THIS SHEET HAS BEEN REPLACED

DISK CARTRIDGE ANTI-RATTLE MECHANISM

RELATED APPLICATION

This application is a continuation-in-part of copending U.S. application Serial No. 08/477,764 filed June 7, 1995 (Attorney's Docket No. IOM-8787) entitled "Disk Cartridge Anti-Rattle Mechanism" by Brian Schick.

BACKGROUND OF THE INVENTION

This invention relates to data storage drives and more particularly, to a removable cartridge for magnetic disk drives.

Magnetic disk drives which write and read digital data from flexible magnetic disks have been extensively used. "Floppy disk drives" have been extensively used for small, so-called microcomputer systems, for word-processing applications and the like. The flexible disk cartridge includes a relatively thin, flexible jacket which is inserted into the floppy disk drive.

Rigid disk drives, such as the IBM 3350, usually have a fixed rigid magnetic media. The magnetic heads do not contact the magnetic surface, but ride on a thin film of air. Because of this, and other features, these disk drives are capable of extremely precise and high speed operation. This type of disk drive is commonly referred to as a "Winchester" drive. Rigid disks enclosed in a rigid, removable cartridge, or shell have also been used. U.S. Patent 4,864,452-Thompson et al is an example of such a drive.

"Bernoulli" disk drives having performance characteristics similar to that of Winchester drives, but with removable cartridges, have been developed. A flexible magnetic disk is enclosed in a rigid box which is normally completely closed. U.S. Patent 4,400,748-Bauck, et al and related patents to the common assignee show such

This Sheet Has Been Replaced



drives using Bernoulli stabilized flexible disks. U.S. Patent No. 4,901,173-Jones et al and related patents to the common assignee, show improvements which relate to so-called "half height" drives.

The cartridges for these drives have a door which closes the cartridge when it is removed from the drive. This prevents debris from contaminating the magnetic recording medium when the cartridge is not in the drive. When the cartridge is inserted into the drive, this door slides to an open position to provide access for the magnetic recording heads to engage the recording medium.

When the cartridge is removed from the drive, it is often subject to rough handling. During handling, physical contact of the disk with the shell may damage the disk, particularly if the disk and cartridge shell are subject to excessive "rattling".

It is an object of the present invention to provide a device which clamps the disk to the cartridge shell when the cartridge is removed from the drive to prevent rattling of the cartridge.

SUMMARY OF THE INVENTION

In accordance with the present invention, a clamping mechanism in a data storage cartridge is actuated when the cartridge is removed from the drive. The mechanism restrains the recording medium to prevent rattling.

The clamping mechanism is driven by the motion of the sliding door. When the door is closed (cartridge out of drive) the mechanism expands and restrains the media from rattling inside the cartridge during handling. When the door is opened (cartridge inserted in the drive) the mechanism contracts such that it is free of the hub and the media is free to rotate.

The mechanism is attached to the sliding door by means of an actuating wire which provides a spring coupling to allow for mechanism over travel at both ends of the sliding stroke as well as compliance to account for relative changes in the distance between the mechanism and sliding door attachment point as the door travels through its stroke. In a preferred embodiment, a member rotatable about the axis of the recording medium has an arm connected to the door and attaches the sliding door to the mechanism. A wire in an opening in the terminal end of the arm telescopes into and out of the opening as the door travels through its stroke.

The clamping mechanism includes a rotating cam which rotates in the same axis as the media, a translating cam follower, a return spring, and an actuating wire, or arm, which connects the rotating cam to the motion of the sliding cartridge door. The mechanism is attached to the cartridge top shell half. It is situated in the cavity formed inside the media hub. The mechanism has two states; locked and unlocked. In the locked state the translating cam follower applies a force against the media hub effectively trapping the hub against the cartridge bottom shell. This force is sufficient to prevent the media from rattling against the cartridge shell halves when out of the drive. In the unlocked state the translating cam does not contact the hub thus allowing the media to spin freely.

The foregoing and other objects, features and advantages of the invention will be better understood from the following more detailed description and appended claims.

SHORT DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a top view of the cartridge of the present invention;

Fig. 2 is a front view of the cartridge;

Fig. 3 is an isometric view of the cartridge with the top shell removed;

Fig. 4 is a section on the lines A-A of Fig. 3;

Fig. 5 is a top view of the spindle motor;

Fig. 5A is a section on the line A-A of Fig. 5 showing the cartridge in place on the motor;

Fig. 6 is broken-away isometric view of the cartridge with the door closed;

Fig. 6A is a view similar to Fig. 6 with the door open;

Fig. 7 is a side view of the cam/cam follower assembly with the cartridge door open;

Fig. 8 is a top view of Fig. 7;

Fig. 8A is a section on the line A-A of Fig. 8;

Fig. 9 is a side view of the cam/cam follower assembly with the cartridge door in the open position;

Fig. 10 is a top view of the assembly of Fig. 9;

Fig. 10B is a section on the line B-B of Fig. 10;

THIS SHEET HAS BEEN REPLACED

Fig. 11 is an isometric view of the cam/cam follower assembly with the cartridge in the open position;

Fig. 11A is an isometric view of the section on the line A-A of Fig. 8;

Fig. 12 is an isometric view of the cam/cam follower assembly with the cartridge door in the open position; and

Fig. 12B is an isometric view of the section on the line B-B in Fig. 10;

Fig. 13 is a broken away perspective view of a preferred embodiment of the invention with the door in the closed position;

Fig. 14 is a cross-section of the cartridge of Fig. 13;

Fig. 15 is a broken-away perspective view of the cartridge of the preferred embodiment with the door in the open position;

Fig. 16 is a cross-section of the cartridge of Fig. 15; and

Fig. 17 is a top-plan view of the cartridge with the top shell and disks removed.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Figs. 1-4 show a cartridge having two half shells 11 and 12 joined together at 13. The cartridge has a front 14, a back 15 and two sides 16 and 17 between substantially flat, planar surfaces 18 and 19. An opening 20 in the front of the cartridge provides access by the read/write heads to the recording disks 22, 22A. A flexible door 23 covers the opening when the cartridge is removed from the drive.

In accordance with the present invention, a clamping mechanism is actuated as the door 23 is opened and closed. This mechanism includes a rotating cam 24 which is rotatable on the same axis as the disks 22. The cam 24 has a surface 25 which extends axially as a function of the circumference of the cam. Translating cam follower 26 (Fig. 6) is moved axially by the surface 25 as the cam 24 rotates. This axial movement clamps the disk 22 against the bottom half of the shell 11 in the position shown in Fig. 4.

As shown in Fig. 3, the rotating cam 24 is connected to the door 23 by the actuating wire 27. Actuating wire 27 provides a spring coupling which allows for over-travel at both ends of the stroke of the door 23. Spring 27 also provides for relative changes in the distance between the cam 24 and the point 28 at which the

This Sheet Has Been Replaced

THIS SHEET HAS BEEN REPLACED

actuating wire 27 is attached to the door 23. This distance varies as the door travels through its stroke.

Recording disks 22 and 22A are mounted on a hub 29 (Figs. 4 and 5A). A spacer 29A separates disks 22 and 22A. The cam follower 26 applies an axial force to the hub 29 to clamp the recording disk 22 against the bottom wall 11 of the shell.

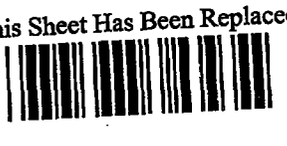
A retaining spring 30 is positioned co-axially with the hub 29. The retaining spring 30 applies torsion to the hub 29 to return it to the position shown in Fig. 3 after it has been translated by the cam follower 26. A compression spring 31 applies bias to the cam follower 26 to return it to a spring 31, which is concentric with, but outside of, the spring 30, provides return force for the cam follower 26 to bring it into its open position. The springs 30 and 31 are both shown in Fig. 11A. The cartridge has a cavity at the center thereof in which the clamping mechanism of the present invention is positioned. A hub cap 32 retains the springs in this cavity.

Figs. 13-17 show a preferred embodiment of the invention in which the connection between the clamping mechanism and the door is a member 33 which is rotatable about the axis of the disks. Rotatable member 33 has an arm 34 extending radially toward the door 23. The terminal end of arm 34 is connected to the door by the wire 35. (Figs. 16 and 17). Wire 35 is disposed in an opening 36 in the arm. The wire telescopes into and out of the opening 36 as the door travels through its stroke. This accommodates the varying radial distance to the door throughout its stroke.

A protrusion 37 on the arm has a spring 38 which provides the closing force needed to close the door through the last portion of its travel. The spring 38 has a bent end 39 which travels in the arcuate path 40. The arcuate path has a notch 41 at the closing end thereof. As the bent end 41 travels along arcuate path 40, it drops into the notch 41 at the closing end of the door stroke. This provides the extra force necessary to close the door.

Arcuate path 40 is a depression in the face of the cartridge. This depression has a cover 42 so that the spring 38, and its bent end 39 travel in a closed path.

This Sheet Has Been Replaced



Various modifications may be made to the preferred embodiment. The appended claims are, therefore, intended to cover all such modifications within the true spirit and scope of the invention.

* C L M S *

THIS SHEET HAS BEEN REPLACED

WHAT IS CLAIMED IS:

1. A cartridge for a drive in which read/write heads read/record data on a recording medium comprising:

a shell;

a recording medium in said shell;

said shell having an opening for access by said read/write heads to said recording medium;

a door covering said opening when said cartridge is removed from said drive; and

clamping means actuated as said door is opened and closed for restraining said medium when said door is closed and freeing said medium for rotation when said door is open.

2. The cartridge recited in claim 1 wherein said clamping means comprises:

a cam rotatable on the same axis as said recording medium, said cam having a surface which extends axially to clamp said medium when said cam is rotated.

3. The cartridge recited in claim 2 further comprising:

a translating cam follower which is moved axially by said cam to clamp said medium against one wall of said shell.

4. The cartridge recited in claim 2 wherein said cam is connected to said door to rotate said cam as said door is moved between the open and the closed position.

5. The cartridge recited in claim 4 wherein said cam is connected to said door by an actuating wire providing a spring coupling which allows for over-travel at both ends of the stroke of said door.

6. The actuator recited in claim 5 wherein said door slides in tracks and wherein said spring coupling provides tolerance for relative changes in the distance between said clamping means and the point at which said spring coupling wire is attached to said sliding door as said door travels through its stroke.

This Sheet Has Been Replaced

* C L M S *

THIS SHEET HAS BEEN REPLACED

7. The cartridge recited in claim 3 further comprising:

a hub on which said recording medium is mounted, said cam follower applying an axial force to said hub to clamp said medium against a planar wall of said shell.

8. The cartridge recited in claim 7 further comprising:

a return spring positioned co-axially with said hub, said return spring applying bias to said hub to return it after it has been translated by said cam follower.

9. The cartridge recited in claim 8 wherein said surface of said cam extends axially toward said planar wall of said cartridge as a function of the circumference of said cam, said cam urging said hub and attached disk against said planar wall when said door is in the closed position, said return spring urging said hub away from said planar wall as said door is moved to the open position.

10. The cartridge recited in claim 8 wherein said hub has a cavity at the center therein and wherein said clamping means is in said cavity.

11. The cartridge recited in claim 4 wherein said cam is connected to said door by a member rotatable about the axis of said recording medium.

12. The cartridge recited in claim 11 wherein said member has an arm extending radially toward said door, the terminal end of said arm being connected to said door.

13. The cartridge recited in claim 12 and further comprising:

a wire connecting the terminal end of said arm to said door, said wire being disposed in an opening in the terminal end of said arm, said wire telescoping into and out of said opening as said door opens and closes.

14. The cartridge recited in claim 11 further comprising:

a spring for returning said door to said closed position when said cartridge is removed from said drive.

15. The cartridge recited in claim 14 further comprising:

a protrusion on said member axially opposite of said arm; and

an arcuate path for said spring, said spring having a bent end, said bent end traveling in said arcuate path as said door moves from the open to the closed position.

This Sheet Has Been Replaced

THIS SHEET HAS BEEN REPLACED

16. The cartridge recited in claim 15 further comprising:

a notch at the end of said arcuate path, said bent end of said spring traveling into said notch to provide the force to close said door through the last portion of travel of said door to its closed position.

17. The cartridge recited in claim 15 further comprising:

a cover for said arcuate path, said spring traveling in the covered arcuate path as said door moves between the open and the closed position.

This Sheet Has Been Replaced

AMENDED CLAIMS

[received by the International Bureau on 07 October 1996 (07.10.96); original claims 2 and 3 cancelled; original claims 1,4,7 and 10 amended; new claims 18-20 added; remaining claims unchanged (4 pages)]

1. A cartridge for a drive in which read/write heads read/record data on a recording medium comprising:

a shell having a front, a back and two sides between substantially flat, planar surfaces;

a recording medium in said shell;

said shell having an opening in the front thereof for access by said read/write heads to said recording medium;

a door covering said opening when said cartridge is removed from said drive; and

a cam rotatable on the same axis as said recording medium, said cam having a surface which extends axially to clamp said medium against one of said sides when said cam is rotated as said door is opened and closed, a translating cam follower which is moved axially by said cam to clamp said medium against one side of said shell as said door is closed and to free said medium for rotation as said cam is rotated to open said door.

2. [canceled)

3. [canceled)

4. The cartridge recited in claim 1 wherein said cam is connected to said door to rotate said cam as said door is moved between the open and the closed position.

5. The cartridge recited in claim 4 wherein said cam is connected to said door by an actuating wire providing a spring coupling which allows for over-travel at both ends of the stroke of said door.

6. The actuator recited in claim 5 wherein said door slides in tracks and wherein said spring coupling provides tolerance for relative changes in the distance between said clamping means and the point at which said spring coupling wire is attached to said sliding door as said door travels through its stroke.

7. The cartridge recited in claim 1 further comprising:

a hub on which said recording medium is mounted. said cam follower applying an axial force to said hub to clamp said medium against a planar wall of said shell.

8. The cartridge recited in claim 7 further comprising:

a return spring positioned co-axially with said hub. said return spring applying bias to said hub to return it after it has been translated by said cam follower.

9. The cartridge recited in claim 8 wherein said surface of said cam extends axially toward said planar wall of said cartridge as a function of the circumference of said cam. said cam urging said hub and attached disk against said planar wall when said door is in the closed position. said return spring urging said hub away from said planar wall as said door is moved to the open position.

10. The cartridge recited in claim 8 wherein said hub has a cavity at the center therein and wherein said cam is in said cavity.

11. The cartridge recited in claim 4 wherein said cam is connected to said door by a member rotatable about the axis of said recording medium.

12. The cartridge recited in claim 11 wherein said member has an arm extending radially toward said door. the terminal end of said arm being connected to said door.

13. The cartridge recited in claim 12 and further comprising:

a wire connecting the terminal end of said arm to said door, said wire being disposed in an opening in the terminal end of said arm, said wire telescoping into and out of said opening as said door opens and closes.

14. The cartridge recited in claim 11 further comprising:

a spring for returning said door to said closed position when said cartridge is removed from said drive.

15. The cartridge recited in claim 14 further comprising:

a protrusion on said member axially opposite of said arm; and

an arcuate path for said spring, said spring having a bent end, said bent end traveling in said arcuate path as said door moves from the open to the closed position.

16. The cartridge recited in claim 15 further comprising:

a notch at the end of said arcuate path, said bent end of said spring traveling into said notch to provide the force to close said door through the last portion of travel of said door to its closed position.

17. The cartridge recited in claim 15 further comprising:

a cover for said arcuate path, said spring traveling in the covered arcuate path as said door moves between the open and the closed position.

18. A cartridge for a drive in which read/write heads read/record data on a recording medium comprising:

a shell;

a recording medium in said shell;

said shell having an opening for access by said read/write heads to said recording medium;

a door covering said opening when said cartridge is removed from said drive; and

a cam rotatable on the same axis as said recording medium, said cam having a surface which extends axially to clamp said medium against one of said sides when said cam is rotated as said door is opened and closed. a translating cam follower which is moved axially by said cam to clamp said medium against one side of said shell as said door is closed and to free said medium for rotation as said cam is rotated to open said door;

said cam being connected to said door to rotate said cam as said door is moved between the open and the closed position;

a member rotatable about the axis of said recording medium, said cam being connected to said door by said member, said member having an arm extending radially toward said door, the terminal end of said arm being connected to said door; and

a wire connecting the terminal end of said arm to said door, said wire being disposed in an opening in the terminal end of said arm, said wire telescoping into and out of said opening as said door opens and closes.

19. A cartridge for a drive in which read/write heads read/record data on a recording medium comprising

a shell;

said recording medium being in said shell;

said shell having an opening for access by said read/write heads to said recording medium

a door covering said opening when said cartridge is removed from said drive;

clamping means actuated as said door is opened and closed for restraining said medium when said door is closed and freeing said medium for rotation when said door is open, said clamping means comprising:

a cam rotatable on the same axis as said recording medium, said cam having a surface which extends axially to clamp said medium when said cam is rotated;

a translating cam follower which is moved axially by said cam to clamp said medium against one wall of said shell;

a hub on which said recording medium is mounted, said cam follower applying an axial force to said hub to clamp said medium against said wall of said shell; and

a return spring positioned coaxially with said hub, said return spring applying bias to said hub to return it after it has been translated by said cam follower.

20. The cartridge recited in claim 19 wherein said surface of said cam extends axially toward said wall of said cartridge as a function of the circumference of said cam, said cam urging said hub and attached disk against said wall when said door is in the closed position, said return spring urging said hub away from said wall as said door is moved to the open position.