Description

This invention is directed generally to the field of disc drives incorporating rotary actuators, and more particularly to an improved pivot support mechanism for the actuator arm.

Disc drives record and reproduce information stores on concentric circular tracks on magnetic discs. The tracks are written and read by magnetic heads which must be accurately positioned over a selected one of the tracks on the surface of the disc. Various methods have been used to position the heads and hold them precisely located over the selected track. The two commonly-used types of head positioning mechanisms are linear and rotary head actuators. DE-A-2812981 and JP-A-59/36379 disclosed examples of such head postioning arrangements.

In the second type, which this invention is directed to, the head moves generally radially in order to access the various disc tracks. However, the movement is usually along a segment of a circle. The commonly-known form of rotary actuator includes a head/arm flexure for supporting the transducer, the transducer or read/write head extending out from a pivot to the track position to be accessed. Extending from the pivot to essentially form a V-shaped actuator arm assembly with the head/arm is an actuator arm, which in turn is coupled to a stepper motor. As the stepper motor rotates, the actuator arm assembly rotates about the pivot point, moving the transducer from track to track. Obviously, a highly stable pivot at the end of the actuator arm distal from the stepper motor is absolutely required, so that with the wear caused by time and repeated usage, and the fluctuations caused by changes in operating temperature, the present position of the transducer relative to a target track and its long term stability over that track is not easily altered. The pivot mechanism must offer high precision, reliability and low mechanical resistance. Further, in the present price-conscious competition in the disc drive market, the pivot mechanism must be easily constructed and assembled.

The pivot mechanisms in the prior art generally include a shaft supporting the junction of the two arms, i.e. the actuator drive arm and the head arm, two ball bearings, and the required spring retainers preload springs and attachment means coupling the separate elements to the arms.

An object of the present invention is to provide a simple and highly-reliable pivot mechanism which still offers the required precision and reliability in positioning the transducer over a desired track on the disc which is provided by other more complex pivot mechanisms.

This invention provides a disc drive including a base casting and upright sidewalls defining a data storage device housing, a rotable disc supported on a spindle motor for constant rotation and having data stored in addressable locations on tracks thereon, and an actuator arm supporting a transducer for accessing said location on the disc where data can be stored, said actuator arm including an elongate first arm portion supported and extending from a pivot bearing point adjacent one of the upright sidewalls to contact a stepper motor supported from the base casting, and a second arm portion extending from the side of said first arm portion over said rotating disc; rotation of said stepper motor causing movement of said arm to position said transducer relative to said disc; said pivot bearing is mounted on said base casting at said pivot point on which the actuator arm is supported by a strip spring characterized in that said pivot bearing includes a beveled surface being in contact with said strip spring which includes first and second ends partially arranged around said bearing between said first and second ends and fastened at said ends to said actuator arm and having its top portion notching forward to bias an end of said first arm portion distal from said bearing assembly into firm contact with said stepper motor so that rotation of said stepper motor will be accurately reflected in movement of said arm.

More specifically the invention provides as the pivot bearing assembly the combination of a bearing surrounded on one side by a wishbone-shaped end of the actuator arm, and on the other side by a biasing spring metal strip whose ends are tightly attached to the split ends of the wishbone of the actuator arm. When the arm assembly is mounted in the disc drive, the bearing is mounted on its center of rotation, with the spring tensile force biasing the head of the actuator arm against the spindle of the stepper motor. By providing the distal end of the actuator arm with a gear sector having gear teeth on its face which mesh with a pinion on the motor shaft of the stepper motor, rotation of the motor shaft across the face of the gear sector causes movement of the actuator arm and with it the flexure and transducer across the surface of the disc. The head arm supporting the flexure and transducer extends from the side of the actuator drive arm at a point near the stepper motor driven end of the drive arm, reducing head arm length.

By adopting this embodiment, the normal bearing pivot assembly is eliminated. A low-cost, easily-assembled disc drive assembly is provided utilizing a minimum number of parts. Minimal off-tracking will occur with shock because of the spring force maintaining the engagement between the actuator arm and the stepper motor. Tooth wear of the gear sector or pinion will cause minimal off-track radially, since the wear causes mostly tangential motion of the head on the track in a further advantageous feature of this invention, the top portion of the spring strip is bent slightly to press against the top of the bearing which is the pivot center for the actuator arm. This imparts a downward force along the length of the actuator arm

so that the arm is pitched slightly downward toward the base at the distal end of the actuator arm. This prevents disengagement of the actuator arm from the stepper motor drive shaft with shocks.

The following is a description of some specific embodiment of the invention with reference to the accompanying drawings in which:

Fig. 1A is a top plan view of the disc drive, a disc drive base casting and actuator arm designed in accordance with this invention;

Fig. 1B is a perspective view of the arrangement of Figure 1A.

FIG 2 is an exploded view of the essential elements of the actuator arm of the present invention;

FIG 3 is a vertical sectional view of the base casting of the present invention;

FIG 4A is a view in section of the bearing housing of the present invention; and

FIG 4B is a plan view of an alternative embodiment of the actuator arm support.

Referring to FIGS 1A and 1B, the major components of a disc drive designed in accordance with the present invention are illustrated, including a housing 2 having a baseplate 4 and upright walls 6, 8, 10 and 12 which define the enclosed region where the rotating disc and actuator arm are positioned. The integral base casting for the base of this disc drive is shown in greater detail in FIG 3. The base casting includes a spindle motor mounting region 20, where the spindle motor is located and supported for rotating the disc on which the data is stored. The disc rotates in the open area indicated generally at 22, 24 where sufficient free space is defined to mount one or more discs for rotation while leaving an area in which air may flow freely over the surface of the disc.

Adjacent one of the sidewalls 4, an area 26 is defined where a stepper motor is located. The drive shaft of the stepper motor extends up through the drive shaft opening 28 to contact the distal portion of the actuator arm which will be described with respect to FIG 1. The step-by-step rotation of the stepper motor will cause movement of the actuator arm, the arm carrying a transducer which is thereby selectively positioned over the surface of the disc in the open region 22 to access the data on the surface of the rotating disc.

The above-described feature of the invention will be more apparent from FIG 1 which shows a top plan view of the storage disc 30 mounted within the housing 2 for rotation about the spindle 31. The actuator arm 32 which includes drive arm 38 and transducer support arm 44 supports the transducer 34 at the end of flexure 36. The arm 32 moves in response to selective stepwise rotation of the stepper motor 37. The actuator arm assembly 32, and specifically drive arm portion 38 extends from a pivot bearing mounting 40 to the drive shaft 42 of the stepper motor 37. The drive arm 38 supports, at one side thereof, extending toward the rotating disc, transducer support arm 44 to which the flexure 36 and transducer 34 are attached. As the drive arm 38 moves back and forth along the path generally described by the arrow 50, the transducer 34 is moved from track to track to access the defined data location.

The drive arm 38 pivots around a bearing generally indicated at 52 which will be described in detail below with reference to FIG 4. The movement of the drive arm 38 occurs in response to rotation of the stepper motor 37 which is mounted beneath the baseplate 4. The drive shaft 42 of the stepper motor 37 extends up through the baseplate 4. The motor drive shaft 26 has a pinion 54 machined thereon to mesh with gear teeth of rack 56 supported on the end of the actuator drive arm 38. Rotation of the shaft 42 causes the arm 38 to rotate generally along the radial path indicated by arrow 50 about the bearing pivot point 52 to move the transducer head 34 from track to track.

The details of the actuator arm including drive arm portion 38 and head arm portion 44 appear more clearly in FIG 2. As shown therein, the actuator arm is made of a lightweight metal or synthetic material, chosen so that the arm is flexible along its long axis, but provides significant strength against any rotation about its longest axis. The arm terminates in a general wishbone shape including arms 62, 64 which extend substantially perpendicular to the major axis of the arm and support the bearing spring 70. The arm 38 in a preferred embodiment is bimetallic, being formed of a combination, in a preferred embodiment, of aluminum for the major section 60 including one of the terminating arms 62, and invar or stainless steel for the other strip spring support arm 64. In this way, the metals are chosen so that the length of one side will grow or diminish faster than the other, causing a slight twisting effect of the arm about the axis of bearing 52 and along path 50, so that the thermal effect on the arm is approximately the same as the growth or diminution of the size of the rotating magnetic disc with temperature.

As has been explained above, the actuator arm 32 and especially drive arm portion 38 is supported at one end and rotates about a bearing 52. The bearing itself is supported from the base 4 as will be described in detail with respect to FIG 4A, and comprises a pair of compliant bearings 53, 54 which are preloaded inward essentially along the lines of force 55, 56 shown. The objective is to crease a very long effective axis. The bearing is preloaded by use of a screw 57. The use of this bearing design allows for possible misalignment of the rack 56 at the driven end of arm 32, and pinion 54 on stepper motor shaft 42. That is, the bearings are loaded on one side 58, and the other bottom side 59 is used for registration by resting on a shoulder 60 of the base casting 4 so that the alignment of the bearing 52 on the base casting

4 is always accurately defined.

The strip spring 70 loads the actuator arm 38, 44 in the direction of the arrow 72 (FIG 2) so that the gear sector face 56 is pressed tightly against the pinion 54 at all times. Small attachment holes 74 in the strip spring 70 together with clamps 76 and screws 78 attach the strip spring 70 tightly to the extended arms 62, 64 of the wishbone on the back of the actuator arm 38. The top portion 80 of the strip spring 70 is notched or beveled forward toward the actuator arm 38. In this way, a torque effect is provided along the long axis of the actuator arm 38 forcing the actuator arm slightly down toward the base 2 in the direction of the arrow 82 shown in FIG 2. Thus, the actuator arm is preloaded against the pinion 56 by strip spring 70, and will stay down against the pinion and will not unload or release from the pinion even in the event of major shock being applied to the disc drive, regardless of the direction of the shock.

The assembly of the actuator arm as a whole is easily accomplished as shown in FIG 2 by providing the rack 56 as a separate element to be screwed to the driven end of the drive arm portion 38 of the actuator arm using support plate 90, and screws 92.

The flexible strip 70 is fastened by the screws 78 to the ends of the arms 62, 64 at the supported end of the actuator arm structure. The spring is fastened tightly to the arm with the curved portion of the spring fastened tightly against the rear surface of the bearing 52, the bent portion 80 pressed against the beveled surface 94 of the bearing so that the spring force is exerted strongly along the axis of the actuator arm to press the pinion against the rack. The gear sector teeth 56 constantly remain in tight coupling transmission arrangement with the pinion 54 so that even with wear or shock, a tight connection continues to exist.

The range of travel of the actuator arm is limited by the crash stop 81 shown in FIG 4B. The stop comprises a plastic insert 82 with an opening for screw 83, and a metal cover 84 which is also held in place by screw 83 which prevents undue flexing of the plastic insert 81. An upright pin 85 on the plastic piece 82 contacts the sides of arm 38 to limit the travel of the arm.

As an alternative to the arm structure shown in FIG 2, the structure shown in FIG 4B may be adopted. In this approach, the actuator arm assembly terminates in two separate arms 100, 102, each formed of bimetallic portions 104, 106 forming one arm, and 108, 110 forming the other. The use of this approach allows for an even more flexible actuator arm which expresses considerable force along the axis 112 which runs the length of the actuator arm while providing the use of bimetallic construction to accomplish the goal of temperature compensation.

Claims

1. A disc drive including a base casting (4) and upright sidewalls (6, 8, 10, 12) defining a data storage device housing (21), a rotable disc (30) supported on a spindle motor for constant rotation and having data stored in addressable locations on tracks thereon, and an actuator arm (32) supporting a transducer (34) for accessing said location on the disc where data can be stored, said actuator arm including an elongate first arm portion (38) supported and extending from a pivot bearing point (52) adjacent one of the upright sidewalls to contact a stepper motor (37) supported from the base casting, and a second arm portion (44) extending from the side of said first arm portion over said rotating disc; rotation of said stepper motor causing movement of said arm to position said transducer relative to said disc; said pivot bearing (52) is mounted on said base casting at said pivot point on which the actuator arm is supported by a strip spring characterized in that said pivot bearing includes a beveled surface (94) being in contact with said strip spring (70) which includes first and second ends partially arranged around said bearing between said first and second ends and fastened at said ends to said actuator arm (38) and having its top portion (80) notching forward to bias an end of said first arm portion distal from said bearing assembly into firm contact with said stepper motor so that rotation of said stepper motor will be accurately reflected in movement of said arm.

2. A disc drive as claimed in claim 1 characterised in that said strip spring (70) includes a curved portion between said ends and surrounding the rear portion of said bearing assembly (52) and attached to said bearing assembly; said rear portion of said bearing assembly being the portion of said bearing assembly located opposite, relative to said pivot point, from said distal end of said first arm portion supported by said bearing assembly; whereby said actuator arm is supported between said bearing assembly and said stepper motor without said actuator arm being directly mounted on said bearing assembly.

3. A disc drive as claimed in claim 1, characterised in that said actuator arm terminates in a wishbone and comprising first and second arms (62, 64) of said wishbone end substantially perpendicular to a long axis of said actuator arm (38), ends of said first and second wishbone end arms being tightly connected to the ends of said strip (70) to support and bias said actuator arm against said stepper motor.

4. A disc drive as claimed in claim 3, characterised in that said actuator arm (38) consists primarily of a first type of metal having a first coefficient of thermal expansion and includes an actuator arm segment (64) of a second type of metal having a different coefficient of thermal expansion so that with changes in temperature said actuator arm shifts said transducer generally along or tangent to said tracks.

5. A disc drive as claimed in claim 4, characterised in that said first metal is aluminium and said second metal is invar.

6. A disc drive as claimed in claims 1 or 2, characterised in that said bearing assembly comprises a pair of axially spaced compliant preloaded bearings (53, 54) and having a lower side disposed adjacent said base casting (4) and a upper side disposed distal from said base casting, said bearing preload provided by a screw (57) having a threaded portion and a cap portion and rotatably movable along the axis of rotation of said bearings to adjust the preload force, said screw cap portion abutting said upper side of said bearing assembly to preload said bearing assembly on said upper side, said lower side of said bearing assembly providing a fixed registration surface which cooperates with a shoulder portion (60) fixedly attached to said base casting so that the positional alignment of said bearing assembly on said base casting is accurately defined.

7. A disc drive as claimed in claim 6, characterised in that said shoulder portion (60) is integral with said base casting (4).

Patentansprüche

1. Plattenantrieb mit einem Basisgußteil (4) und hochstehenden Seitenwänden (6, 8, 10, 12), die ein Datenspeichervorrichtungsgehäuse (21) bilden, mit einer in Drehung versetzbaren Platte (30), die auf einem Spindelmotor für eine konstante Rotation gelagert ist und auf der Daten in adressierbaren Positionen auf Spuren gespeichert sind, und mit einem Betätigungsarm (32), der einen Wandler (34) für den Zugang zu der Stelle auf der Platte trägt, wo Daten gespeichert werden können, wobei der Betätigungsarm einen langgestreckten ersten Armabschnitt, der sich von einem Schwenklagerpunkt (52) angrenzend an eine der hochstehenden Seitenwände erstreckt und davon gehalten wird, um einen von dem Basisgußteil getragenen Schrittmotor (37) zu kontaktieren, und einen zweiten Armabschnitt (44) aufweist, der sich von der Seite des ersten Armabschnitts aus über die sich drehende Platte erstreckt, die Drehung des Schrittmotors eine Bewegung des Arms verursacht, um den Wandler bezüglich der Platte zu positionieren, und das Schwenklager (52) auf dem Basisgußteil an dem Schwenkpunkt angebracht ist, an dem der Betätigungsarm durch eine Bandfeder gehalten ist, dadurch gekennzeichnet, daß das Schwenklager eine abgefaste Fläche (94) hat, die in Kontakt mit der Bandfeder (70) steht, welche ein erstes und ein zweites Ende, die teilweise um das Lager herum zwischen dem ersten und zweiten Ende angeordnet und an den Enden an dem Betätigungsarm (38) festgelegt sind und einen oberen, nach vorne eingekerbten Abschnitt (80) hat, um ein Ende des zur Lageranordnung distalen ersten Armabschnitts in einen festen Kontakt mit dem Schrittmotor vorzuspannen, so daß eine Drehung des Schrittmotors sich genau in eine Bewegung des Arms umsetzt.

2. Plattenantrieb nach Anspruch 1, dadurch gekennzeichnet, daß die Bandfeder (70) zwischen den Enden einen gekrümmten Abschnitt hat, der den hinteren Abschnitt der Lageranordnung (52) umgibt und an der Lageranordnung befestigt ist, wobei der hintere Abschnitt der Lageranordnung der Teil der Lageranordnung ist, der bezüglich des Schwenkpunkts zu dem distalen Ende des ersten Armabschnitts gegenüberliegend positioniert ist, welcher von der Lageranordnung gehalten wird, wodurch der Betätigungsarm zwischen der Lageranordnung und dem Schrittmotor gehalten ist, ohne daß der Betätigungsarm direkt an der Lageranordnung angebracht ist.

3. Plattenantrieb nach Anspruch 1, dadurch gekennzeichnet, daß der Betätigungsarm in einem Dreieckslenker endet, wobei ein erster Arm (62) und ein zweiter Arm (64) des Dreieckslenkers im wesentlichen senkrecht zu einer langen Achse des Betätigungsarms (38) enden und das Ende des ersten Dreieckslenkerendarms und das Ende des zweiten Dreieckslenkerendarms fest mit den Enden des Bandes (70) verbunden sind, um den Betätigungsarm gegen den Schrittmotor zu halten und vorzuspannen.

4. Plattenantrieb nach Anspruch 3, dadurch gekennzeichnet, daß der Betätigungsarm (38) hauptsächlich aus einer ersten Metallart mit einem ersten Wärmeausdehnungskoeffizienten besteht und ein Betätigungsarmsegment (64) aus einer zweiten Metallart mit einem anderen Wärmeausdehnungskoeffizienten hat, so daß bei Temperaturänderungen der Betätigungsarm den Wandler insgesamt längs der Spuren oder tangential zu ihnen verschiebt.

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5. Plattenantrieb nach Anspruch 4, dadurch gekennzeichnet, daß das erste Metall Aluminium ist und daß das zweite Metall Invar ist.

6. Plattenantrieb nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Lageranordnung ein Paar von axial im Abstand angeordneten, nachgiebigen, unter Vorlast stehenden Lagern (53, 54) aufweist, wobei eine untere Seite angrenzend an das Basisgußteil (4) und eine obere Seite distal von dem Basisgußteil angeordnet ist, die Lagervorlast durch eine Schraube (57) herbeigeführt wird, die einen Gewindeabschnitt und einen Kappenabschnitt hat und längs der Drehachse der Lager zur Einstellung der Vorlastkraft drehbeweglich ist, der Schraubenkappenabschnitt an der Oberseite der Lageranordnung anliegt, um die Lageranordnung auf der Oberseite unter Vorlast zu setzen, und die Unterseite der Lageranordnung eine fixierte Paßfläche bildet, die mit einem Schulterabschnitt (60) zusammenwirkt, der an dem Basisgußteil so festgelegt ist, daß die Positionsausrichtung der Lageranordnung auf dem Basisgußteil genau bestimmt ist.

7. Plattenantrieb nach Anspruch 6, dadurch gekennzeichnet, daß der Schulterabschnitt (60) ein Stück mit dem Basisgußteil (4) bildet.

Revendications

1. Unité de disque comprenant une embase moulée (4) et des parois latérales montantes (6, 8, 10, 12) définissant un boîtier (21) de dispositif de mémorisation de données, un disque tournant (30) supporté sur un moteur à axe pour une rotation constante et ayant des données stockées dans des emplacements adressables sur des pistes situées sur ce disque, et un bras d'actionneur (32) supportant un transducteur (34) pour accéder audit emplacement sur le disque où des données peuvent être stockées, ledit bras d'actionneur comprenant une première partie de bras allongée (38) supportée par et s'étendant depuis un point (52) de pivot à palier adjacent à l'une des parois latérales montantes pour entrer en contact avec un moteur pas à pas (37) supporté par l'embase moulée, et une seconde partie de bras (44) s'étendant depuis le côté de ladite première partie de bras au-dessus dudit disque tournant ; une rotation dudit moteur pas à pas provoquant un mouvement dudit bras pour positionner ledit transducteur par rapport audit disque ; ledit palier de pivot (52) est monté sur ladite embase moulée audit point de pivotement sur lequel le bras d'actionneur est supporté par un ressort à ruban, caractérisé en ce que ledit palier de pivot comprend une surface biseautée (94) en contact avec ledit ressort à ruban (70) qui comprend des première et seconde extrémités partiellement disposées autour dudit palier entre lesdites première et seconde extrémités et fixé par lesdites extrémités audit bras d'actionneur (38) et ayant sa partie supérieure (80) encochée vers l'avant pour solliciter une extrémité de ladite première partie de bras, distale par rapport audit ensemble à palier, en contact ferme avec ledit moteur pas à pas afin qu'une rotation dudit moteur pas à pas se traduise avec précision par un mouvement dudit bras.

2. Unité de disque selon la revendication 1, caractérisée en ce que ledit ressort à ruban (70) comprend un tronçon courbé entre lesdites extrémités et entourant la partie arrière dudit ensemble à palier (52) et relié audit ensemble à palier ; ladite partie arrière dudit ensemble à palier étant la partie dudit ensemble à palier située de façon à être opposée, par rapport audit point de pivotement, à ladite extrémité distale de ladite première partie de bras supportée par ledit ensemble à palier ; grâce à quoi ledit bras d'actionneur est supporté entre ledit ensemble à palier et ledit moteur pas à pas sans que ledit bras actionneur soit monté directement sur ledit ensemble à palier.

3. Unité de disque selon la revendication 1, caractérisée en ce que ledit bras d'actionneur se termine en une fourchette et comportant des premier et second bras (62, 64) de ladite extrémité en fourchette sensiblement perpendiculaires à un grand axe dudit bras d'actionneur (38), des extrémités desdits premier et second bras de l'extrémité en fourchette étant reliées étroitement aux extrémités dudit ruban (70) pour supporter et solliciter ledit bras actionneur contre ledit moteur pas à pas.

4. Unité de disque selon la revendication 3, caractérisée en ce que ledit bras actionneur (38) est constitué principalement d'un premier type de métal ayant un premier coefficient de dilatation thermique et comprend un segment (64) de bras actionneur d'un second type de métal ayant un coefficient de dilatation thermique différent de manière que, avec des variations de la température, ledit bras actionneur déplace ledit transducteur globalement le long desdites pistes ou tangentiellement auxdites pistes.

5. Unité de disque selon la revendication 4, caractérisée en ce que ledit premier métal est de l'aluminium et ledit second métal est de l'invar.

6. Unité de disque selon la revendication 1 ou 2, ca-

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ractérisée en ce que ledit ensemble à palier comporte deux paliers préchargés, souples espacés axialement (53, 54) et ayant un côté inférieur disposé à proximité immédiate de ladite embase moulée (4) et un côté supérieur disposé à distance de ladite embase moulée, ladite précharge du palier étant produite par une vis (57) ayant une partie filetée et une partie de chapeau et pouvant tourner et se déplacer le long de l'axe de rotation desdits paliers pour régler la force de précharge, ladite partie à chapeau de la vis butant contre ledit côté supérieur dudit ensemble à palier pour préchauffer ledit ensemble à palier sur ledit côté supérieur, ledit côté inférieur dudit ensemble à palier présentant une surface fixe de cadrage qui coopère avec une partie à épaulement (60) reliée fixement à ladite embase moulée afin que l'alignement de la position dudit ensemble à palier sur ladite embase moulée soit défini avec précision.

7. Unité de disque selon la revendication 6, caractérisé en ce que ladite partie à épaulement (60) est réalisée d'une seule pièce avec ladite embase moulée (4).