CRASH STOP AND MAGNETIC LATCH FOR A VOICE COIL ACTUATOR

The present invention relates generally to an improved latching arrangement for head positioner assemblies within information storage systems such as disc drives. More particularly, the invention relates to a magnetic latch for securing rotatable head positioner assemblies in place when the disc drives are not in use.

Disc drive machines record and reproduce information on a recording media. The media generally takes the form of circular information storage discs having a multiplicity of concentric tracks. Conventional Winchester type disc drives include a plurality of vertically aligned rotating information storage discs, each having at least one associated magnetic head that is adapted to transfer information between the disc and an external system. Each head is carried by an elongated flexure arm. The flexure arms are vertically aligned and are each attached to a common head positioner assembly. The head positioner assembly is adapted to move the heads back and forth in unison across the face of the vertically aligned discs. The head positioner

assembly may be either rotationally mounted, or may take the form of a linear carriage that is free to move back and forth along a single axis. In rotary mounted head positioner assemblies, a voice coil motor rotates the head positioner assembly about a pivot mechanism to precisely position the heads relative to the magnetic discs.

Due to the precise positioning requirements of the read/write heads, the head positioner assembly must be finely balanced and the pivot mechanism must offer high precision and reliability in order to minimize undesirable vibrations within the drive. New drives constantly push for higher access speed and more memory storage within a confined space. In high speed compact disc drives, such as the 3 1/2 inch drives now becoming popular, if any of the drive's components have primary resonant frequencies under approximately 5 Khz, mechanical movement within the drive will occasionally excite the resonant frequencies during normal operation which can limit the drives performance and/or generate undesirable noise which gives the appearance of an inferior quality product.

When the disc drive is not in use, it is important to "park" the heads in a position where they will not either mechanically or electrically interfere with the information storage media. The head positioner assembly must be held in place even when the drive is dropped, struck or otherwise mishandled. To hold the head positioner assembly (and thus the heads) in place while the drive is not in use, a latching arrangement is typically provided. One common latching arrangement utilizes a selectively actuatable solenoid to hold the head positioner assembly in place, however, such systems have several

drawbacks including the need for supporting electronics, and increased power requirements, relying on moving parts occupying a large amount of space.

This invention provides a magnetic latch for a disc drive system having a head positioner assembly for positioning a plurality of transducer heads relative to a recording media located within a disc housing, the head positioner assembly being movable with respect to the disc housing, the magnetic latch including a bumper stop flixably mounted to the housing for limiting the head positioner assembly's movement in one direction, a strike plate carried by the head positioner assembly that is formed of a magnetic material and magnetic means supported in the bumper stop for magnetically engaging the strike plate to latch the head positioner assembly against the bumper stop when the drive is not in use, said magnet means including a slidable element that is slidably coupled to the bumper stop to insure that the magnet means firmly engages the strike plate.

Thus the invention provides an effective head positioner assembly latching arrangement that has a low part count and is easy to assemble at low costs. A magnetic latching is provided for a head positioner assembly which does not effect the balance of the head positioner assembly.

The features of the present invention that are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a top view of a disc drive that incorporates the present invention with its upper casing removed.

FIGURE 2 is a side view of the disc drive shown in Figure 1.

FIGURE 3 is an exploded perspective view of a voice coil motor suitable for driving a rotary head positioner assembly.

FIGURE 4 is an exploded perspective view of a magnetic latch fabricated in accordance with the present invention.

FIGURE 5 is a back view of the magnetic latch shown in Figure 4;

FIGURE 6 is a an exploded perspective view of a bumper stop; and

FIGURE 7 is an elevation view of a strike plate for forming a contact surface for both the magnetic latch and bumper stops.

Referring first to Figures 1 & 2, a rotary disc drive system suitable for incorporating the teaching of the present invention is shown in diagrammatic form. A plurality of magnetic information storage discs 20 are journaled about a spindle motor assembly 30 within a housing 5 having upper and lower casing members 7 & 9 respectively. Each magnetic disc 20 has a multiplicity of concentric circular information storage tracks for recording information. Spacers 23 are disposed between adjacent information storage discs 20 to maintain their spacing and a disc clamp 25 positioned above the top information storage disc 21 firmly secures the magnetic discs 20 the spindle motor assembly 30.

A head positioner assembly 40 includes a pivot housing 42 that is rotationally coupled between the upper and lower casings 7,9 in one corner of the housing 5 by pivot bearing 44. The head positioner assembly 40 carries a plurality of head arm flexures 50 that each carry a magnetic read/write head 52 for reading information from and writing information onto the magnetic discs 20. The head positioner assembly 40 also carries a servo arm 54 which carries a servo head 55 for accurately positioning the magnetic heads 52 relative to the information storage tracks. The head and servo arms are each attached to the head positioner assembly 40 by individual flexure mounts 58. A voice coil motor 60 is adapted to precisely rotate the head positioner assembly back and forth such that the magnetic and servo heads move together across the magnetic discs. A magnetic latch 70 holds the head positioner assembly in place when the disc drive is not in use. The rotational movements of the head positioner assembly 42 are

limited by bumper stops 80 which are disposed directly behind the voice coil motor 60.

The head positioner assembly 40 includes a pivot housing 42 that is journaled about pivot mechanism 44. The pivot housing is somewhat E shaped and has a plurality of forwardly extending vertically aligned platforms that each form a mounting base for a single flexure mount 58. The coil 64 for voice coil motor 60 is attached to the back side of the pivot housing 42 by a single center screw 107. To minimize weight at a reasonable cost, the pivot housing 42 is fabricated from aluminum. As can be appreciated by reference to Figure 1, in the preferred embodiment, the pivot housing 42 as well as almost everything it carries are symmetrical about its longitudinal axis. The symmetry is desirable to precisely balance the head positioning assembly, which reduces undesirable internal vibrations.

A 32 pin connector 150 serves as the communications port between the disc drive and an external computer system. Two printed circuit cables (PCCs) are coupled between the connector 150 and the pivot housing 42. Electrical communications between the disc controller and the voice coil motor 60 are made over a drive PCC 90. Communications between the data and servo heads 52, 55 and the system controller are made over a read/write PCC 95. To more closely mechanically balance the head positioner assembly, drive PCC 90 and read/write PCC 95 are crossed such that they bias the pivot housing 42 in opposite directions, thereby reducing the parasitic torque on the system. The crossed nature of the printed circuit cables also reduces noise generated from electrical interference between the cables.

Referring next to Figure 3, the voice coil motor 60 includes a center pole 62 having coil 64 journaled thereabout in a spaced apart relation. Outer poles 66 are sandwiched over the top and bottom sides of the coil 64 and are sized so as to allow coil 64 to move freely back and forth over the enter pole within the confines set by bumper stops 80. The outer poles are identical in construction.

A strike plate 100 (see Figure 7) is mounted to the back side of coil 64. The strike plate forms a contact surface for both magnetic latch 70 and bumper stops 80. Since the strike plate 100 is the contact surface for the magnetic latch, it must be formed of a magnetic material such as magnetic stainless steel. A support member 105 is coupled to the front surface of coil 64 to form an attachment plate for the pivot housing 42. The pivot housing may be firmly secured to the support member 105 via screw 107. Strike plate 100 and support member 105 may be bonded to the coil using a suitable epoxy.

When the disc drive is not in use, it is important to park the heads in a position where they will not either mechanically or electrically interfere with the information storage media. The head positioner assembly must be held in place even when the drive is dropped, struck or otherwise mishandled. To hold the head positioner assembly (and thus the heads) in place while the drive is not in use, a magnetic latch 70 is provided in one of the bumper stops 81 that limits the rotational movements of the head positioner assembly. Specifically, the inner bumper stop 81 is positioned such that when strike plate 100 rests against it, the heads will be located adjacent the spindle motor assembly 30 spaced apart from the spacers 23 that are journaled about the spindle motor

assembly. The second bumper stop 82 is positioned such that the heads will be outside of the outermost information storage track on the discs 20 when strike plate 100 rests against bumper stop 82.

Referring next to Figure 6, bumper stop 82 includes bumper pad 84 disposed within a frame 86 that is securely fastened to the center pole 62. The bumper pad is formed from a resilient material such as rubber and is press fit into a recess 87 within the frame 86. The leading edge of the bumper pad 84 forms its contact surface 85.

Referring next to Figures 4 and 5, the embodiment of the magnetic latch chosen for the purpose of illustration will be described. The magnetic latch 70 includes upper and lower magnetic poles 71 and 72 respectively that are disposed about magnet 74. Poles 71 and 72 are substantially "L" shaped, having an extended portion 76 and a catch portion 77. The magnet 74 is rectangular. The poles extend slightly beyond the magnet 74 to prevent the magnet from being hit by strike plate 100. It should be appreciated that the poles are independently slidable so that they can readily engage strike plate 100 without any air gaps when the strike plate is in contact with the magnetic latch 70.

The bumper stop 81 is virtually identical to bumper stop 82 except that the bumper pad 88 within bumper stop 81 has a recess 89 therein. The magnetic latch 70 is placed within the recess 89 in bumper pad 88 such that the extended portions of poles 71 and 72 extend beyond the contact surface 85 of bumper pad 88. The poles 71, 72, as well as the magnet 74 are loosely placed within the recess 89 with the catch portions 77 of the poles being arranged to limit the

distance the poles can slide relative to the bumper stop to prevent the magnetic latch from slipping out of the bumper stop. Since the poles are not connected together, they may slide independently relative to the bumper stop.

It will be appreciated that the voice coil motor 60 must be designed to generate sufficient torque to pull the strike plate 100 away from the magnetic latch 70. The magnet chosen as magnet 74 in conjunction with poles 71 and 72 has a magnetic field with a very flat profile. This is desirable to minimize the effect that the latch has on the head positioner assembly when the heads are positioned over the data recording area of the information storage discs. By way of example, a suitable design strength for the magnetic latch is one in which the latch will withstand a 70 g shock pulse sustained diagonally across the drive.

In operation, the head positioner assembly will rest in a "home" position when the disc drive is not in use wherein magnetic latch 70 firmly holds the pivot housing in place. When a command is received to start the drive and access the disc, the voice coil motor is activated to pull the strike plate away from the magnetic latch and position the heads as directed. After the requested functions have been executed, the head positioner assembly is returned to the home position and the drive is stopped.

The described latching structure has several advantages. Primarily it allows the pivot housing to be symmetrically balanced. An evenly balanced head positioner assembly is very important to high speed discs

Although only one embodiment of the present invention has been described herein, it should be understood that the present invention may be embodied in many other specific forms without departing from the scope of the invention. Particularly, it should be appreciated that the actual configuration of the various disc drive components may be widely varied. The construction of the magnetic latch as well as its integration into the bumper stop may be widely varied as well. Therefore, the present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein, but may be modified within the scope of the appended claims.

CLAIMS

1. A magnetic latch for a disc drive system having a head positioner assembly for positioning a plurality of transducer heads relative to a recording media located within a disc housing, the head positioner assembly being movable with respect to the disc housing, the magnetic latch including:

a bumper stop fixably mounted to the housing for limiting the head positioner assembly's movement in one direction;

a strike plate carried by the head positioner assembly that is formed of a magnetic material; and

magnetic means supported in the bumper stop for magnetically engaging the strike plate to latch the head positioner assembly against the bumper stop when the drive is not in use;

said magnetic means including a slidable element that is slidably coupled to the bumper stop to insure that the magnetic means firmly engages the strike plate.

2. A magnetic latch for a disc drive system having a head positioner assembly for positioning a plurality of transducer heads relative to a recording media located within a disc housing, the magnetic latch including:

a bumper stop for limiting the head positioner assembly's movement in one direction, the bumper stop having a recess therein;

a strike plate carried by the head positioner assembly that is formed of a magnetic material;

magnetic means supported in the bumper stop for magnetically engaging the strike plate to latch

the head positioner assembly against the bumper stop when the drive is not in use; and

a bumper means disposed within said recess, including a bumper pad formed of a resilient material and carries said magnetic means to cushion the impact of the strike plate when it strikes said magnetic means;

said magnetic means including a slidable element that is slidably coupled to said bumper stop to insure that the magnetic means firmly engages said strike plate.

3. A magnetic latch as claimed in Claim 2, wherein the slidable element extends past the magnetic means in the bumper stop toward the strike plate to ensure that the strike plate does not hit the magnetic means at the end of its path of travel.

4. A disc drive system comprising:

a magnetic transducer head;

a magnetic recording media;

a head positioner assembly for positioning the transducer head relative to the recording media;

the head positioner assembly including a pivot mechanism, a pivot housing that carries said transducer head, said pivot housing being journaled about the pivot mechanism, and a voice coil motor for rotating said pivot housing about said pivot mechanism, the voice coil motor having a centre pole, a coil journaled about the centre pole in a spaced apart relation and a pair of outer poles disposed on opposite sides of said coil;

a bumper stop for limiting the head positioner assembly's movement in one direction, the bumper stop having a recess therein;

a strike plate formed of a magnetic

material, said strike plate being carried by the coil;

magnetic means carried by the bumper stop for magnetically engaging the strike plate to latch the head positioner assembly against the bumper stop when the drive is not in use; and

a bumper means disposed within said recess including a bumper pad formed of a resilient material and carrying said magnetic means for cushioning the impact of the strike plate when it strikes said magnetic means;

said magnetic means including a slidable element that is slidably coupled to said bumper stop to insure that the magnet means firmly engages said strike plate.

5. A disc drive as claimed in Claim 4 wherein the slidable element extends past the magnetic means in the bumper stop toward the strike plate to ensure that the strike plate does not hit the magentic means at the end of its path of travel.

6. A disc drive as claimed in Claim 4 or Claim 5 wherein said bumper stop is supported outside a region defined by said pair of outer poles where said coil is moving, said strike plate being mounted on said coil outside the region defined by said coil so that the bumper stop is defined directly behind the voice coil motor.

7. A disc drive as claimed in Claim 4 or Claim 5 wherein said magnetic means has a magnetic field with a very flat profile to minimize the effect of the latch on the head positioner when the heads are positioned over the storage disc.

8. A magnetic latch for a disc drive system

having a head positioner assembly for positioning at least one transducer head relative to a recording media located within a disc housing, the head positioner assembly being movable by a rotary voice coil motor with respect to the disc housing, the magnetic latch including:

a bumper stop fixably mounted to the housing for limiting the head positioner assembly's movement in one direction;

a strike plate formed of a magnetic material connected to the head positioner assembly; and

magnetic means connected to the bumper stop for magnetically engaging the strike plate to latch the head positioner assembly against the bumper stop when the drive is not in use;

said magnetic means including a slidable element that is slidably coupled to said bumper stop to insure that the magnetic means firmly engages said strike plate.

9. A magnetic latch as recited in Claim 8 wherein said strike plate is an elongated member.

10. A magnetic latch as recited in Claim 8 or Claim 9 further comprising a bumper pad formed from a resilient material which prevents the strike plate from hitting the magnetic means.

11. A magnetic latch as claimed in any one of Claims 8, 9 or 10 wherein the slidable element extends past the magnetic means in the bumper stop toward the strike plate to ensure that the strike plate does not hit the magnetic means at the end of its path of travel.

12. A magnetic latch as claimed in Claim 11

wherein said bumper stop is supported outside a region defined by said pair of outer poles where said coil is moving, said strike plate being mounted on said coil outside the region defined by said coil, so that the bumper stop is defined directly adjacent the voice coil motor.

13. A disc drive as claimed in any one of Claims 8 to 12 wherein said magnetic means has a magnetic field with a very flat profile to minimize the effect of the latch on the head positioner when the heads are positioned over the storage disc.

14. A magnetic latch for a disc system having a head positioner assembly including a rotary voice coil motor for positioning at least one transducer head relative to a recording media located within a disc housing, the head positioner assembly being movable with respect to the disc housing, the magnetic latch comprising:

a strike plate formed of a magnetic material incorporated into the head positioner assembly; and

engagement means for engaging the strike plate when the drive is not in use;

said engagement means comprising a bumper stop connected to the housing for limiting the head positioner assembly's movement in one direction;

a magnetic means connected to the bumper stop which magnetically engages the strike bumper to latch the head positioner assembly against the bumper stop; and

a slidable element that is slidably coupled to said bumper stop to insure that the magnetic means firmly engages said strike plate.

15. A magnetic latch as claimed in Claim 14

wherein the slidable element extends past the magnetic means in the bumper stop toward the strike plate to ensure that the strike plate does not hit the magnetic means at the end of its path of travel.

16. A magnetic latch as recited in Claim 14 or 15 wherein said engagement means further comprises a bumper pad formed of a resilient material and carrying said magnetic means for cushioning the impact of the strike plate when it strikes the magnetic means.

17. A disc drive system comprising:

a magnetic transducer head supported by an arm for movement over the disc;

a magnetic recording media;

a head positioner assembly for positioning the transducer head relative to the recording media, including a rotary voice coil motor for moving said arm about a pivot;

bumper stop means for limiting the head positioner assembly's movement in one direction;

a strike plate formed of a magnetic material connected to the head positioner assembly supported at said motor region of said arm; and

wherein the bumper stop means further comprises magnetic means for magnetically engaging the strike plate to latch the head positioner assembly against the bumper stop when the drive is not in use;

said magnetic means including a slidable element that is slidably coupled to said bumper stop means to insure that the magnetic means firmly engages said strike plate.

18. A disc drive as claimed in Claim 16

wherein the slidable element extends past the magnetic means in the bumper stop means toward the strike plate to ensure that the strike plate does not hit the magnetic means at the end of its path of travel.

19. A disc drive as claimed in Claim 17 or 18 wherein the bumper stop means includes a bumper pad formed of a resilient material and carrying said magnetic means for cushioning the impact of the strike plate when it strikes the magnetic means.

20. A disc drive as claimed in Claim 19 wherein said bumper stop means is supported outside a region defined by said pair of outer poles where said coil is moving, said strike plate being mounted on said coil outside the region defined by said coil so that the bumper stop means is defined directly adjacent the voice coil motor.

21. A disc drive as claimed in Claim 20 wherein said magnetic means has a magnetic field with a very flat profile to minimize the effect of the latch on the head positioner when the heads are positioned over the storage disc.

22. A magnetic latch substantially as hereinbefore described with reference to and illustrated in the drawings.

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