication 6, caractérisé en ce que les aimants (18, 19) s'étendent chacun sur un angle de l'ordre de 90°.