



BRUSHLESS DC MOTOR FOR DISC DRIVE

BACKGROUND OF INVENTION

1. Field of the Invention

5 This invention relates to a brushless DC motor, more specifically, to a brushless DC motor for a disc drive with higher fidelity which is accomplished by retaining a rotor unmovably in a axial direction using a core insulator and by centering a disc automatically when it is put on the upper side
10 of the rotor.

2. Description of the prior art

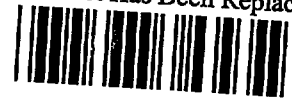
Generally, most of bearings used in a spindle motor for a digital video disc (DVD) drive or a compact disc (CD) drive are ball bearings or sintered bearings. For these motors, there
15 should be an axially retaining structure which stops a rotor from releasing and maintains the assembled structure when a disc is put or discarded. It consists of ball bearings and springs to control the pre-pressure of ball bearings in the case of ball bearings while the retaining in sintered fluid bearings is
20 possible through a design of the outer structure of the rotor and the base. However, as for a high speed spindle motor of a DVD drive, ball bearings are not proper due to vibration and noise, and the outer structure of a rotor and base has the problem that the unbalance power of rotating rotor is relatively greater.

25 Fig. 1 is a sectional view of a spindle motor of the prior art using a dynamic pressure bearing. A bearing1a is forcibly inserted into a bore formed in an upper and central portion of the base. A shaft2 is inserted into the bearing1a. A stator1b is

provided in the outer circumferential face of the base1 and a cap-type rotor is secured to the upper end of the shaft2. A magnet3a is provided in a inner circumferential face of the rotor. When a power is applied to the coils wound in the stator facing the stator1b, a magnetic force arises in the magnet and the rotor rotates around. On the upper side of the rotor, a disc4 is located and a disc clamp5 is provided at the bottom side of the door6.

The conventional spindle motor has a groove2a for generating a dynamic pressure. When the shaft2 rotates at high speed, the oil filled between the shaft2 and the bearing1a generates dynamic pressure and the shaft2 is retained in the radial direction by the pressure. While the shaft rotates, a disc located on the upper side of the rotor rotates and information written in the disc is read. However, the rotor3 could be released or could be moved in the axial direction of the shaft. The shaft is not retained in the axial direction due to the minute space between the shaft2 and the bearing1a for generating the dynamic pressure. Therefore, when the grip of the disc clamp5 is released the rotor3 could be lifted by magnets formed at the bottom face of the disc clamp5. To solve the problem a structure between the rotor3 and the base has been suggested but has failed to meet the requirements of low vibration and noise due to relatively greater unbalance power of rotating rotor. In addition, there has been no desirable means of adjusting the center of the rotation of a disc to alleviate unbalance. Insertion of the disc through the hole of the disc into a projection in the upper side of the rotor3 damages the loadability of the disc.





SUMMARY OF THE INVENTION

It is an object of this invention to provide a brushless DC motor with higher fidelity wherein the rotor is retained in the axial direction and cannot be released by using a novel structure of a stator insulator which insulates a body from an stator without an additional structure, and thus without additional unvalence power.

It is another object of this invention to provide a brushless DC motor with higher fidelity wherein the center of a rotating disc is adjusted automatically.

In order to obtain the objects, according to the present invention, there is provided a brushless DC motor for a disc drive comprising:

- a base;
- a coil-wound stator secured to the upper portion of the base;
- one or more first stopper extending from said stator;
- a shaft defined as a rotation axis of said motor;
- a bearing system secured to the upper portion of the base to receive the shaft so that said shaft rotates coaxially with said stator;
- a rotor having a hub and a cylindrical wall portion extending downward at the fringe of said hub, said rotor being secured to said shaft via said hub;
- one or more magnets secured to the inner circumferential face of said cylindrical wall portion of said rotor so that said magnets face said stator with an air gap therebetween; and
- a second stopper secured to said rotor, in such a way that said

first stopper block said second stopper and said rotor is retained in the axial direction.

By the such construction, the release of rotor is repressed.

BRIEF DESCRIPTION OF THE DRAWINGS

5 Fig. 1 is a sectional view of a conventional motor.

Fig. 2 is a sectional view of the motor according to an embodiment of this invention.

Fig. 3 is a partial view in the perspective of the motor according to another embodiment of this invention.

10 Fig. 4 is a sectional view of the motor according to another embodiment of this invention

Fig. 5 is a partial view in the perspective of the motor according to another embodiment of this invention.

15 Fig. 6 is a sectional view of the motor according to another embodiment of this invention

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Desirable embodiments according to this invention will be described with reference to attached Figures.

20 Fig. 2 is a sectional view of the motor according to an embodiment of this invention.

Fig. 3 is a partial view in the perspective of the motor according to another embodiment of this invention. A hollow bearing11 is inserted into a bore at the central and upper portion10a of the base. A coil-wound stator14 is provided at the circumferential face of the upper portion10a of the base10. The
25 upper portion10a of the base is cylindrical which comprises inner wall for securing a bearing system, outer wall for securing a stator14 and a top wall linking the previous two walls.



A stator insulator16 insulates a stator14 from a base10. The insulator consists of a cylinder16a and two groups of covers16a abutting outwardly the top end and the bottom end of the cylinder respectively. A shaft12 is inserted into the hole of the bearing11. Oil is filled to the space between the shaft12 and the bearing11. A dynamic pressure is generated during rotation of the shaft12 by the groove13 formed at the circumferential face of the shaft.

A rotor18 is located coaxially with the stator14. The rotor18 has a hub, one or more magnets and a cylindrical wall portion extending downward from the hub. The rotor is engaged with the shaft via the hub. The hub17 of the rotor18 is engaged with the shaft12 at the upper portion of the shaft. One or more magnets19 secured to the inner circumferential face of the cylindrical wall portion of the rotor so that the magnets face the stator with an air gap therebetween. When a power is applied to the coils wound in the stator facing the magnets19 a magnetic force arises in the magnet and the rotor rotates around. On the upper side of the rotor a disc4 is located and a disc clamp5 is provided under the door6. A disc20 is put on the upper side of the rotor18 and is opened or closed by the door21. A disc clamp22 having magnets and rotating idly is provided under the door21 and press the disc against the upper face of the rotor by magnetic force. A means to repress the lift of the motor18 is provided. It represses the movement of the rotor in the axial direction when the rotor rotates or the disc is lifted. A plurality of the first stoppers having inward projection are provided radially at the upper end of the insulator16a. A second stopper is provided



at the lower end of the hub17. The second stopper26 is a hollow circular plate or a flange secured to the lower end of the hub17. The first stoppers blocks the second stopper and repress the movement of the rotor18 in the axial direction.

5 To adjust the center of the rotor18 to the clamp22 , center adjusting means is provided. A upwardly enlarging conical elastomer28 is provided as a means for adjusting the center of the disc. The bottom of the elastomer lies on the flange of the second stopper26. A plurality of guides having guide surfaces31
10 are provided at the upper end of the elastomer28. The guide's surface contacts the surface of the hole formed in the center of the disc. When the guides30 are inserted into slots formed at the upper portion of the rotor, the guide surface31 are exposed from the slots. The elastomer28 consists of plastic and has a
15 circularV-shape neck.

A hollow bearing is secured into the upper portion10a of the base10 and a coil-wound stator14 is secured on the circumferential surface of the base. An insulator16 is provided to insulate the stator14 from the base10. A shaft12 is inserted
20 into a bearing11. Oil for dynamic pressure is filled to the space between the shaft12 and the bearing11. The hub17 for rotating the rotor is combined to the upper portion of the shaft12. A second stopper26 is provided at the lower end of the hub17 and, a plurality of the first stopper25 extends radially from the
25 insulator. About 1 mm gap exists between the first stopper25 and the second stopper26. Therefore, the first stopper25 and the second stopper26 do not impede each other and the rotor rotates normally. When the rotor18 is lifted upward the gap is decreased



and the first stopper block the second stopper.

The lift of the rotor18 occurs as follows. When a disc20 is put on the upper surface of the rotor18 and the door is closed the disc clamp22 pushes the upper portion of the disc. A magnet
5 provided at the bottom of the disc clamp22 pulls in the hub17 and the disc clamp22 pushes the upper side of the disc20. When a power is applied to the coil15, the magnetic force rotates the shaft12 and the rotor18 at high speed the information written in the disc is read. When the door is open the rotor stops and then
10 the disc clamp22 is lifted. At this instant the magnet23 pulls the hub17 and the rotor18 upwardly and could release the rotor. However, in this invention the first stopper25 blocks the second stopper26 and only disc clamp22 is released.

When a disc is put on the upper side of the rotor18 the
15 center of the disc is adjusted automatically. A plurality of guides are exposed from the upper side of the rotor18. When a disc is put on the upper side of the rotor18, the disc is inserted into the guides through guide surfaces31. At this instant, guides descends a little. The hole20a of the disc is
20 inserted into the guides through the guide surfaces31 completely and the center of the disc20 is adjusted to the center of the rotor. The neck29 absorb a shock of the weight of a disc.

Fig. 4 is a sectional view of a spindle motor according to another embodiment of the invention. Same numerals are designated
25 to the same structure regardless of embodiment. In this embodiment. Center adjusting means is different from the previous one. The center adjusting means absorbs the shock of the weight of a disc and adjusts the center of a disc to the center of the



rotor when a disc is put on the rotor. A coil spring elastomer20a is used. The elastomer is fitted to the outer surface face of the projection of the hub17 and the bottom of the elastomer lies on the plate of the second stopper. A plurality of guides are
5 disposed radially at the upper end of the elastomer28a.

A plurality of guides having guide surfaces31 are provided at the upper end of the elastomer28. The guide's surface contacts the inner surface of the hole formed in the center of the disc. When the guides30 are inserted into slots formed at the upper
10 portion of the rotor, the guide surface31 are exposed from the slots. When a disc is put on the upper side of the rotor18 the center of the disc is adjusted automatically. A plurality of guides are exposed from the upper side of the rotor18. when a disc is put on the upper side of the rotor, the disc is inserted
15 into the guides through guide surfaces31. At this instant, guides descends a little. The hole20a of the disc is inserted into the guides through the guide surfaces31 completely and the center of the disc20 is adjusted to the center of the rotor18.

Fig. 6 is a sectional view of a spindle motor according to another embodiment of the invention. Same numerals are designated to the same structure regardless of embodiment. In this
20 embodiment a first stopper is formed at the upper end of the upper portion of the base and a second stopper is formed as flange monolithically with the hub of the rotor. The operation is the same as the other embodiment and the description of it is
25 omitted.

As described above, a means to repress the lift of the motor18 is provided at the stator18 and the hub17. A plurality of



the first stopper are provided radially at the upper end of the insulator16a. A second stopper is provided at bottom end of the hub17. The second stopper26 is a hollow circular plate. A means to repress the lift of the motor18 is provided at the stator18 and the hub17. The brushless DC motor of the present invention has higher fidelity that the rotor is retained in the axial direction and cannot be released by using a novel structure of a stator insulator which insulates a body from the stator without an additional structure, and thus without additional unvalence power. The brushless DC motor of the present invention also has the merit that it is convenient to adjust the center of a disc, and thus to load a disc.

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WHAT ID CLAIMED IS:

1. A brushless DC motor for a disc drive comprising:
a base;

a coil-wound stator secured to the upper portion of the
base;

one or more first stoppers secured to said stator;

a shaft defined as a rotation axis of said motor;

a bearing system forcibly inserted into a bore formed in the
upper portion of the base to receive the shaft so that said shaft
rotates coaxially with said stator;

a rotor having a hub, a cylindrical wall portion extending
downward at the fringe of said hub, said rotor being secured to
said shaft via said hub, one or more magnets secured to the inner
circumferential face of said cylindrical wall portion of said
rotor so that said magnets face said stator with an air gap
therebetween; and

a second stopper secured to said rotor, in such a way that
said first stopper block said second stopper and said rotor is
retained in the axial direction.

2. A brushless DC motor for a disc drive according to Claim 1,
wherein said motor has an insulation between said rotor and said
base, and the first stoppers extends from the upper end of said
insulator equidistantly.

3. A brushless DC motor for a disc drive according to Claim 2,
wherein the second stopper is a flange connected to the lower
end of the hub of the rotor whereby the lift of the rotor is
depressed in such a way that the first stopper block said
flange.





4. A brushless DC motor for a disc drive comprising:

a base;

a coil-wound stator secured to the upper portion of the base;

5 one or more first stoppers secured to the upper end of the upper portion of said base;

a shaft defined as a rotation axis of said motor;

a bearing system forcibly inserted into a bore formed in the upper portion of the base to receive the shaft so that said shaft
10 rotates coaxially with said stator;

a rotor having a hub, a cylindrical wall portion extending downward at the fringe of said hub, said rotor being secured to said shaft via said hub, one or more magnets secured to the inner circumferential face of said cylindrical wall portion of said
15 rotor so that said magnets face said stator with an air gap therebetween;

a second stopper secured to said rotor, in such a way that said first stopper block said second stopper and by said rotor is retained in the axial direction.

20 5. A brushless DC motor for a disc drive according to Claim 4, wherein the upper portion of the base comprises an outer wall to secure the stator, an inner wall to secure the bearing system and an upper end wall for linking the outer wall and providing the first stoppers.

25 6. A brushless DC motor for a disc drive according to Claim 5, wherein the second stopper is formed at the lower end of the hub monolithically with the hub.

7. A brushless DC motor for a disc drive comprising:





a base;

a coil-wound stator secured to the upper portion of the base;

one or more first stoppers extending from said stator;

5 a shaft defined as a rotation axis of said motor;

a bearing system forcibly inserted into a bore formed in the upper portion of the base to receive the shaft so that said shaft rotates coaxially with said stator;

10 a rotor having a hub, a cylindrical wall portion extending downward at the fringe of said hub, said rotor being secured to said shaft via said hub a plurality of guides disposed circumferentially and equidistantly on a projection of the upper surface of the rotor to guide a disc to a position coaxial with the rotor when a disc is put on the upper surface of the rotor
15 one or more magnets secured to the inner circumferential face of said cylindrical wall portion of said rotor so that said magnets face said stator with an air gap therebetween;

a second stopper secured to said rotor, in such a way that said first stopper block said second stopper and said rotor is
20 retained in the axial direction.

8. A brushless DC motor for a disc drive according to Claim 7, wherein an insulator is provided between the stator and the base to insulate the stator from the base and a plurality of the first stoppers are provided at the upper end of the insulator
25 circumferentially and equidistantly.

9. A brushless DC motor for a disc drive according to Claim 8, wherein the second stopper is a flange outwardly formed at the lower end of the hub of the rotor whereby the first stopper





blocks the second stopper and the lift of the rotor is repressed.

10. A brushless DC motor for a disc drive according to Claim 7,
further comprising a cone-shape elastomer provided at the outer
circumferential face of the hub.

11. A brushless DC motor for a disc drive according to Claim 10,
wherein the elastomer has a neck for elasticity.

12. A brushless DC motor for a disc drive according to Claim 7,
wherein the elastomer is a coil spring.

13. A brushless DC motor for a disc drive according to Claim 7,
wherein the rotor has a projection with a plurality of slots
which is disposed radially and at the same angle between each of
the slots on the upper side of the rotor.

14. A brushless DC motor for a disc drive comprising:

a base;

a coil-wound stator secured to the upper portion of the
base;

one or more first stoppers secured to the upper portion of
the base;

a shaft defined as a rotation axis of said motor;

a bearing system forcibly inserted into a bore formed in the
upper portion of the base to receive the shaft so that said shaft
rotates coaxially with said stator;

a rotor having a hub, a cylindrical wall portion extending
downward at the fringe of said hub, said rotor being secured to
said shaft via said hub one or more magnets secured to the inner
circumferential face of said cylindrical wall portion of said
rotor so that said magnets face said stator with an air gap





therebetween;

a second stopper secured to said rotor, in such a way that said first stopper block said second stopper and said rotor is retained in the axial direction.

- 5 15. A brushless DC motor for a disc drive according to Claim 14, wherein the upper portion of the base comprises an outer wall for securing the stator, an inner wall to secure the bearing system and an upper end wall for linking the outer wall and the inner wall, and receiving the first stopper.
- 10 16. A brushless DC motor for a disc drive according to Claim 15, wherein the second stopper is formed at the edge of the hub monolithically with the hub.
- 15 17. A brushless DC motor for a disc drive according to Claim 14, further comprising a cone-shape elastomer engaged with the outer circumferential face of the hub to support the guides elastically.
18. A brushless DC motor for a disc drive according to Claim 17, wherein the elastomer has a neck for elasticity.
- 20 19. A brushless DC motor for a disc drive according to Claim 17, wherein the elastomer is a coil spring.
20. A brushless DC motor for a disc drive according to Claim 14, wherein the rotor has a projection with a plurality of slots which is disposed radially and at the same angle between each of the slots on the upper side of the rotor.

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