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Specification

1. Title of the Invention:

Magnetic disk device

2. Detailed Description of the Invention:

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[Field of the invention]

The present invention relates to a magnetic disk device including a rotatable magnetic disk, a rotatable carriage having a magnetic head attached to its end and a rotary actuator for rotating the carriage between a base and a cover.

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[Background art]

Generally, the magnetic disk device as described above has been provided with a voice coil motor as a rotary actuator. The voice coil motor is equipped with a coil attached to a carriage and upper and lower yokes having magnets for applying a magnetic field to the coil.

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Conventionally, an attaching part for attaching yokes for such a voice coil motor has been constructed as illustrated in Figure 8. Referring to Figure 8, reference numeral 1 designates a base, 2 designates a cover and a carriage (not illustrated) having a magnetic head attached to its end is provided so as to be rotatable about an axis O. Reference numeral 3 denotes a first lower yoke to which a first magnet 4 is attached, 5 designates

a second upper yoke to which a second magnet 6 is attached and a coil (not shown) mounted on the carriage is located between the opposed surfaces of these magnets 4 and 6. The coil, the yokes 3 and 5 and the magnets 4 and 6 constitute the voice coil motor as the rotary actuator. The yokes 3 and 5 are connected together as one connected member, and then, the connected member is fixed to the base 1 by means of a fixing screw 7. The fixing screw 7 passes through the lower yoke 3 from the upper yoke 5 and is screwed to the base 1. After the yokes 3 and 5 are secured to the base 1 by means of the fixing screw 7, the cover 2 is mounted on them.

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[Problems to be solved by the invention]

However, since the yokes 3 and 5 are only fixed to the base 1 side by means of the fixing screw 7, it has been difficult to firmly secure them to the base. Further, when the carriage is rotated by the voice coil motor, the yokes 3 and 5 have been vibrated thereby by virtue of a reaction thereof, which has caused undesirably a noise.

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In addition, since the fixing screw 7 is located between the opposed surfaces of the yokes 3 and 5, the fixing screw 7 may possibly inconveniently become an obstacle when the carriage is mounted between the base and the cover. In other words, when the carriage and the magnetic disk are mounted between the base and the cover, the carriage has needed to be mounted so as to be largely separated from the magnetic disk in order to prevent the carriage from interfering with the magnetic disk, while the carriage is kept located between the opposed surfaces of the yokes 3 and 5. In that case, the fixing screw 7 located between

the opposed surfaces of the yokes 3 and 5 has disadvantageously restricted the mounted position of the carriage. Therefore, the position of the fixing screw 7 must be set outward in such a way that the fixing screw 7 does not interfere with the carriage in its mounted position. As a result, there have been undesirably encountered problems that the size of yokes 3 and 5 has needed to be enlarged, which has resulted in the large-size of the entire body of the magnetic disk device.

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Accordingly, it is an object of the present invention to provide a magnetic disk device in which the generation of vibration or noise can be prevented by firmly or strongly fixing the yokes of a rotary actuator and the size of the yokes can be reduced.

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It is another object of the present invention to provide a magnetic disk device in which the movable range of the rotary actuator can be widely set.

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[Summary of the invention]

According to the present invention, there is provided a magnetic disk device having a rotatable magnetic disk, a rotatable carriage having a magnetic head attached to its end and a rotary actuator for rotating said carriage between a base and a cover, said rotary actuator including a coil attached to the carriage, a first yoke having a first magnet attached thereto and opposed to the position of the coil in the side of the base and a second yoke having a second magnet attached thereto, opposed to the position of the coil in the side of the cover and connected to

the first yoke, the magnetic disk device comprising: an attaching member for attaching the first yoke to the base; and fixing screws passing through the second yoke and the first yoke from the cover to thereby threadedly fix them to the base.

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[Preferred embodiment]

Now, an embodiment of the present invention will be described hereinafter by referring to Figures 1 to 7.

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Figure 1 is an exploded perspective view of the entire body of a magnetic disk device. With reference to Figure 1, reference numeral 11 designates a lower base, and 12 designates an upper cover. A magnetic disk 13 rotatable about an axis O1, a carriage 15 having a magnetic head 14 attached to its end and rotatable about an axis O2 and a voice coil motor M as a rotary actuator for rotating the carriage 15 are provided between the base and the cover. The voice coil motor M is provided with a coil 16 (see Figure 2) attached to the carriage 15 and a yoke connecting member 20.

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Figure 2 is a plan view of the magnetic disk device with the cover 12 removed. Figure 3 is an exploded perspective view for explaining a part for attaching the yoke connecting member 20 to the base 11. Figure 4 is a sectional view of a part for attaching the yoke connecting member 20 to the base 11 and the cover 12. In the yoke connecting member 20, reference numerals 21 and 22 represent first and second yokes substantially triangular in plan view. In Figure 3, the right and left corner

parts of the first yoke 21 are provided with bent parts 21A bent upward. A protruding part 21B is formed on the upper end of each of the bent parts 21A. Referring to Figure 3, again, the right and left corners of the second yoke 22 are provided with cut-out parts 22A to which the protruding parts 21B are fitted. First and second magnets 23 and 24 are mounted on the respective inner surfaces of the first and second yokes 21 and 22 which are opposed to each other. The coil 16 attached to the carriage 15 is located in a magnetic field between the opposed surfaces.

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As illustrated in Figure 3, through holes 21C and 21B respectively located on the same vertical axes are formed on the right and left parts of the first and second yokes 21 and 22. Each of the through holes 21C has a relatively large diameter so as to be fitted to each of circular cylinder parts 11A projected on the inner surface of the base 11. A fixing screw 31 is threadedly inserted into the central hole 11B of each of the circular cylinder parts 11A. As illustrated in Figure 4, each fixing screw 31 passes through the hole 12A of the cover 12 and the through holes 22B and 21C and is screwed to the hole 11B of the circular cylinder 11A. Each of the through holes 22B has a relatively small diameter so as to pass the fixing screw 31 therethrough. Further, as shown in Figure 4, a tapped hole 21D meshing with a lower attaching screw (attaching member) 32 inserted into the hole 11C of the base 11 is formed on the central part of the first yoke 21.

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Next, steps of attaching the yoke connecting member 20 to the base will be described in the following.

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The yoke connecting member 20 is attached to the base 11 while the carriage 15 is located between the magnets 23 and 24, as illustrated by solid lines in Figures 1 and 3. The yoke connecting member 20 itself is formed only by fitting the protruding parts 21B into the cut-out parts 22A by virtue of the magnetic force of the magnets 23 and 24.

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The yoke connecting member 20 is positioned on the base 11, as illustrated in Figure 4, depending on the fitting state between the holes 21C of the first yoke 21 and the circular cylinder parts 11A on the base 11 and ups and downs formed on the inner surface of the base 11. Then, the lower attaching screw 32 is passed through the hole 11C opened on the base 11 and threadedly inserted into the tapped hole 21D of the first yoke 21, so that the yoke connecting member 20 is fixed onto the base 11. Then, after the cover 12 is mounted on the base 11, the fixing screws 31 are passed through the through holes 22B from the holes 12A of the cover 12, so that the fixing screws 31 are screwed or threadedly inserted into the holes 11B of the circular cylinder parts 11A. Thus, the yoke connecting member 20 is secured between the base 11 and the cover 12.

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As a result, the yoke connecting member 20 is firmly or strongly attached to a proper position between the base 11 and the cover 12. Accordingly, when the recording head 14 is positioned on the magnetic disk 13 by rotating the carriage 15 by means of the voice coil motor M in order to write or read data by the recording head 14 on the rotating magnetic disk 13, the vibration of the yoke connecting member 20 caused by the reaction due to

the positioning of the recording head is suppressed. A polygonal line A in Figure 5 shows the vibrational characteristic of the voice coil motor M. As apparent from the polygonal line A, the vibration can be more suppressed and noise can be more reduced than those shown in the vibrational characteristic of a polygonal line B of the voice coil motor so mounted as seen in Figure 8 mentioned above.

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In the meantime, since the fixing screws 31 are secured or mounted onto the base 11 after the cover 12 is mounted on the base 11, that is, after the carriage 15 and the yoke connecting member 20 are mounted on the base 11, the fixing screws 31 do not become obstacles when the carriage 15 and the yoke connecting member 20 are mounted on the base 11. This is an extremely advantageous point when the position of the carriage 15 is maintained upon its mounting. Specifically, when the carriage 15 and the yoke connecting member 20 are positioned and mounted on the base 11, as illustrated in Figure 1, while the carriage 15 is kept located between the opposed surfaces of the yokes 21 and 22, or when the magnetic disk 13 is mounted on the base 11 thereafter, the carriage 15 and the yoke connecting member 20 need to have a positional relationship as illustrated by the solid line in Figure 2 in order to avoid the interference between the carriage 15 and the magnetic disk 13. Thus, the carriage 15 needs to be mounted on a position so that it does not interfere with the magnetic disk 13. At that time, since the fixing screws 31 have not been mounted on the base, there is no member interfering with the mounting position of the carriage 15 between the opposed surfaces of the yokes 21 and 22. Therefore, the mounting position of the carriage 15 can be maintained or held by using all the range between the opposed surfaces of the yokes 21 and 22 including preset positions on which the fixing screws 31 are mounted. Consequently, the mounting position of the

carriage 15 can be ensured without enlarging the size of the yokes 21 and 22 as compared with the case where the fixing screw 7 is located between the yokes 3 and 4 before the cover 2 is mounted on the base as in the case of the above mentioned conventional example shown in Figure 8.

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Figure 6 is an explanatory view for explaining the connected state of the yoke connecting member 20. A range L1 between the right and left bent parts 21A shows a region in which the voice coil motor M can move. The width of the bent part 21A corresponds to the thickness of the yoke 21. The bent parts 21A are simply bent to the end parts of the yoke 21 in their structures. Therefore, the movable range L1 is comparatively widely set relative to the whole width of the yoke connecting member 20 in the horizontal direction in Figure 6. The movable range L1 can be set more widely than the movable range L2 of the voice coil motor M when the yokes 21 and 22 having the same size are connected together by right and left stud members 41 as illustrated in a comparative example of Figure 7. Therefore, when the same movable range L1 is to be maintained, the yoke connecting member 20 must have the connected state using the bent parts 21A, so that the voice coil motor M can be made compact. The movable range L1 of the voice coil motor M can be widely or broadly set in such a way, and accordingly, the mounting position of the carriage 15 can be readily held. If the mounting position of the carriage 15 is assuredly held, the bent parts 21A may be employed at least on the upper side of the connecting parts of the yokes 21 and 22 shown in Figure 2.

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[Advantages of the invention]

As described above, according to the magnetic disk device of the present invention, since the first yoke and the second yoke are mounted between the base and the cover by using the attaching member for attaching the first yoke in the base side to the base and the fixing screws passing through the second yoke in the cover side and the first yoke from the cover and screwed to the base, the first and second yokes can be firmly or strongly secured between the base and the cover and the generation of vibration or noise can be prevented. Further, since the fixing screws are screwed to the base after the cover is mounted on the base, all the range between the opposed surfaces of the yokes can be used so that the mounting position of the carriage can be maintained when the carriage is mounted together with the yokes between the cover and the base. Furthermore, the yokes can be made more compact and thus the entire body of the magnetic disk device can be made more compact than the conventional case where the mounting position of the carriage is limited because the fixing screws are located between the opposed surfaces of the yokes.

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The first and second yokes are connected together on the bent parts formed on at least one of the first and second yokes. Therefore, the movable range of the rotary actuator can be widely set. Consequently, while the size of the rotary actuator can be made compact, a desired movable range can be ensured.

3. Brief Description of the Drawings:

Figure 1 shows an exploded perspective view of the entire body of a magnetic disk device according to an embodiment of the present invention;

Figure 2 is a plan view with the cover of the magnetic disk device shown in Figure 1 removed;

Figure 3 is an exploded perspective view for explaining parts for attaching a yoke connecting member shown in Figure 1 between a cover and a base;

Figure 4 is a sectional view showing the parts for attaching the yoke connecting member shown in Figure 1;

Figure 5 is an explanatory view for explaining the vibrational characteristic of the magnetic disk device shown in Figure 1;

Figure 6 is a schematic side view for explaining the connected form of the yoke connecting member shown in Figure 1;

Figure 7 is a schematic side view for explaining a comparative example of the connected form of the yoke connecting member; and

Figure 8 is a sectional view showing parts for attaching yokes between a cover and a base in a conventional magnetic disk device.

[Description of symbols]

11 ... Base

12 ... Cover

13 ... Magnetic disk

14 ... Magnetic head

- 15 ... Carriage
- 16 ... Coil
- 20 ... Yoke connecting member
- 21 ... First yoke
- 22 ... Second yoke
- 23 ... First magnet
- 24 ... Second magnet
- 31 ... Fixing screw
- 32 ... Attaching screw (attaching member)
- M ... Voice coil motor (rotary actuator)



4. Claims:

- 1 A magnetic disk device having a rotatable magnetic disk, a rotatable carriage having a magnetic head attached to its end and a rotary actuator for rotating said carriage between a base and a cover, said rotary actuator including a coil attached to said carriage, a first yoke having a first magnet attached thereto and opposed to the position of the coil in the side of the base and a second yoke having a second magnet attached thereto, opposed to the position of the coil in the side of the cover and connected to the first yoke, said magnetic disk device comprising:

an attaching member for attaching said first yoke to said base; and

fixing screws passing through the second yoke and the first yoke from the cover to thereby threadedly fix them to said base.

- 2 A magnetic disk device according to Claim 1, wherein at least one of said first and second yokes is provided with a bent part bent in the direction in which the first and second yokes are opposed to each other and said first and second yokes are connected together in said bent part.
- 3 A magnetic disk device according to Claim 1 or 2, wherein said attaching member is an attaching screw attached or screwed to said first yoke from said base.