

slider with a round spherical bearing face was slowly swept across the surface of the disk. It was believed by the inventor that some particles struck the rounded side of the slider, and were dislodged. There was also described, a strong movement of air laterally outward from under the slider, which helps to carry dislodged particles, and other particles not so dislodged, clear of the slider. The slider was moved radially outward from the disk center by about one fourth the width of the slider per rotation of the disk.

Fibers contacting the disk surface were used in US-A-No. 3,366,390 issued to Applequist et al. to dislodge dust particles. Air flow from the rotating disk then carries the particles off of the disks.

All of the previous solutions were directed toward larger particles than presently are encountered. Such large particles were easily dislodged, and spun off the disk surface. The small particles which cause problems in today's disk drive devices do not dislodge so easily. The prior solutions have not proven effective in clearing disk surfaces of such debris.

### SUMMARY OF THE INVENTION

It is an object of the present invention to ameliorate one or more disadvantages of the prior art.

According to one aspect of the invention there is provided a data storage device comprising: a disk having a data storing surface; means for controllably rotating said disk in first and second directions; a slider supported adjacent the data storing surface of said disk, said slider transducing data when said disk is rotated in the first direction; and means for moving the slider to remove debris from the data storing surface when said disk is rotated in the second direction.

According to another aspect of the invention there is provided a data storage device comprising: a disk having a data storing surface; means for controllably rotating said disk in first and second directions; a slider supported adjacent the data storing surface of said disk, said slider having a surface forming a plowing edge; and means for moving the slider to plow debris from the data storing surface when said disk is rotated in the second direction.

According to still another aspect of the invention there is provided a data storage device comprising: a disk having a data storing surface; means for controllably rotating said disk in first and second directions; a slider supported adjacent the data storing surface of said disk, said slider having a surface forming a plowing edge; means for moving the slider to plow debris from the data storing surface when said disk is rotated in the second direction; a frame for supporting the disk rotating means and actuator means; and a cover sealingly coupled to the frame for preventing harmful particle contamination from entering the data storage device.

According to still another aspect of the invention there is provided a data storage device comprising: a disk having a data storing surface; means for controllably rotating said disk in first and second directions; and a slider supported adjacent the data storing surface of said disk, said slider transducing data when said disk is rotated in the first direction, and removing debris from the data storing surface when said disk is rotated in the second direction.

According to yet another aspect of the invention there is provided a data storage device comprising: a disk having a data storing surface; means for controllably rotating said disk in first and second directions; a slider supported adjacent the data storing surface of said disk, said slider having a surface forming a plowing edge; actuator means

for moving the slider to plow debris from the data storing surface when said disk is rotated in the second direction; a frame for supporting the disk rotating means and actuator means; a cover sealingly coupled to the frame for preventing harmful particle contamination from entering the data storage device; means for monitoring the error rates of the disk drive; and means for initiating the cleaning of the disk based on said error rates.

### DESCRIPTION OF THE PREFERRED EMBODIMENTS

For a better understanding of the present invention, reference can be made to the accompanying drawings, in which:

Fig. 1 is an exploded view of a disk drive device.

Fig. 2 is a detailed view of a spindle and spindle motor assembly for the disk drive of Fig. 1.

Fig. 3 is a block diagram of a spindle motor controller.

Fig. 4 is a perspective view of a disk slider.

Fig. 5 is a bottom view of the disk slider of Fig. 4.

Fig. 6 is a block diagram side view of the front end of a disk slider.

Fig. 7 is a block diagram side view of the back end of a disk slider.

Fig. 8 is a perspective view of a disk slider.

Fig. 9 is a bottom view of the disk slider of Fig. 8.

Fig. 10 is a top view of a disk and actuator.

Fig. 11 is a block diagram of an actuator motor controller.

These drawings are not intended as a definition of the invention, but are provided solely for the purpose of

## CLAIMS

1. A data storage device comprising:
  - a disk having a data storing surface;
  - means for controllably rotating said disk in first and second directions;
  - a slider supported adjacent the data storing surface of said disk, said slider transducing data when said disk is rotated in the first direction; and
  - means for moving the slider to remove debris from the data storing surface when said disk is rotated in the second direction.
2. The data storage device of claim 1 wherein said slider supports a head for reading and writing data.
3. The data storage device of claim 2 wherein said head comprises a magnetoresistive transducer.
4. The data storage device of claim 2 wherein said head comprises a thin film magnetoresistive transducer.
5. The data storage device of claim 2 wherein said head comprises an inductive transducer.
6. The data storage device of claim 2 wherein said head comprises a thin film inductive transducer.
7. The data storage device of claim 1 wherein said slider is comprised of a ceramic material.
8. The data storage device of claim 1 wherein said slider is comprised of ferrite.
9. The data storage device of claim 1 wherein said slider is overcoated with carbon.
10. The data storage device of claim 1 wherein said slider supports a ferrite transducer head for reading and writing data.
11. The data storage device of claim 1 wherein said slider has an outer diameter rail and a back end surface, said slider further comprising a plowing edge formed by the intersection of the surface of said outer diameter rail adjacent the disk surface, and the back end surface of the slider.

12. The data storage device of claim 11 wherein said slider further comprises an outer diameter edge and a second plowing edge formed by the intersection of the outer diameter edge of the slider and the surface of the outer diameter rail adjacent the disk surface.
13. The data storage device of claim 12 wherein the angle of intersection of the outer diameter edge of the slider and the surface of the outer diameter rail is sufficiently great and sharp to inhibit debris on the disk surface from sliding under the rail surface.
14. The data storage device of claim 1 wherein said slider has at least one rail, and a plowing edge formed by the intersection of the surface of at least one rail adjacent the disk surface and at least one side of the slider.
15. The data storage device of claim 14 wherein the angle of intersection of the outer diameter edge of the slider and the surface of said rail is sufficiently great and sharp to inhibit debris on the disk surface from sliding under the rail surface.
16. The data storage device of claim 1 and further comprising:
  - means for monitoring the error rates of the disk drive; and
  - means for initiating the cleaning of the disk based on said error rates.
17. The data storage device of claim 1 and further comprising:
  - means for monitoring the number of start-stop cycles of the disk drive; and
  - means for initiating the cleaning of the disk based on said count.
18. The data storage device of claim 1 and further comprising:
  - means for monitoring the error rates of the disk drive;
  - means for initiating the cleaning of the disk based on said error rates;
  - means for monitoring the number of start-stop cycles of the disk drive; and
  - means for initiating the cleaning of the disk based on said count.
19. A data storage device comprising:
  - a disk having a data storing surface;
  - means for controllably rotating said disk in first and second directions;

a slider supported adjacent the data storing surface of said disk, said slider having a surface forming a plowing edge; and

means for moving the slider to plow debris from the data storing surface when said disk is rotated in the second direction.

20. A data storage device comprising:

a disk having a data storing surface;

means for controllably rotating said disk in first and second directions;

a slider supported adjacent the data storing surface of said disk, said slider having a surface forming a plowing edge;

means for moving the slider to plow debris from the data storing surface when said disk is rotated in the second direction;

a frame for supporting the disk rotating means and actuator means; and

a cover sealingly coupled to the frame for preventing harmful particle contamination from entering the data storage device.

21. The data storage device of claim 20 wherein said slider supports a head for reading and writing data.

22. The data storage device of claim 21 wherein said head comprises a magnetoresistive transducer.

23. The data storage device of claim 21 wherein said head comprises a thin film magnetoresistive transducer.

24. The data storage device of claim 21 wherein said head comprises an inductive transducer.

25. The data storage device of claim 21 wherein said head comprises a thin film inductive transducer.

26. The data storage device of claim 20 wherein said slider is comprised of a ceramic material.

27. The data storage device of claim 20 wherein said slider is comprised of ferrite.

28. The data storage device of claim 20 wherein said slider is overcoated with carbon.

29. The data storage device of claim 20 wherein said slider has an outer diameter rail, and said plowing edge is formed by the intersection of the surface of the rail adjacent the disk surface, and the back end of the slider.

30. The data storage device of claim 29 wherein a second plowing edge is formed by the intersection of the outer diameter edge of the slider and the surface of the outer diameter rail.

31. The data storage device of claim 30 wherein the angle of intersection of the outer diameter edge of the slider and the surface of the outer diameter rail is sufficiently great enough to inhibit debris on the disk surface from sliding under the rail surface.

32. The data storage device of claim 20 wherein the slider includes an outer diameter rail and an outer diameter edge, said plowing edge formed at the intersection of the outer diameter edge and the surface of the outer diameter rail, the angle of intersection between the outer diameter edge of the slider and the surface of the outer diameter rail being sufficiently great and sharp to inhibit debris on the disk surface from sliding under the rail surface.

33. The data storage device of claim 30 wherein the angle of intersection of the outer diameter edge of the slider and the surface of the outer diameter rail is sufficiently great and sharp to inhibit debris on the disk surface from sliding under the rail surface.

34. The data storage device of claim 20 and further comprising:  
means for monitoring the error rates of the disk drive; and  
means for initiating the cleaning of the disk based on said error rates.

35. The data storage device of claim 20 and further comprising:  
means for monitoring the number of start-stop cycles of the disk drive; and  
means for initiating the cleaning of the disk based on said count.

36. The data storage device of claim 20 and further comprising:  
means for monitoring the error rates of the disk drive;  
means for initiating the cleaning of the disk based on said error rates;  
means for monitoring the number of start-stop cycles of the disk drive; and

- means for initiating the cleaning of the disk based on said count.
37. A data storage device comprising:
- a disk having a data storing surface;
  - means for controllably rotating said disk in first and second directions; and
  - a slider supported adjacent the data storing surface of said disk, said slider transducing data when said disk is rotated in the first direction, and removing debris from the data storing surface when said disk is rotated in the second direction.
38. The data storage device of claim 37 and further comprising:
- means for monitoring the error rates of the disk drive; and
  - means for initiating the cleaning of the disk based on said error rates.
39. The data storage device of claim 37 and further comprising:
- means for monitoring the error rates of the disk drive;
  - means for initiating the cleaning of the disk based on said error rates;
  - means for monitoring the number of start-stop cycles of the disk drive; and
  - means for initiating the cleaning of the disk based on the count.
40. A data storage device comprising:
- a disk having a data storing surface;
  - means for controllably rotating said disk in first and second directions;
  - a slider supported adjacent the data storing surface of said disk, said slider having a surface forming a plowing edge;
  - actuator means for moving the slider to plow debris from the data storing surface when said disk is rotated in the second direction;
  - a frame for supporting the disk rotating means and actuator means;
  - a cover sealingly coupled to the frame for preventing harmful particle contamination from entering the data storage device;
  - means for monitoring the error rates of the disk drive; and
  - means for initiating the cleaning of the disk based on said error rates.