Description

The present invention relates generally to a head positioning assembly for disc drive apparatus and more particularly to an improved linear actuator.

Disc drive machines record and reproduce information stored in concentric circular tracks recorded on magnetic discs. Tracks are written and read by magnetic heads which cooperate with the surface of the disc. Various methods have been used to position the head including lead screws and band drives. Band drives are shown and described in U.S. Patents 3,881,139 and 4,161,004 and 4,170,146 among others. These drives convert rotary motion of a stepper motor to linear motion of the carriage which moves the heads mounted on the carriage radially across the disc to record and read adjacent concentric circular tracks. The drive band is wrapped around the motor shaft or a pulley attached to the shaft and has its ends attached to the carriage whereby rotation of the shaft wraps one end of the band on the pulley while unwrapping the other causing the carriage to move linearly.

Guide means are associated with the carriage to guide the carriage in its linear travel to assure that the heads move radially across the associated disc. A new track is recorded at each step of the stepper motor. The spacing of the tracks is dependant upon the amount of rotation that the motor shaft undergoes with each step and the diameter of the pulley on which the band is wound. This configuration called a linear carriage or linear actuator, is typically supported by six precisely aligned ball bearings, riding on two ground and hardened metallic rods. This makes the magnetic head transfer mechanism rather complex and expensive as compared to the rotary actuator, where two supporting bearings are sufficient. Although the linear carriage design has its disadvantages, many times design requirements or stiffness advantages mandate the use of this accessing device.

GB—A—1326842 discloses a linear positioner for transducer and more particularly to a read-write transducer movable over the surface of a data disc comprising a carriage adapted to mount the transducer, carriage guide means for linearly guiding and supporting the carriage to position the transducer relative to the recording disc and linear drive means for imparting linear movement to the carriage. The carriage guide means comprises a plurality of rollers captured in grooves in the carriage guide means at least two of the rollers being provided on one side of the carriage and a third roller on the other side of the carriage.

In the magnetic recording filed, there is a demand for greater data recording density which makes it desirable to minimise the spacing between tracks and yet be able to recover the stored information by being able to locate precisely a particularly track for retrieval or writing.

An object of the present invention is to provide a linear actuator capable of low inertia, low friction movement over short distances to facilitate accessing of closely adjacent tracks. A further objective is to design a disk drive which is easy to manufacture because all its parts are easy to align and which does not contain lubricants which are a source of contamination for disks.

This invention provides head positioning apparatus for positioning magnetic heads across a recording medium including a carriage adapted to mount said magnetic heads; carriage guide means for linearly guiding and supporting said carriage to position said heads relative to said recording medium; and linear drive means for imparting linear movement to said carriage, said carriage guide means comprising a plurality of rollers captured in grooves in the carriage guide means and at least two of said rollers being provided on one side of said carriage and a third roller on the other side of said carriage; wherein the rollers are also captured in grooves in the carriage, a retainer is provided for rotatably accommodating said rollers and wherein means are provided for moving the retainer proportionally to the movement of the carriage to hold the rollers in position relative to the carriage.

In a preferred arrangement according to the invention the distances of said third roller to each of said first and second rollers on the other side of said carriage is substantially equal.

It is further preferred that said retainer has moving means comprising a pinion movable with said retainer along a rack fixed stationary relative to said carriage guide means, and a second rack fixed stationary relative to said carriage.

In any of the above arrangements the pinion may be located substantially equidistant from the two rollers located on one side of the carriage.

Also in any of the above arrangements said carriage guide means may comprise first and second rails mounted on opposite sides of said carriage, one of said rails being fixed, the other of said rails being biased laterally toward said carriage.

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

Figure 1 is a side elevational view of a drive carriage as is well known in the disc drive industry;

Figure 2 is a top view of the carriage (without head carrying mechanism or drive mechanism) showing the relationship of the carriage, the side wall, the bearings and retainer of the invention;

Figure 3 is an end elevational view of the carriage, retainer and guide mechanism of the present invention.

In U.S. Patent No. 4,323,939 issued April 6, 1982 entitled "Hard Fixed Drive Assembly and Read/Write Head Actuator" assigned to the assignee of this invention, there is described a disc drive apparatus in which the present invention is useful; and the disclosures of this patent are incorporated herein by reference.

Referring to Figure 1, a head carriage useful with a typical linear actuator comprises a stepper

motor (not shown) having a drive shaft 12, and a pulley 13 carried at one end of the drive shaft 12 and adapted to receive a drive band 14. This band, as is well known in the disc drive technology, includes an inner portion secured by a screw 16 to one end of the carriage 17 and a pair of outer portions secured by a screw 18 to the other end of the carriage. Preferably the drive band includes a U shaped spring portion 21 to maintain predetermined tension on the band. The center portion of the band, where the inner and outer portions merge, is suitably secured to the pulley 13. Rotation of the pulley clockwise or counter clockwise winds and unwinds band portions to move carriage 17 to position the heads. The carriage includes (as shown in Figure 2) spaced bearings 23, 24, 25 disposed in a generally triangular configuration. These rolling elements preferably comprise hardened and ground balls. The balls are confined between rails 27 and 29 and the moving carriage 17.

Both the rails 27, 29 and the sides of the carriage 17 have V shaped grooves 30, 31 for positioning the balls between the support rails and the carriage. Thus the balls roll smoothly as the carriage rolls back and forth between the rails 27 and 29.

In order to minimize clearance between the rolling balls 23—25 and the V shaped grooves 30, 31, one of the rails 27 is spring mounted 34, preferably from a side wall of the disc drive. The other rail 29 is fixed or may even comprise a portion of the side wall of the disc drive. As a result of the spring mounted rail, the balls are laterally confined and maintained in close contact with the defined trackway. This provides lateral self alignment with minimum wear on the bearings. This arrangement is important because the carriage 17 as shown in Figure 1 is relatively light, and mounts an E shaped or other suitable mount 38 for a plurality of magnetic heads 39 which are adapted to be aligned selectively with one or more tracks on the associated recording discs. Thus by controlling the stepper motor, the carriage 17 moves linearily along a path 40 (Figure 2) to move the heads radially in and out across the associated disc to read and write information on the disc surface.

It is obviously important to confine the ball bearings 23—25 in the longitudinal as well as the lateral direction. This longitudinal confinement is provided by a generally triangular retainer 50 (Figures 2 and 3) to move parallel with and proportional (2:1) to movement of the rolling carriage 17. The triangular retainer 50 (Figures 2 and 3) has holes in its upright walls 52, 54 (Figure 3) in which each of the ball bearings can rotate. This provides for appropriate longitudinal confinement of the ball bearings while providing a system which needs no lubrication to allow for free rolling contact of the balls as the carriage slides in and out along the pathway 40 (Figure 2).

As shown in Figure 3, the retainer 50 is itself located along the pathway 40 (Figure 2) by a rack and pinion mechanism which assures a constant relative position of balls 23—25 relative to the carriage 17 at any time during use of the mechanism. This retainer and rack and pinion combination assure proper location of the ball bearings even under shock or vibration conditions. The gear of pinion 60 is generally centered along pathway 40 (Figure 2) between two of the ball bearings 23, 24 on one side of the carriage. One of the toothed racks 62 on which the pinion rotates is fixedly mounted, preferably on the fixed rail 29. The other rack 64 comprises a piece which is mounted directly to the rolling carriage 17. One of the racks is intended to be secured to or an integral part of the carriage. This dual rack and pinion mechanism assures that the retainer displacement is half of the movement of the carriage at all times, and helps assure proper positioning of the carriage while retaining the position of the ball bearings relative to the carriage.

Both the carriage 17 and the supporting rails 27, 29 can be of materials such as aluminum extrusions. The ball contact areas comprising the grooves 30, 31 can, for example, be hard anodized or hard chrome plated for wear resistance and shock durability. The racks 62, 64 and pinion 60 are precision injected molded components. Other materials may be apparent to a person of skill in the art; this invention is not limited to use of these materials.

The advantage of this ball and V groove channel arrangement is that those elements define a plane parallel with the desired plane of movement of the read/write heads. Consequently, no alignment or high precision construction is required, and the mechanism is relatively free of binds, jams, and sliding friction to allow for more accurate placement of the heads relative to the discs. The embodiment disclosed herein utilizes three balls in a triangular array; three balls define a plane and facilitate manufacture of the invention. The addition of even one additional ball would allow the possibility of misalignment from the desired plane and eliminate one clear advantage of the three ball arrangement. The application of more balls in either channel with an expanded size retainer is possible.

Claims

1. Head positioning apparatus for positioning magnetic heads across a recording medium including a carriage (17) adapted to mount said magnetic heads; carriage guide means (27, 29) for linearly guiding and supporting said carriage to position said heads relative to said recording medium; linear drive means for imparting linear movement to said carriage and said carriage guide means comprising a plurality of rollers (23, 24, 25) captured in grooves (30, 31) in said carriage guide means at least two of said rollers (23, 24) being provided on one side of said carriage and a third roller (25) on the other side of said carriage; characterised in that the rollers are also captured in grooves of the carriage, a

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Both the carriage 17 and the supporting rails 27, 29 can be of materials such as aluminum extrusions. The ball contact areas comprising the grooves 30, 31 can, for example, be hard anodized or hard chrome plated for wear resistance and shock durability. The racks 62, 64 and pinion 60 are precision injected molded components. Other materials may be apparent to a person of skill in the art; this invention is not limited to use of these materials.

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retainer (50) for rotatably accommodating said rollers is provided and in that means (60, 62, 64) are provided for moving the retainer proportionally to the movement of the carriage to hold the rollers (23, 24, 25) in position relative to the carriage.

2. Head positioning apparatus as claimed in Claim 1, characterised in that the distances of said third roller (25) to each of the other two rollers are substantially equal.

3. Head positioning apparatus as claimed in any of Claims 1 to 2 characterised in that said retainer has moving means comprising a pinion (60) movable with said retainer along a rack (62) fixed stationary relative to said carriage guide means, and a second rack (64) fixed stationary relative to said carriage.

4. Head positioning apparatus as claimed in any of Claims 1 to 3 characterised in that the pinion is located substantially equidistant from the two rollers located on one side of the carriage.

5. Head positioning apparatus as claimed in any of Claims 1 to 4 characterised in that said carriage guide means comprise first and second rails mounted on opposite sides of said carriage, one of said rails (39) being fixed, the other of said rails (30) being biased laterally toward said carriage.

6. Head positioning apparatus as claimed in claim 5 characterised in that said carriage guide means includes one rail spring biased toward said carriage to retain said bearings in said groove.

7. Head positioning apparatus as claimed in claim 6 characterised in that said rollers are disposed in a triangular array, said pinion being approximately centered between two of the rollers on the same side of said carriage.

Patentansprüche

1. Kopfpositioniervorrichtung zum Positionieren von Magnetköpfen über einem Aufzeichnungsmedium mit einem Schlitten (17), der zum Anbringen der Magnetköpfe geeignet ist; mit Schlittenführungseinrichtungen (27, 29) zum linearen Führen und Abstützen des Schlittens, um die Köpfe bezüglich des Aufzeichnungsmediums zu positionieren; und mit einer Linearantriebseinrichtung, um dem Schlitten eine lineare Bewegung zu erteilen, wobei die Schlittenführungseinrichtungen eine Vielzahl von Rollen (23, 24, 25) aufweisen, die in Nuten (30, 31) in den Schlittenführungseinrichtungen aufgenommen sind, wenigstens zwei der Rollen (23, 24) auf einer Seite des Schlittens und eine dritte Rolle (25) auf der anderen Seite des Schlittens vorgesehen sind, dadurch gekennzeichnet, daß die Rollen auch in Nuten des Schlittens aufgenommen sind, daß ein Halter (50) für die drehbare Aufnahme der Rollen vorgesehen ist und daß Einrichtungen (60, 62, 64) zum Bewegen des Halters proportional zur Bewegung des Schlittens vorgesehen sind, um die Rollen (23, 24, 25) relativ zum Schlitten in Position zu halten.

2. Kopfpositioniervorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Abstände der dritten Rolle (25) zu jeder der beiden anderen Rollen im wesentlichen gleich sind.

3. Kopfpositioniervorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der Halter Bewegungseinrichtungen mit einem Ritzel (60), das mit dem Halter längs einer Zahnstange (62) beweglich ist, die relativ zu den Schlittenführungseinrichtungen stationär festgelegt ist, und eine zweite Zahnstange (64) aufweist, die bezüglich des Schlittens stationär befestigt ist.

4. Kopfpositioniervorrichtung nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß das Ritzel im wesentlichen im gleichen Abstand von den beiden Rollen angeordnet ist, die sich auf einer Seite des Schlittens befinden.

5. Kopfpositioniervorrichtung nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die Schlittenführungseinrichtungen erste und zweite Schienen aufweisen, die auf gegenüberliegenden Seiten des Schlittens angeordnet sind, wobei die eine Schiene (39) festgelegt ist, während die andere Schiene (30) seitlich zum Schlitten hin vorgespannt ist.

6. Kopfpositioniervorrichtung nach Anspruch 5, dadurch gekennzeichnet, daß die Schlittenführungseinrichtungen eine Schienenfeder aufweisen, die zu dem Schlitten hin vorgespannt ist, um die Rollen in der Nut zu halten.

7. Kopfpositioniereinrichtung nach Anspruch 6, dadurch gekennzeichnet, daß die Rollen in einer Dreiecksanordnung positioniert sind, wobei das Ritzel zwischen zwei der Rollen auf der gleichen Seite des Schlittens annähernd zentriert ist.

Revendications

1. Appareil de positionnement de têtes destiné à positionner des têtes magnétiques en travers d'un support d'enregistrement, comprenant un chariot (17) conçu pour le montage desdites têtes magnétiques; des moyens (27, 29) de guidage du chariot destinés à guider linéairement et supporter ledit chariot pour positonner lesdites têtes par rapport audit support d'enregistrement; des moyens d'entraînement linéaire destinés à communiquer un mouvement linéaire audit chariot, lesdits moyens de guidage du chariot comprenant plusieurs organes de roulement (23, 24, 25) emprisonnés dans des gorges (30, 31) desdits moyens de guidage du chariot, au moins deux desdits organes de roulement (23, 24) étant prévus sur un premier côté dudit chariot et un troisième organe de roulement (25) sur l'autre côté dudit chariot; caractérisé en ce que les organes de roulement sont également emprisonnés dans des gorges du chariot, un élément de retenue (50) destiné à loger lesdits organes de roulement en leur permettant de tourner est prévu et en ce que des moyens (60, 62, 64) sont prévus pour déplacer l'élément de retenue proportionellement au mouvement du chariot afin de maintenir les organes (23, 24, 25) en position par rapport au chariot.

2. Appareil de positonnement de têtes selon la revendication 1, caractérisé en ce que les dis-

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tances dudit troisième organe de roulement (25) à chacun des deux autres organes de roulement sont sensiblement égales.

3. Appareil de positionnement de têtes selon l'une quelconque des revendications 1 et 2, caractérisé en ce que ledit élément de retenue comporte des moyens de déplacement comprenant un pignon (60) mobile avec ledit élément de retenue le long d'une crémaillère (62) fixée de façon immobile par rapport audit moyen de guidage du chariot; et une seconde crémaillère (64) fixée de façon immobile par rapport audit chariot.

4. Appareil de positionnement de têtes selon l'une quelconque des revendications 1 à 3, caractérisé en ce que le pignon est situé sensiblement à égale distance des deux organes de roulement disposés sur un premier côté du chariot.

5. Appareil de positionnement de têtes selon l'une quelconque des revendications 1 à 4, caractérisé en ce que lesdits moyens de guidage du chariot comprennent des premier et second rails montés sur des côtés opposés dudit chariot, l'une desdits rails (29) étant fixe, l'autre desdits rails (30) étant rappelé latéralement vers ledit chariot.

6. Appareil de positionnement de têtes selon la revendication 5, caractérisé en ce que lesdits moyens de guidage du chariot comprennent un rail rappelé par ressort vers ledit chariot pour retenir lesdits organes de roulement dans ladite gorge.

7. Appareil de positionnement de têtes selon la revendication 6, caractérisé en ce que lesdits organes de roulement sont disposés en triangle, ledit pignon étant approximativement centré entre deux des organes de roulement sur le même côté dudit chariot.

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