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PIVOT SUPPORT FOR ACTUATOR ARM

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

Disc drives record and reproduce information stored 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 disclose examples of such head positioning arrangements.

In the second, rotary type, to 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 preset position of the transducer relative to a target track

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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.

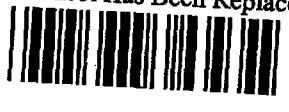
The pivot mechanisms in the prior art generally include a shaft supporting the juncture of the two arms, i.e. the actuator drive arm and the head arm, two ball bearings, and the required spring retainers pre-load springs and attachment means coupling the separate elements to the arms.

This invention provides a disc drive including a base casting and upright sidewalls defining a data storage device housing, a rotatable disc supported on a spindle motor for constant rotation and having data stored in addressable locations on tracks thereon, an actuator arm supporting a transducer for accessing said locations on the disc where data can be stored, the actuator arm being supported at one end by a bearing support structure at a pivot point and about which thearm may rotate; wherein said bearing support structure comprises a pre-loaded compliant bearing assembly mounted to said base casting to support said actuator arm at one end thereof.

The following is a description of some specific embodiments of the invention with reference to the accompany 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;

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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, 19 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.

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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 base-plate 4. The motor drive shaft 42 has a pinion 42a machined

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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 wish-bone 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

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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

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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.

Other alternatives to the present invention may become apparent to a person of skill in the art who studies the present invention disclosure. Therefore, the scope of the present invention is to be limited only by the following claims.

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CLAIMS:

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1. A disc drive including a base casting and upright sidewalls defining a data storage device housing, a rotatable disc supported on a spindle motor for constant rotation and having data stored in addressable locations on tracks thereon, an actuator arm supporting a transducer for accessing said locations on the disc where data can be stored, the arm being supported at one end by a bearing support structure at a pivot point and about which the arm may rotate; characterised in that said bearing support structure comprises a pre-loaded compliant bearing assembly mounted to said base casting to support said actuator arm at one end thereof.

2. A disc drive as claimed in claim 1, characterised in that said bearing support structure comprises a raised shoulder region extending from said base casting at a fixed predetermined position, a shaft attached at one end to said shoulder region and extending from said shoulder region and having a threaded bore extending axially into said shaft from the other end, a pair of compliant bearings coaxially mounted around said shaft, a screw having a threaded portion and a cap portion, said theaded portion matingly engaging said threaded shaft bore, said lower surface of said bearing assembly having a face for resting on said shoulder so that positional alignment of the bearing assembly on said base casting is accurately defined, said shaft and each said bearing having axial lengths chosen so that when said screw is tightened into said threaded bore said cap portion couples a force to one end of said pair of compliant bearings to inwardly preload said bearings when said screw is tightened into said shaft threaded bore, whereby possible misalignment

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of an end of said actuator arm distal from said pivot point is accommodated and a long effective axis is created.

3. A disc drive as claimed in claim 1 or claim 2, characterised in that said bearing support structure comprises a bearing assembly including first and second axially spaced compliant preloaded bearings, each said bearing having an inner ring bearing race and an outer ring bearing race, an inner cylindrical shaft fixedly mounted to a raised shoulder region extending from said base casting and coupled to said base casting at a lower end and having a threaded hole coaxial with said shaft extending internal to said shaft from an upper end, said shaft matingly engaging a bearing bore hole internal and coaxial to said inner ring bearing race of each said bearing when said bearings are mounted to said shaft, and a screw having a threaded portion and a cap portion, said first bearing having an upper face and a lower face, said lower face disposed adjacent said base casting and said upper face disposed distal to said base casting when said bearing is mounted to said shaft, said second bearing having an upper face and a lower face, said lower face disposed adjacent said first bearing upper face and said upper face disposed distal to said base casting when said bearing is mounted to said shaft, said bearing pre-load provided by said screw rotatably movable parallel to the axis of rotation of said bearings for exerting an adjustable preload force to said bearing assembly, said screw cap portion transferring said force to said second bearing inner ring bearing race at said upper face and said lower face of said second bearing transferring said force to said upper face of said first bearing inner ring bearing race and said first bearing lower face being supported by said shoulder so that said preload is imparted to said

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bearing assembly on said upper side and said lower side of said bearing assembly providing a fixed registration surface which cooperates with said shoulder portion fixedly attached to said base casting so that the positional alignment of said bearing assembly on said base casting is accurately defined.

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