Description

This invention is directed generally to the field of disc drives and more particularly to a mechanical lock for a carriage assembly and a disc type data storage device. The lock is particularly useful in preventing the read/write heads from moving across the discs when a sudden shock is applied to the disc drive. Such a mechanical lock is described in EP-A 0 126 973.

As is well known, disc drive machines record and reproduce information stored on concentric tracks recorded on magnetic discs. The tracks are written and read by magnetic heads or transducers which cooperate with the surface of the disc. These heads are carried from track to track by motor driven carriages. A typical unit or actuator for providing this head positioning function is described in EP-A 0 225 124 assigned to the Assignee of this invention.

It is of course apparent that the carriage should be free to move without undue restraint or drag when it is desired to move the transducer from track to track. However, it is also necessary that some device be provided to secure the carriage from free movement when power is not being applied to the motor which moves the carriage. In the absence of such a securing device, both heads and medium are subject to damage due to uncontrolled motion. This is not a problem in disc drives using a stepper motor. A stepper motor has significant detent force when no power is being applied; thus, the attached carriage is naturally restrained from undefined movement. However, with the advent of voice coil motor drives, the problem of restraining the carriage from undefined movement has become serious.

In a typical voice coil motor drive, coils and magnets are located on either side of the carriage. The motor drives the carriage by the direction and amplitude of current applied; but when no current is applied, the carriage is free to move.

It is therefore an objective of this invention to provide an improved mechanical lock for use in restraining the actuator in a disc drive.

Specifically, an objective of this invention is to prevent carriage movement in an inactive disc drive using a voice coil motor.

In the prior art, the carriage has been driven to a home position and mechanically locked in that position. However, a hard shock will release the carriage, because the solenoid which is used to automatically release the drive must inherently be inexpensive and relatively low in power. If a larger restraining spring is used to bias the latch against the carriage, then a larger and more expensive solenoid will be needed.

This problem has become even more significant with the advent of portable computers wherein the disc drive is much more frequently subjected to sudden shocks, and such shocks may occur while the drive is being carried.

Therefore, it is an objective of this invention to provide a disc drive lock which can utilize a solenoid and spring of relatively limited force while providing significant restraining force against any sudden movement of the disc drive in response to mechanical shock.

In normal operation, the carriage is driven to the home position and mechanically locked in place when power is removed from the drive. Typically it is the motion of the carriage that triggers the locking action. To minimize the energy required and to avoid producing high deceleration forces when the carriage contacts the locking mechanism, it is generally desirable that the force required to activate the latch be as low as possible.

In that in many disc drives, crash stops are provided at each end of the carriage stroke to cushion the impact of the carriage should an electronics failure cause the carriage to accelerate in an uncontrolled manner. As one of the failure modes could be an acceleration of the carriage into the home position, it would be desirable that the lock not interfere with the function of the crash stops.

These and other objectives and advantages of this invention are achieved by a dynamic lock mechanism for holding said carriage in a fixed position relative to said frame comprising a plunger guided by a solenoid and a further frame for movement between a first position wherein said plunger engages an extension on said carriage to lock said carriage in said fixed position and a second position wherein said plunger is withdrawn from said carriage to allow said carriage to position said transducer with respect to a recording media, spring means surrounding said plunger for normally biasing said plunger into said first position, said solenoid being responsive to a signal to withdraw said plunger from said first position to said second position, and characterised in that shock absorbing means comprising a counterweight pivotally linked to said plunger are provided for absorbing a shock applied to said frame and preventing movement of said plunger away from said first position in the absence of actuation of said solenoid.

The mass of the plunger the mass of the counterweight and their relative distances from the pivot are designed such that the shock force is neutralized, preventing the plunger from moving back toward the solenoid and releasing the carriage. Furthermore, by proper sizing of the aforementioned variables, the mechanical time constant (time it takes for the lock to react) can be adjusted so that the lock will not interfere with carriage motion in the event of high speed motion onto the crash stops.

The advantages and technical features of this invention will become more apparent from a study of the following disclosure, wherein

Fig. 1 is a top plan view of a linear actuator mounted in a housing of the type in which this invention is particularly useful and showing the positional relationship of the lock, motor, and storage discs;

Fig. 2 is an exploded isometric view of the lock of this invention;

In that in many disc drives, crash stops are provided at each end of the carriage stroke to cushion the impact of the carriage should an electronics failure cause the carriage to accelerate in an uncon-

trolled manner. As one of the failure modes could be

FIG 3 is an isometric view of an assembled lock of the type shown in Figure 2;

FIG 4 is a top view of the lock and carriage with the carriage entering the lock area;

FIG 5 is a top view of the lock and carriage in the locked position; and

FIG 6 is a top view of the lock in the activated position with the plunger withdrawn from the carriage.

FIG 1 shows a standard disc drive arrangement of the type shown in EP-A 0 225 124, including a voice coil drive motor 10 driving a carriage 12 carrying transducer heads from track to track on disc 14. When power is to be removed from the drive, the carriage is driven to a home position fully retracted from that portion of the disc on which the data is stored, and the carriage is engaged by the dynamic lock 16 of this invention.

FIG 2 shows in exploded view the basic mechanical elements of this invention. The dynamic lock is carried in a frame generally shown at 30 with the plunger extending out toward the carriage through a window 32. The plunger itself 34 is positionally controlled by a solenoid 36. It is biased toward the carriage by spring 38. When the solenoid 36 is activated, the plunger 34 is pulled back toward the solenoid against the pressure of spring 38. The counterweight 40 is rotationally fastened by pin 50 to a ledge 44 of frame 30.

The assembled lock appears in FIG 3. with the weight 40 pinned in place by pin 50, and the solenoid 36 retracting the tip 52 of plunger 34. The operation of the dynamic lock is shown clearly in FIGS 4, 5 and 6. These figures show the various positions of the counterweight 40 and its finger 42 which extends into a recess 60 in the side of the plunger facing the counterweight. Entering the home position as shown in FIG 4, the carriage extension 62 strikes the tip 64 of plunger 34. This pushes the plunger 34 into the solenoid 36, permitting the carriage 12 to move past the plunger. The spring 38 biases the plunger back out toward the carriage. Thus, when the carriage 12 has moved into the position shown in FIG 5, the plunger 34 is propelled by the spring 38 back into the recess 66 to capture the carriage between the crash stop 68 and the plunger. This capture position is shown clearly in FIG 5.

To release the carriage, power is applied to the solenoid, retracting the plunger 34 and compressing the spring as shown in FIG 6. The carriage is now free to be driven away from the crash stop by the voice coil motor.

Special significance of this invention lies in its operation during application of a shock load which would move the plunger into the solenoid, thereby releasing the carriage. It must be remembered that it is highly desirable to utilize a very weak spring, such that other means of preventing plunger movement must be utilized.

During application of a shock load to the disc drive housing, the shock load forces applied to the entire assembly via the housing of the disc drive itself and frame 30. During large shock loads, the spring 38 does not provide sufficient force to overcome the inertia of the plunger 34. As a result, the plunger begins to move relative to the solenoid. This has the same effect of the plunger retraction step of FIG 6, freeing the carriage for movement.

The counterweight 40 is designed such that the shock load applied to the plunger will be transmitted through finger 42 into the counterweight. Because the finger is directed against the direction of rotation of the plunger, the shock is carried to the counterweight 40, in a direction opposite the shock load. As the mass moment of the counterweight is equal to the mass moment of the plunger, and their directions are opposite, the shock force applied to the plunger is neutralized. The counter-weighted system of this invention allows the usage of a relatively weak return spring or bias spring 38, and in turn allows the use of a small, inexpensive, low powered solenoid without the danger of unintended release of the carriage lock. Because the counterweight can rotate about the frame, the lever 42 can rotate within the recess when power is applied by the solenoid 40, retracting the plunger against the bias of spring 38. The counterweight restrains movement of the plunger only in the event of sharp force being applied to the frame 30 in the retraction direction of the plunger.

Should a malfunction of the drive cause full power to be applied to the voice coil motor and in turn cause the carriage to accelerate, uncontrolled, into the home position, the carriage 12 will reach a relatively high velocity upon entering the lock area. As the carriage is not controlled, there is no electronic means of decelerating the carriage. Therefore, the crash stop 68 has been provided made of a suitable material such as rubber to decelerate the carriage. Under these high-speed conditions, the carriage pushes the lock plunger 34 into the solenoid as it moves past, similar to operation under normal conditions. Upon coming in contact with the crash stop, the rubber is compressed and the motion of the carriage is stopped. The crash stop is designed such that the carriage is decelerated at a controlled rate in order to avoid damage to the carriage heads. As the rubber has been compressed, however, it acts as a spring propelling the carriage out of the home position at a relatively high velocity. Reengagement of the latch at this point would subject the carriage and head transducers to a relatively high shock, potentially causing damage. However, in this invention and under the conditions of high-speed impact, as the counterweight has allowed use of a weak return spring, reengagement of the carriage by the plunger is avoided.

After the carriage has pushed the plunger 34 into the solenoid and has continued travelling into the crash stop, the return spring will be applying a force to the plunger to return it to its original position. This invention utilizes a relatively weak return spring 38. Therefore, the plunger return force will be small, and the acceleration of the plunger slow. Thus, the carriage 12 will compress the crash stop, rebound and travel out of the lock area before the plunger travels to a point where it could engage the carriage.

Claims

1. In an actuator having a frame and a transducer carriage for positioning a transducer with respect to a recording media, a dynamic lock mechanism for holding said carriage (12) in a fixed position relative to said frame (30) comprising a plunger (34) guided by a solenoid (36) and a further frame for movement between a first position wherein said plunger engages an extension on said carriage to lock said carriage in said fixed position and a second position wherein said plunger is withdrawn from said carriage to allow said carriage to position said transducer with respect to a recording media, spring means (38) surrounding said plunger for normally biasing said plunger into said first position, said solenoid being responsive to a signal to withdraw said plunger from said first position to said second position, and characterised in that shock absorbing means comprising a counterweight (40) pivotally linked (42, 50) to said plunger are provided for absorbing a shock applied to said frame and preventing movement of said plunger away from said first position in the absence of actuation of said solenoid.

2. A dynamic lock as in claim 1, characterised in that the recording media is a rotatable media with a plurality of data tracks, the transducer carriage (12) being driven by a motor (10) along a linear path for positioning the transducer to co-act with a desired data track, the locking mechanism being positioned at right angles to said linear path between said motor (10) and said rotatable storage media.

3. A dynamic lock as in any of Claim 1 and 2, characterised in that said spring means (38) provides a relatively weak force compared to the force created by a shock load acting on said plunger.

4. A dynamic lock as in any of Claims 1 to 3, characterised in that the mass moment of said counterweight (40) is substantially equal to the mass moment of said plunger (34) about a pivot (50) fixed to said frame, whereby shock loads applied to said plunger are offset by said counterweight without movement of said plunger away from said first position.

5. A dynamic lock as in any of Claims 1, 3 or 4 including means (50) for mounting the counterweight (40) to the frame guiding said plunger, and means (42) for linking said counterweight to an end of said plunger (34) near to said carriage, said counterweight allowing free movement of said plunger in response to actuation of said solenoid, and offsetting shocks to said plunger to prevent movement thereof in the absence of actuation of said solenoid.

6. A dynamic lock as in Claim 5, characterised in that said plunger (34) has a recess in a side thereof facing said counterweight (40), said counterweight linking means including a finger (42) mounted for rotation on an edge of said frame (30) and extending into said recess of said plunger.

Patentansprüche

1. Dynamischer Sperrmechanismus für einen Stellantrieb mit einem Rahmen und einem Wandlerschlitten zum Positionieren eines Wandlers gegenüber einem Aufzeichnungsmedium, zum Halten des Schlittens (12) in einer festen Stellung gegenüber dem Rahmen (30), mit einem von einem Elektromagneten (36) geführten Stößel (34) und einem weiteren Rahmen zur Bewegung zwischen einer ersten Stellung, in der der Stößel eine Verlängerung am Schlitten ergreift und den Schlitten in der festen Stellung sperrt, und einer zweiten Stellung, in der der Stößel vom Schlitten rückgezogen ist, so daß der Schlitten den Wandler gegenüber einem Aufzeichnungsmedium in Stellung bringen kann, wobei eine Federeinrichtung (38) den Stößel umgibt und den Stößel normalerweise in die erste Stellung vorspannt, wobei der Elektromagnet auf ein Signal anspricht, den Stößel aus der ersten in die zweite Stellung zurückzuziehen, gekennzeichnet durch eine Stoßdämpfungseinrichtung mit einem Gegengewicht (40), das schwenkbar mit dem Stößel verbunden (42, 50) ist und einen auf den Rahmen wirkenden Stoß dämpft und verhindert, daß sich der Stößel bei fehlender Betätigung des Elektromagnetes aus der ersten Stellung wegbewegt.

2. Dynamische Sperre nach Anspruch 1, dadurch gekennzeichnet, daß das Aufzeichnungsmedium ein drehbares Medium mit mehreren Datenspuren ist, wobei der Wandlerschlitten (12) von einem Motor (10) längs eines linearen Weges angetrieben ist, um die Wandler derart zu positionieren, daß sie mit einer gewünschten Datenspur zusammenwirken, wobei der Speichermechanismus unter rechten Winkeln zu den linearen Wegen zwischen dem Motor (10) und dem drehbaren Speichermedium angeordnet ist.

3. Dynamische Sperre nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Federeinrichtung (38) verglichen mit der durch eine auf den Stößel wirkende Stoßbelastung erzeugten Kraft eine verhältnismäßig schwache Kraft erzeugt.

4. Dynamische Sperre nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß das Massenmoment des Gegengewichts (40) im wesentlichen gleich ist dem Massenmoment des Stößels (34) um eine am Rahmen befestigte Schwenkachse (50), wodurch die auf den Stößel wirkenden Stoßbelastungen durch das Gegengewicht ohne Bewegung des Stößels aus der ersten Stellung abgelenkt werden.

5. Dynamische Sperre nach Anspruch 1, 3 oder 4, mit einer Einrichtung (50) zum Befestigen des Gegengewichts (40) am den Stößel führenden Rahmen, und mit einer Einrichtung (42) zum Verbinden des Gegengewichts mit einem Ende des Stößels (34) in der Nähe des Schlittens, wobei das Gegengewicht auf Betätigung des Elektromagneten eine freie Bewegung des Stößels erlaubt, und zum Ablenken von Stößen auf den Stößel, um zu verhindern, daß dieser sich bei fehlender Betätigung des Elektromagneten bewegt.

6. Dynamische Sperre nach Anspruch 5, dadurch gekennzeichnet, daß der Stößel (34) in einer dem Gegengewicht (40) zugewandten Seite desselben eine Ausnehmung aufweist, wobei die Gegengewicht-Verbindungseinrichtung einen an einer Kante des Rahmens (30) befestigten und in die Ausnehmung des Stößels ragenden Finger (42) aufweist.

* C L M S *

Revendications

1. Dans un actionneur comportant un bâti et un chariot à transducteur destiné à positionner un transducteur par rapport à un support d'enregistrement, un mécanisme de verrou dynamique destiné à maintenir ledit chariot (12) dans une position fixe par rapport audit bâti (30) comprenant un plongeur (34) guidé par une bobine (36) et un autre bâti afin de se déplacer entre une première position dans laquelle ledit plongeur s'enclenche avec une saillie dudit chariot pour verrouiller ledit chariot dans ladite position fixe et une seconde position dans laquelle ledit plongeur est rétracté dudit chariot pour permettre audit chariot de positionner ledit transducteur par rapport à un support d'enregistrement, un moyen à ressort (38) entourant ledit plongeur pour rappeler normalement ledit plongeur dans ladite première position, ladite bobine réagissant à un signal en rétractant ledit plongeur de ladite première position vers ladite seconde position, et caractérisé en ce que des moyens d'absorption de choc comprenant un contrepoids (40) relié de façon pivotante (42, 50) audit plongeur sont prévus pour absorber un choc appliqué audit bâti et empêcher ledit plongeur de s'éloigner de ladite première position en l'absence d'une excitation de ladite bobine.

2. Verrou dynamique selon la revendication 1, caractérisé en ce que le support d'enregistrement est un support rotatif portant plusieurs pistes de données, le chariot (12) à transducteur étant entraîné par un moteur (10) le long d'un trajet linéaire pour positionner le transducteur afin qu'il coopère avec une piste de données souhaitée, le mécanisme de verrouillage étant positionné de façon à former un angle droit avec ledit trajet linéaire entre ledit moteur (10) et ledit support rotatif d'enregistrement.

3. Verrou dynamique selon l'une des revendications 1 et 2, caractérisé en ce que ledit moyen à ressort (38) produit une force relativement faible en comparaison avec la force engendrée par la charge d'un choc agissant sur ledit plongeur.

4. Verrou dynamique selon l'une quelconque des revendications 1 à 3, caractérisé en ce que le moment de la masse dudit contrepoids (40) est sensiblement égal au moment de la masse dudit plongeur (34) autour d'un pivot (50) fixé audit bâti, afin que des charges de choc appliquées audit plongeur soient compensées par ledit contrepoids sans que ledit plongeur s'éloigne de ladite première position.

5. Verrou dynamique selon l'une quelconque des revendications 1, 3 et 4, comprenant des moyens (50) pour le montage du contrepoids (40) sur le bâti guidant ledit plongeur, et des moyens (42) destinés à relier ledit contrepoids à une extrémité dudit plongeur (34) proche dudit chariot, ledit contrepoids permettant un mouvement libre dudit plongeur en réponse à l'excitation de ladite bobine, et compensant des chocs appliqués audit plongeur pour empêcher celui-ci de se déplacer en l'absence d'une excitation de ladite bobine.

6. Verrou dynamique selon la revendication 5, caractérisé en ce que ledit plongeur (34) présente un évidement dans un côté de ce plongeur faisant face audit contrepoids (40), lesdits moyens de liaison du contrepoids comprenant un doigt (42) monté de façon à tourner sur un bord dudit bâti (30) et pénétrant dans ledit évidement dudit plongeur.

* C L M S *