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TITLE OF THE INVENTION

METHOD OF MANUFACTURING HEAD ACTUATOR ASSEMBLY AND
METHOD OF MANUFACTURING DISK DEVICE

BACKGROUND OF THE INVENTION

5 This invention relates to a method of
manufacturing a head actuator assembly used in a disk
device and a method of manufacturing the disk device.

 In recent years, disk devices, such as magnetic
disk devices, and optical disk devices, have been
10 widely used as external recording devices of computers
and image recording devices. A magnetic disk device
as an example of a disk device comprises magnetic
disks located in a case, a spindle motor that supports
and rotates the disks, magnetic heads for writing and
15 reading information to and from the disks, and a head
actuator assembly that supports the heads for movement
with respect to the disks.

 Usually, the head actuator assembly has a slider
formed having a magnetic head, a suspension that
20 supports the slider, and an arm that supports the
suspension. A wiring pattern is fixed on the
suspension and the arm, the slider is fixed on the
wiring pattern, and the magnetic head is connected
electrically to the wiring pattern.

25 The arm of the head actuator assembly is
rotatably supported by a bearing assembly. A voice
coil that constitutes a voice coil motor is mounted on

the other end of the arm. The magnetic head can be moved to any desired position on a magnetic disk by rotating the head actuator assembly by the voice coil motor.

5 In the magnetic disk device described above, the magnetic head flies at a very low height above a surface of the magnetic disk as it records and reproduces information. Thus, very small foreign matter must be prevented from getting into the device,
10 so that the device must be assembled in a high-performance clean room. Generally, therefore, the head actuator assembly is also assembled in the clean room. Recently prevailing magnetic heads have an ultrathin-film structure, so that their electrostatic
15 resistance is very low, and they are expected to be assembled in an environment that is backed by highly sophisticated measures to counter static electricity.

 In general, as is described in Jpn. Pat. Appln. KOKAI Publication No. 2002-269714, for example,
20 a magnetic head is temporarily assembled as a head-gimbals assembly (hereinafter referred to as an HGA), a peculiar component, attached to a suspension, and is subjected to inspection thereafter. In assembly processes, the HGA is attached to an arm that is
25 supported by a bearing assembly, and a voice coil is attached to a mechanical part including an arm. A head actuator assembly is assembled by further

connecting the HGA electrically to a flexible board that has a control circuit.

5 All these assembly processes are performed in a clean room. Also proposed is a configuration such that a suspension and an arm are formed integrally with each other or a head stack is formed by stacking in layers suspensions that are previously fixed to arms, individually.

10 If the head actuator assembly is assembled entirely in the clean room in this manner, the clean room should be large, and the assembly conditions strict. In assembling a suspension assembly, moreover, signal wires that extend from the magnetic head and overlies the suspension are connected to the flexible circuit board having the control circuit by
15 soldering or the like. Possibly, the magnetic head may undergo dielectric breakdown caused by fine static electricity during connection work or its preceding assembly operations.

20 BRIEF SUMMARY OF THE INVENTION

According to an aspect of the present invention, there is provided a method of manufacturing a head actuator assembly, which has a head which processes information for a disk-shaped recording medium,
25 a suspension which supports the head, an arm which supports the suspension and is rotatably supported by a bearing portion, signal wires which extend on the

suspension and the arm and are connected electrically to the head, a board unit having a connecting end portion connected to the signal wires, and a control section which controls the information processing of the head, the method comprising: mounting the signal wires on the suspension and the arm; connecting the connecting end portion of the board unit to the signal wires mounted on the suspension and the arm; and mounting the head on the suspension and connecting the head electrically to the signal wires which are connected to the connecting end portion of the board unit.

According to another aspect of the present invention, there is provided a method of manufacturing a head actuator assembly, which has a plurality of heads which individually process information for disk-shaped recording media, a plurality of suspensions which support the heads, individually, a plurality of arms which support the suspensions, individually, and are rotatably supported by a bearing portion, signal wires which extend on the suspensions and the arms and are connected electrically to the heads, a control section which controls the information processing of the heads and a board unit having a connecting end portion connected to the signal wires, the method comprising: mounting the signal wires on the suspensions and the arms; connecting the connecting

end portion of the board unit to the signal wires mounted on the suspensions and the arms; and mounting the heads on the suspensions and connecting the heads electrically to the signal wires which are connected
5 to the connecting end portion of the board unit.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention, and together
10 with the general description given above and the detailed description of the embodiments given below, serve to explain the principles of the invention.

FIG. 1 is a plan view showing the interior of a hard disk drive (hereinafter referred to as an HDD) according to a first embodiment of the invention;
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FIG. 2 is a perspective view showing a head actuator assembly of the HDD;

FIG. 3 is an exploded perspective view showing the head actuator assembly;

20 FIG. 4 is a sectional view showing a bearing assembly of the head actuator assembly;

FIG. 5 is a plan view showing a manufacturing process for the head actuator assembly;

FIG. 6 is a perspective view showing a head actuator assembly according to a second embodiment of
25 the invention;

FIG. 7 is a sectional view showing a bearing

assembly of the head actuator assembly of the second embodiment;

FIG. 8 is an exploded perspective view showing the head actuator assembly of the second embodiment;

5 FIG. 9 is a plan view showing a manufacturing process for the head actuator assembly of the second embodiment;

10 FIG. 10 is a perspective view showing a head actuator assembly according to a third embodiment of the invention;

FIG. 11 is a perspective view showing an HGA of the head actuator assembly of the third embodiment;

FIG. 12 is an exploded perspective view showing the head actuator assembly of the third embodiment;

15 FIG. 13 is a sectional view showing a bearing assembly of the head actuator assembly of the third embodiment;

20 FIG. 14 is a perspective view showing a head actuator assembly according to a fourth embodiment of the invention;

FIG. 15 is a sectional view showing a bearing assembly of the head actuator assembly of the fourth embodiment; and

25 FIG. 16 is an exploded perspective view showing the head actuator assembly of the fourth embodiment.

DETAILED DESCRIPTION OF THE INVENTION

A method of manufacturing a head actuator

assembly according to a first embodiment of this invention will now be described in detail with reference to the accompanying drawings. First, an HDD will be described as a disk device that is provided
5 with the head actuator assembly.

As shown in FIG. 1, the HDD comprises a case 12 in the form of an open-topped rectangular box and a top cover (not shown). The top cover is screwed to the case with screws and closes a top opening of the
10 case 12.

The case 12 contains a magnetic disk 16 for use as a recording medium, a spindle motor 18, a magnetic head 33, a carriage assembly 22. The spindle motor 18 serves as a drive unit that supports and rotates
15 the disk 16. The magnetic head 33 is used to write and read information to and from the disk 16. The carriage assembly 22 supports the magnetic head 33 for movement with respect to the magnetic disk 16. The case 12 further contains a voice coil motor
20 (hereinafter referred to as a VCM) 24, a ramp load mechanism 20, a flexible printed circuit board unit (hereinafter referred to as an FPC unit) 21; etc. The VCM 24 rotates and positions the carriage assembly 22. The ramp load mechanism 20 holds the magnetic
25 head 33 in a retreated position off the magnetic disk 16 when the head 33 is moved to the outermost periphery of the disk. The FPC unit 21 is mounted

with a read-write amplifier for use as a control circuit for recording and reproducing signals, for example. A printed circuit board (not shown) for controlling the respective operations of the spindle
5 motor 18, VCM 24, and magnetic heads through the FPC unit 21 is screwed to the outer surface of a bottom wall of the case 12. The carriage assembly 22 and the FPC unit 21 constitute the head actuator assembly.

The magnetic disk 16 has a magnetic recording
10 layer on its surface. The disk 16 is fitted on the outer periphery of a hub (not shown) of the spindle motor 18 and fixedly supported on the hub by a clamp spring 17. As the motor 18 is driven, the disk 16 is rotated at a given speed of, e.g., 4,200 rpm, in the
15 direction of arrow B.

As shown in FIGS. 1 to 4, the carriage assembly 22 comprises a bearing assembly 26 fixed to the bottom wall of the case 12, two head gimbals assemblies (hereinafter referred to as HGA's) 35 and 35b
20 supported on the bearing assembly, and a spacer ring 34. The bearing assembly 26, which serves as a bearing portion, is provided with a cylindrical sleeve 27 and a bearing unit 25 fitted coaxially in the sleeve. The bearing unit 25 is fitted on a pivot 23
25 that is set up on the bottom wall of the case 12. Thus, the sleeve 27 is rotatably supported on the pivot 23 by the bearing unit 25.

An annular flange 28 is formed on the upper end of the sleeve 27, and a thread portion 29 is formed on the outer periphery of the lower end portion of the sleeve. As shown in FIG. 4, the bearing unit 25 has a retaining cylinder 41, a pair of bearings 43, and a spacer ring 47. The bearings 43 are fitted in the retaining cylinder and opposed to each other with a given gap between them. The spacer ring 47 is located between the paired bearings in the retaining cylinder.

As shown in FIGS. 2 and 3, the HGA 35 comprises an arm 30 attached to the sleeve 27, a suspension 32 extending from the arm, and a magnetic head 33 that is supported on an extended end of the suspension by a gimbals portion 39. The arm 30 is a thin flat plate of a stainless-steel, such as SUS304, with a thickness of about 200 μm . A circular through hole 31 is formed in one end or proximal end portion of the arm 30. The proximal end portion of the arm 30 is formed having a positioning hole 38 through which a positioning screw 37 is passed.

The suspension 32 is formed of an elongated leaf spring with a thickness of 20 to 100 μm . The proximal end of the suspension 32 is fixed to the distal end of the arm 30 by spot welding or adhesive bonding and extends from the arm. The suspension 32 and the arm 30 may be molded integrally from the same material.

The magnetic head 33 has a substantially rectangular slider and a recording/reproducing magnetic resistance (MR) head formed on the slider, and is fixed to the gimbals portion 39 on the distal end portion of the suspension 32. The head 33 has electrodes (not shown).

As shown in FIGS. 2 and 3, the magnetic head 33 is connected electrically to a main FPC 42 (mentioned later) through a relay flexible printed circuit board (hereinafter referred to as a relay FPC) 40 that has signal wires. The relay FPC 40 is stuck on the respective inner surfaces of the arm 30 and the suspension 32 and extends from the distal end of the suspension to the proximal end portion of the arm.

The relay FPC 40 is in the form of an elongated belt as a whole, and its distal end is connected electrically to the electrodes of the magnetic head 33 by bonding or soldering. The other end portion of the relay FPC 40 is cranked and extends outward from the proximal end portion of the arm 30. The other end portion of the relay FPC 40 constitutes a junction 44. The junction 44 is formed having a plurality of connector pads 45, which are spaced in its longitudinal direction. The junction 44 extends parallel to the inner surface of the arm 30. The pads 45 are provided on that surface of the junction 44 which is opposite to the arm 30.

The HGA 35b has the same configuration as the HGA 35, and these two are symmetrical with respect to each other. More specifically, the HGA 35b comprises an arm 30 attached to the sleeve 27 of the bearing assembly 26, a suspension 32 extending from the arm, and a magnetic head 33 that is supported on an extended end of the suspension by a gimbal portion 39. The arm 30 has a circular through hole 31 in its proximal end portion, and a tapped hole 38b formed near the through hole 31. A relay FPC 40 is stuck on the respective inner surfaces of the arm 30 and the suspension 32 and extends from the distal end of the suspension to the proximal end portion of the arm. The distal end of the relay FPC 40 is connected electrically to the magnetic head 33. The other end portion of the relay FPC 40 is cranked and extends outward from the proximal end portion of the arm 30. The other end portion of the relay FPC 40 constitutes a junction 44. The junction 44 is formed having a plurality of connector pads 45, which are spaced in its longitudinal direction.

The spacer ring 34 that serves as a spacer member has a through hole 46 through which the sleeve 27 is passed, a projection 48 that projects sideways, and a support frame 50 that extends in a direction opposite to the arm 30. The ring 34 is molded integrally from a synthetic resin or the like. A voice coil

51 that constitutes a part of the VCM 24 is embedded in the support frame 50. The spacer ring 34 has a positioning hole 51b that is formed in a position corresponding to the positioning hole 38 of the arm 30.

As shown in FIGS. 1 to 3, the FPC unit 21 has a base portion 52 and the main flexible printed circuit board (main FPC) 42. The base portion 52 is formed by bending a flexible printed circuit board into a substantially rectangular shape. The main FPC 42 is an elongated belt that extends from the base portion 52. These elements are formed integrally of a common flexible printed circuit board. The base portion 52 is mounted with a plurality of electronic components, such as a head amplifier, connector, etc., which control information processing of the magnetic head 33. The base portion 52 is fixed on the bottom wall of the case 12.

An extended end portion of the main FPC 42 that extends from the base portion 52 constitutes a connecting end portion 54.

The connecting end portion 54 is provided integrally with a rectangular junction 55 that projects upward and a rectangular junction 55b that projects downward. A plurality of connector pads 56 are provided on the respective surfaces of the junctions 55 and 55b and arranged at spaces in the

longitudinal direction of the junctions. These connector pads 56 correspond to the connector pads 45 of the relay FPC 40 in number and location. The connector pads 56 are connected electrically to the base portion 52 through a conductor pattern of the main FPC 42.

A metallic reinforcing plate 58 is stuck on the reverse side of the connecting end portion 54 including the junctions 55 and 55b. The junctions 55 and 55b are bent at right angles to the connecting end portion 54 and face each other. The connecting end portion 54 and the reinforcing plate 58 are formed having a through hole 65 through which a fixing screw is passed. A jig may be used to settle positions in the transverse and circumferential directions without using the positioning screw.

The HGA's 35 and 35b and the spacer ring 34 are mounted in layers on the sleeve 27 of the bearing assembly 26. The arm 30 of the HGA 35 is fitted on the sleeve 27 in a manner such that it is stacked on the flange 28 in the axial direction of the sleeve 27 with the sleeve passed through the through hole 31. The arm 30 of the other HGA 35b is fitted on the sleeve 27 in a manner such that it is stacked on the spacer ring 34 with the sleeve 27 passed through the through hole 31.

The two arms 30 and the spacer ring 34 that are

fitted on the sleeve 27 are sandwiched between the flange 28 and a combination of a washer 66 and a nut 68 and are fixedly held on the sleeve 27. The washer 66 is fitted on the lower end portion of the sleeve
5 27, while the nut 68 is screwed on the thread portion 29 of the sleeve 27. The positioning screw 37 is passed from above through the positioning hole 38 in the arm 30 of the HGA 35 and the positioning hole 51b in the spacer ring 34, and screwed into the tapped
10 hole 38b in the arm 30 of the HGA 35b. Thus, the one arm 30, the spacer ring 34, and the other arm 30 are located in given relative positions with respect to the circumferential direction of the sleeve 27. The two arms 30 extend in the same direction from the
15 sleeve 27 and are rockable together with the sleeve 27. The respective magnetic heads 33 of the HGA's 35 and 35b are situated opposite each other.

The connecting end portion 54 of the main FPC 42 is fixed to the projection 48 of the spacer ring 34
20 with screws. The junction 44 of the relay FPC 40 that extends from the one arm 30 is overlapped on the one junction 55 of the main FPC 42. The connector pads 45 of the junction 44 are soldered and connected
mechanically and electrically to the connector pads 56
25 of the junction 55. Likewise, the junction 44 of the relay FPC 40 that extends from the other arm 30 is overlapped on the other junction 55b of the main FPC

42. The connector pads 45 of the junction 44 are soldered and connected mechanically and electrically to the connector pads 56 of the junction 55b. Thus, the magnetic heads 33 are connected electrically to the FPC unit 21 through the relay FPC 40 and the main FPC 42, whereupon the head actuator assembly is completed.

As is evident from FIG. 1, the head actuator assembly constructed in this manner is located in the case of the HDD, and the bearing assembly 26 is mounted on the bottom wall of the case 12 by the pivot 23. The base portion 52 of the FPC unit 21 is fixed on the bottom wall of the case 12 with screws. The voice coil 51 that is fixed to the support frame 50 is situated between a pair of yokes 70 that are fixed on the case 12. The voice coil 51, along with these yokes and a magnet (not shown) fixed to one of the yokes, constitute the VCM 24.

If the voice coil 51 is energized to actuate the HDD, the HGA's 35 and 35b rock, whereupon the magnetic heads 33 are moved and positioned on a desired track of the magnetic disk 16. The respective magnetic heads 33 of the HGA's 35 and 35b are situated opposite each other with the magnetic disk 16 between them and moved individually on the opposite surfaces of the disk. The magnetic disk 16 used in this case has magnetic recording layers on its opposite sides,

individually.

The head actuator assembly of this construction is manufactured in the following processes. First, the suspensions 32 are fixed to the arms 30, as shown in FIG. 3, and the relay FPC's 40 are then stuck on the arms and the suspensions. The arms 30 and the suspensions 32 are formed in two sets. On the other hand, the spacer ring 34, which is fitted with the voice coil 51, and the FPC unit 21 are prepared in advance.

Subsequently, the one arm 30, the spacer ring 34, and the other arm 30 are attached in succession to the sleeve 27 of the bearing assembly 26, and the nut 68 is temporarily tightened with the aid of the washer 66 to form a stack assembly. Thereafter, the connecting end portion 54 of the main FPC 42 is screwed to the projection 48 of the spacer ring 34, and the connector pads 45 of the paired relay FPC's 40 are soldered individually to their corresponding connector pads 56 on the connecting end portion 54. Thus, the relay FPC's 40 and the FPC unit 21 are connected electrically and mechanically to one another.

As shown in FIG. 5, thereafter, at least one of the two arms 30 on the sleeve 27 is rocked around the sleeve 27, whereupon the two arms are positioned and tacked in a manner such that they are staggered by a margin larger than the width of each magnetic head

33 in their rocking direction. The two arms 30 may be mounted on the sleeve 27 so as to establish the aforesaid positional relations in advance.

Then, the carriage assembly 22 and the FPC unit 21, which are temporarily assembled, are cleaned temporarily. The foregoing manufacturing processes are performed in the atmosphere, for example. The temporary cleaning may be omitted.

After the temporary cleaning, the carriage assembly 22 and the FPC unit 21 are carried into a clean room, and these elements, including the sleeve 27, are subjected to advanced cleaning in the clean room. After the magnetic heads 33 are then bonded onto the gimbals portions 39 of the suspensions 32, their electrodes are soldered and connected electrically to the pads (not shown) of the relay FPC's 40. In doing this, the two arms 30 are staggered, and the respective distal end portions of the suspensions 32 that are to be mounted with the magnetic heads are also staggered. Therefore, the magnetic heads 33 can be easily mounted and connected without any interference between the two suspensions 32. After the heads 33 are connected, the two arms 30 are aligned in opposite positions, and the nut 68 is regularly tightened to fix the arms to the sleeve 27.

After the magnetic heads 33 are mounted in this manner, the carriage assembly 22 and the FPC unit 21

are subjected again to advanced cleaning to be cleared of dust. Ultrasonic cleaning using, for example, water as a medium is employed as the advanced cleaning. Finally, the bearing unit 25 is forced into the sleeve 27 to form the bearing assembly 26 in the clean room. When these processes are carried out, the head actuator assembly is completed. The manufactured head actuator assembly is located in a predetermined position in the case 12.

10 According to the method of manufacturing the head actuator assembly constructed in this manner and the method of manufacturing the disk device, the magnetic heads 33 are mounted on the suspensions and connected electrically to the relay FPC's 40 after the relay FPC's 40 are connected electrically to the FPC unit 21. Conventionally, at least two cycles of connecting operations are performed, including operation for mounting the magnetic heads on the suspensions and operation for connecting the signal wires, which extends through the suspension and arm, to the FPC unit 21 thereafter. According to the present embodiment, however, the connecting operation that involves a high possibility of applying static electricity to signal terminal areas of the magnetic heads can be restricted to one cycle for magnetic head mounting. Thus, the magnetic heads can be securely prevented from being damaged by static electricity,

and the yield of manufacture can be improved.

Further, other component members can be assembled with the magnetic heads 33 off and thoroughly cleaned thereafter. Thus, the complicated assembly that
5 requires high accuracy can be carried out outside the clean room, so that the manufacturing efficiency can be improved, and the assembly conditions can be eased. Since no magnetic head is present during all other assembly operations than the magnetic head mounting,
10 consideration for static electricity can be greatly lessened, and the manufacturing efficiency can be improved.

According to the first embodiment, furthermore, a plurality of arms are staggered in their rocking
15 direction and tacked, and the magnetic heads are mounted and connected in this state. Thus, the magnetic heads can be efficiently mounted and connected without interfering with the other suspension or the like.

20 The following is a description of an HDD according to a second embodiment of this invention. Like reference numerals are used to designate like portions of the first and second embodiments, and a detailed description of those portions is omitted.

25 According to the second embodiment, as shown in FIGS. 6 to 8, a bearing portion of a head actuator assembly includes a bearing unit 25 alone without

including a sleeve. The bearing unit 25 has a retaining cylinder 41, a pair of bearings 43, and a spacer ring 47. The bearings 43 are fitted in the retaining cylinder and opposed to each other with a given gap between them. The spacer ring 47 is located between the paired bearings in the retaining cylinder. An outwardly extending annular flange 41a is formed integrally on the upper end of the retaining cylinder 41. A thread portion 41b is formed on the outer periphery of the lower end portion of the retaining cylinder 41. The bearing unit 25 is attached to two arms 30 with the retaining cylinder 41 directly fitted in through holes 31 that are formed individually in the respective proximal end portions of the arms 30.

15 In manufacturing the head actuator assembly of this construction, suspensions 32 are first fixed to the arms 30, as shown in FIG. 8, and relay FPC's 40 are then stuck on the arms and the suspensions. The arms 30 and the suspensions 32 are formed in two sets. On the other hand, a spacer ring 34, which is fitted with a voice coil 51, and an FPC unit 21 are prepared in advance. The arms 30, the suspensions 32, a support frame 50, the voice coil 51, and the FPC unit 21 are subjected to ultrasonic cleaning using, for example, water as a medium. The foregoing manufacturing processes are performed in the atmosphere.

After the cleaning, the assembly and the FPC unit 21 are carried into a clean room, and the one arm 30, the spacer ring 34, and the other arm 30 are attached in succession to the retaining cylinder 41 of the bearing unit 25 in the clean room. Thereafter, a nut 68 is temporarily tightened with the aid of a washer 66 to form a stack assembly.

Subsequently, a connecting end portion 54 of a main FPC 42 is screwed to a projection 48 on the spacer ring 34, and connector pads 45 of the paired relay FPC's 40 are soldered individually to their corresponding connector pads 56 on the connecting end portion 54. Thus, the relay FPC's 40 and the FPC unit 21 are connected electrically and mechanically to one another.

As shown in FIG. 9, thereafter, at least one of the two arms 30 on the retaining cylinder 41 is rocked around the cylinder 41, whereupon the two arms are positioned and tacked in a manner such that they are staggered by a margin larger than the width of each magnetic head in their rocking direction. The two arms 30 may be mounted on the sleeve 27 so as to establish the aforesaid positional relations in advance.

Subsequently, only magnetic head mounting portions of the suspensions 32 are cleaned in the clean room. After the magnetic heads 33 are then

bonded onto gimbals portions 39 of the suspensions 32, their electrodes are soldered and connected electrically to the pads (not shown) of the relay FPC's 40. In doing this, the two arms 30 are staggered, and the
5 respective distal end portions of the suspensions 32 that are mounted with the magnetic heads are also staggered. Therefore, the magnetic heads 33 can be easily mounted and connected without any interference between the two suspensions 32.

10 After the heads 33 are mounted, the two arms 30 are aligned in opposite positions, and the nut 68 is regularly tightened to fix the arms to the bearing unit 25. Thereafter, only the magnetic heads 33 and their surroundings are subjected again to advanced
15 cleaning. When these processes are carried out, the head actuator assembly is completed. The manufactured head actuator assembly is located in a predetermined position in a case 12.

20 Also in the second embodiment arranged in this manner, the same functions and effects of the first embodiment can be obtained.

 The following is a description of an HDD according to a third embodiment of this invention. Like reference numerals are used to designate like
25 portions of the first to third embodiments, and a detailed description of those portions is omitted. According to the third embodiment, as shown in

FIGS. 10 to 13, a head actuator assembly is provided with one HGA 35 alone, and its bearing portion is composed of a bearing unit 25 alone without including a sleeve.

5 A carriage assembly 22 comprises a bearing assembly 26 fixed on the bottom wall of a case 12, an HGA 35 supported on the bearing assembly, and a spacer ring 34. The bearing unit 25, which serves as a bearing portion, has a retaining cylinder 41, a pair
10 of bearings 43, and a spacer ring 47. The bearings 43 are fitted in the retaining cylinder and opposed to each other with a given gap between them. The spacer ring 47 is located between the paired bearings in the retaining cylinder. An outwardly extending annular
15 flange 41a is formed integrally on the upper end of the retaining cylinder 41. A thread portion 41b is formed on the outer periphery of the lower end portion of the retaining cylinder 41.

 The HGA 35 comprises an arm 30 attached to the
20 bearing unit 25, a suspension 32 extending from the arm, and a magnetic head 33 that is supported on an extended end of the suspension by a gimbals portion 39. The arm 30 is a thin flat plate of a stainless-steel material, such as SUS304, with a thickness of
25 about 200 μ m. A circular through hole 31 is formed in one end or proximal end portion of the arm 30. The proximal end portion of the arm 30 is formed

having a positioning hole 38 through which a positioning screw 37 is passed.

The suspension 32 is formed of an elongated leaf spring with a thickness of 20 to 100 μm .

5 The proximal end of the suspension 32 is fixed to the distal end of the arm 30 by spot welding or adhesive bonding and extends from the arm. The suspension 32 and the arm 30 may be molded integrally from the same material.

10 The magnetic head 33 is connected electrically to a main FPC 42 (mentioned later) through a relay FPC 40 that has signal wires. The relay FPC 40 is stuck on the respective inner surfaces of the arm 30 and the suspension 32 and extends from the distal end of the suspension to the proximal end portion of the arm.

15 The relay FPC 40 is in the form of an elongated belt as a whole, and its distal end is connected electrically to the electrodes of the magnetic head 33 by bonding or soldering. The other end portion of the relay FPC 40 is cranked and extends outward from the proximal end portion of the arm 30. The other end

20 portion of the relay FPC 40 constitutes a junction 44. The junction 44 is formed having a plurality of connector pads 45, which are spaced in its longitudinal direction. The junction 44 extends parallel to the inner surface of the arm 30. The pads 45 are provided on that surface of the junction 44 which is

opposite from the arm 30.

5 The spacer ring 34 has a through hole 46 through which the bearing unit 25 is passed, a projection 48 that projects sideways, and a support frame 50 that extends in a direction opposite from the arm 30. The ring 34 is molded integrally from a synthetic resin or the like. A voice coil 51 that constitutes a part of a VCM 24 is embedded in the support frame 50. The spacer ring 34 has a tapped hole 51b that is
10 formed in a position corresponding to the positioning hole 38 of the arm 30.

An FPC unit 21 has a base portion 52 and the main FPC 42. The base portion 52 is formed by bending a flexible printed circuit board into a substantially
15 rectangular shape. The main FPC 42 is an elongated belt that extends from the base portion. These elements are formed integrally of a common flexible printed circuit board. The base portion 52 is mounted with a plurality of electronic components, such as
20 a head amplifier, connector, etc., which control information processing of the magnetic head. The base portion 52 is fixed on the bottom wall of the case 12.

An extended end portion of the main FPC 42 that extends from the base portion 52 constitutes a
25 connecting end portion 54. The connecting end portion 54 is provided integrally with a rectangular junction 55 that projects upward. A plurality of connector

pads 56 are provided on the surface of the junction 55 and arranged at spaces in the longitudinal direction of the junction. These connector pads 56 correspond to the connector pads 45 of the relay FPC 40 in number and location. The connector pads 56 are connected electrically to the base portion 52 through a conductor pattern of the main FPC 42. A metallic reinforcing plate 58 is fixed to the reverse side of the connecting end portion 54 including the junction 55. The reinforcing plate 58 is bent substantially at right angles along a boundary of the junction 55. The connecting end portion 54 and the reinforcing plate 58 are formed having a through hole 65 through which a fixing screw is passed.

The arm 30 and the spacer ring 34 constructed in this manner are mounted in layers on the retaining cylinder 41 of the bearing unit 25. As shown in FIG. 12, the suspension 32 and the arm 30 on which the relay FPC 40 is mounted are fitted on the retaining cylinder 41 with the retaining cylinder passed through the through hole 31, and laminated on the flange 41a in the axial direction of the retaining cylinder 41. The spacer ring 34 is fitted on the bearing unit 25 in a manner such that it is laminated on the arm 30 with the retaining cylinder 41 passed through the through hole 46.

The arm 30 and the spacer ring 34 are sandwiched

between the flange 41a and a combination of a washer 66 and a nut 68 and are fixedly held on the retaining cylinder 41. The washer 66 is fitted on the lower end portion of the cylinder 41, while the nut 68 is
5 screwed on the thread portion 41b. Further, the positioning screw 37 is passed from above through the positioning hole 38 in the arm 30 and screwed into the tapped hole 51b in the spacer ring 34. Thus, the arm 30 and the spacer ring 34 are located in given
10 relative positions with respect to the circumferential direction of the sleeve 27. A jig may be used to settle positions in the transverse and circumferential directions without using the positioning screw.

The arm 30 extends outward from the retaining
15 cylinder 41 in the circumferential direction and is rockable together with the retaining cylinder. The connecting end portion 54 of the main FPC 42 is fixed to the projection 48 of the spacer ring 34 with screws. The junction 44 of the relay FPC 40
20 is overlapped on the junction 55 of the main FPC 42. The connector pads 45 of the junction 44 are soldered and connected mechanically and electrically to the connector pads 56 of the junction 55. Thus, the magnetic head 33 is connected electrically to the FPC
25 unit 21 through the relay FPC 40 and the main FPC 42, whereupon the head actuator assembly is completed.

The carriage assembly 22 is located in a

predetermined position in the case 12 with the bearing unit 25 fitted on a pivot that is set up on the bottom wall of the case. The base portion 52 of the FPC unit 21 is fixed on the bottom wall of the case 12 with
5 screws.

The voice coil 51 that is fixed to the support frame 50 is situated between a pair of yokes that are fixed on the case 12. The voice coil 51, along with these yokes and a magnet (not shown) fixed to one of
10 the yokes, constitute the VCM 24. If the voice coil 51 is energized to actuate the HDD, the carriage assembly 22 rocks, whereupon the magnetic head 33 is moved and positioned on a desired track of the magnetic disk 16.

15 In manufacturing the head actuator assembly of this construction, the suspension 32 is first fixed to the arm 30, as shown in FIG. 12, and the relay FPC 40 is then stuck on the arm and the suspension. The spacer ring 34, which is fitted with the voice
20 coil 51, and the FPC unit 21 are prepared in advance. The arm 30, suspension 32, support frame 50, voice coil 51, and FPC unit 21 are subjected to ultrasonic cleaning using, for example, water as a medium. The foregoing manufacturing processes are performed in
25 the atmosphere.

After the cleaning, the above components and the FPC unit 21 are carried into a clean room. In the

clean room, the connecting end portion 54 of the main FPC 42 is screwed to the projection 48 of the spacer ring 34, and the connector pads 45 of the relay FPC 40 are soldered individually to their corresponding connector pads 56 on the connecting end portion 54. Thus, the relay FPC 40 and the FPC unit 21 are connected electrically and mechanically to each other. Thereafter, only a magnetic head mounting portion of the suspension 32 is cleaned in the clean room. After the magnetic head 33 is then bonded onto the gimbals portion 39 of the suspension 32, its electrodes are soldered and connected electrically to the pads (not shown) of the relay FPC 40. After the magnetic head 33 is mounted, only the magnetic head 33 and its surroundings are subjected again to advanced cleaning.

Thereafter, the arm 30 and the spacer ring 34 are attached in succession to the retaining cylinder 41 of the bearing unit 25 in the cleaning room. Then, the nut 68 is tightened with the aid of the washer 66 to fix the arm and the spacer ring 34 to the bearing unit 25. When these processes are carried out, the head actuator assembly is completed. The manufactured head actuator assembly is located in a predetermined position in the case 12.

Also in the third embodiment arranged in this manner, the magnetic head 33 is mounted on the suspension and connected electrically to the relay FPC

40 after the relay FPC 40 and the FPC unit 21 are connected electrically to each other. Accordingly, the connecting operation that involves a high possibility of applying static electricity to a signal
5 terminal area of the magnetic head can be restricted to one cycle for magnetic head mounting. Thus, the magnetic head can be securely prevented from being damaged by static electricity, and the yield of manufacture can be improved. Since no magnetic head
10 is present during all other assembly operations than the magnetic head mounting, consideration for static electricity can be greatly lessened, and the manufacturing efficiency can be improved.

The following is a description of an HDD
15 according to a fourth embodiment of this invention. Like reference numerals are used to designate like portions of the first to fourth embodiments, and a detailed description of those portions is omitted. According to the fourth embodiment, as shown in
20 FIGS. 14 to 16, a head actuator assembly is provided with one HGA 35 alone, and its bearing portion is composed of a sleeve 27 and a bearing unit 25.

A carriage assembly 22 comprises a bearing assembly 26 fixed on the bottom wall of a case of
25 the HDD, an HGA 35 supported on the bearing assembly, and a spacer ring 34. The bearing assembly 26, which serves as a bearing portion, is provided with the

cylindrical sleeve 27 and the bearing unit 25 fitted coaxially in the sleeve. The bearing unit 25 is mounted on a pivot 23 that is set up on the bottom wall of the case. Thus, the sleeve 27 is rotatably supported on the pivot 23 by the bearing unit 25.

An annular flange 28 is formed on the upper end of the sleeve 27, and a thread portion 29 is formed on the outer periphery of the lower end portion of the sleeve. The bearing unit 25 has a retaining cylinder 41, a pair of bearings 43, and a spacer ring 47. The bearings 43 are fitted in the retaining cylinder and opposed to each other with a given gap between them. The spacer ring 47 is located between the paired bearings in the retaining cylinder.

The HGA 35 comprises an arm 30 attached to the sleeve 27, a suspension 32 extending from the arm, and a magnetic head 33 that is supported on an extended end of the suspension by a gimbals portion 39. The proximal end portion of the arm 30 is formed having a circular through hole 31 and a positioning hole 38 through which a positioning screw 37 is passed.

The arm 30 and the spacer ring 34 are mounted in layers on the sleeve 27 of the bearing assembly 26. The suspension 32 and the arm 30, on which a relay FPC 40 is mounted, are fitted on the sleeve 27 in a manner such that it is laminated on the flange 28 in the axial direction of the sleeve 27 with the sleeve

passed through the through hole 31. The spacer ring 34 is fitted on the sleeve 27 in a manner such that it is laminated on the arm 30 with the sleeve 27 passed through a through hole 46.

5 The arm 30 fitted on the sleeve 27 and the spacer ring 34 are sandwiched between the flange 28 and a combination of a washer 66 and a nut 68 and are fixedly held on the sleeve 27. The washer 66 is fitted on the lower end portion of the sleeve 27,
10 while the nut 68 is screwed on the thread portion 29 of the sleeve. Further, the positioning screw 37 is passed from above through the positioning hole 38 in the arm 30 and screwed into a tapped hole 51b in the spacer ring 34. Thus, the arm 30 and the spacer
15 ring 34 are located in given relative positions with respect to the circumferential direction of the sleeve 27.

 The arm 30 extends outward from the sleeve 27 in the circumferential direction and is rockable together
20 with the sleeve. A connecting end portion 54 of a main FPC 42 is fixed to a projection 48 of the spacer ring 34 with screws. A junction 44 of the relay FPC 40 is overlapped on a junction 55 of the main FPC 42. Connector pads 45 of the junction 44 are soldered and
25 connected mechanically and electrically to connector pads 56 of the junction 55. Thus, the magnetic head 33 is connected electrically to an FPC unit 21 through

the relay FPC 40 and the main FPC 42, whereupon the head actuator assembly is completed.

The head actuator assembly of this construction is manufactured in the following processes. First,
5 the suspension 32 is fixed to the arm 30, as shown in FIG. 16, and the relay FPC 40 is then stuck on the arm and the suspension. Further, the spacer ring 34, which is fitted with a voice coil 51, and the FPC unit 21 are prepared in advance.

10 Subsequently, the arm 30 and the spacer ring 34 are attached in succession to the sleeve 27 of the bearing assembly 26, and the nut 68 is temporarily tightened with the aid of the washer 66 to form a stack assembly. Thereafter, the connecting end
15 portion 54 of the main FPC 42 is screwed to the projection 48 of the spacer ring 34, and the connector pads 45 of the relay FPC 40 are soldered individually to their corresponding connector pads 56 on the connecting end portion 54. Thus, the relay FPC 40
20 and the FPC unit 21 are connected electrically and mechanically to each other.

Then, the carriage assembly 22 and the FPC unit 21, which are temporarily assembled, are cleaned temporarily. The foregoing manufacturing processes
25 are performed in the atmosphere, for example. The temporary cleaning may be omitted.

After the temporary cleaning, the carriage

assembly 22 and the FPC unit 21 are carried into
a clean room, and these elements, including the sleeve
27, are subjected to advanced cleaning in the clean
room. After the magnetic head 33 is then bonded onto
5 the gimbals portion 39 of the suspension 32, its
electrodes are soldered and connected electrically to
the pads (not shown) of the relay FPC 40.

After the magnetic head 33 is mounted in this
manner, the carriage assembly 22 and the FPC unit 21
10 are subjected again to advanced cleaning to be cleared
of dust. Ultrasonic cleaning using, for example,
water as a medium is employed as the advanced
cleaning. Then, the bearing unit 25 is forced into
the sleeve 27 to form the bearing assembly 26 in the
15 clean room. When these processes are carried out, the
head actuator assembly is completed. The manufactured
head actuator assembly is located in a predetermined
position in the case 12.

Also in the fourth embodiment arranged in this
20 manner, the same functions and effects of the
foregoing embodiments can be obtained.

This invention is not limited directly to the
embodiments described above, and its components may be
embodied in modified forms without departing from the
scope or spirit of the invention. Further, various
25 inventions may be made by suitably combining a
plurality of components described in connection with

the foregoing embodiments. For example, some of the components according to the foregoing embodiments may be omitted. Furthermore, components according to different embodiments may be combined as required.

5 In the foregoing embodiments, the bearings and the magnetic heads are mounted in the clean room after all the other component members than them are assembled in the atmosphere. Alternatively, however, other assembly operations, such as connection between
10 the relay and main FPC's, may be performed in the clean room. The cleaning method is not limited to ultrasonic cleaning, and any other cleaning methods may be used instead.

 Further, the manufacturing methods for the head
15 actuator assembly and the disk device according to this invention may be also applied to a head actuator assembly of an HDD that is provided with two or more magnetic disks and a head actuator assembly that has three or more HGA's. Furthermore, this invention may
20 be also applied to head actuator assemblies of any disk devices, such as optical disk devices, other than magnetic disk devices.

WHAT IS CLAIMED IS:

1. A method of manufacturing a head actuator assembly, which has a head which processes information for a disk-shaped recording medium, a suspension
5 which supports the head, an arm which supports the suspension and is rotatably supported by a bearing portion, signal wires which extend on the suspension and the arm and are connected electrically to the head, a board unit having a connecting end portion
10 connected to the signal wires, and a control section which controls the information processing of the head, the method comprising:

mounting the signal wires on the suspension and the arm;

15 connecting the connecting end portion of the board unit to the signal wires mounted on the suspension and the arm; and

mounting the head on the suspension and connecting the head electrically to the signal wires
20 which are connected to the connecting end portion of the board unit.

2. The method of manufacturing a head actuator assembly according to claim 1, wherein the head is mounted on the suspension after the bearing portion is
25 attached to the arm.

3. The method of manufacturing a head actuator assembly according to claim 1, wherein the mounting

head includes locating the suspension, the arm, the
signal wires, and the board unit having the connecting
end portion thereof connected to the signal wires in
a clean room, and then mounting the head on the
5 suspension in the clean room.

4. The method of manufacturing a head actuator
assembly according to claim 3, wherein the head is
mounted on the suspension after the arm is attached to
the bearing portion in the clean room.

10 5. The method of manufacturing a head actuator
assembly according to claim 3, wherein the head is
mounted on the suspension after the arm is attached to
a bearing unit which constitutes the bearing portion
in the clean room.

15 6. A method of manufacturing a head actuator
assembly, which has a plurality of heads which
individually process information for disk-shaped
recording media, a plurality of suspensions which
support the heads, individually, a plurality of arms
20 which support the suspensions, individually, and are
rotatably supported by a bearing portion, signal wires
which extend on the suspensions and the arms and are
connected electrically to the heads, a control section
which controls the information processing of the heads
25 and a board unit having a connecting end portion
connected to the signal wires, the comprising:

mounting the signal wires on the suspensions and

the arms;

connecting the connecting end portion of the board unit to the signal wires mounted on the suspensions and the arms; and

5 mounting the heads on the suspensions and connecting the heads electrically to the signal wires which are connected to the connecting end portion of the board unit.

7. The method of manufacturing a head actuator assembly according to claim 6, wherein the heads are
10 mounted on the suspensions after the arms are attached to a sleeve of the bearing portion.

8. The method of manufacturing a head actuator assembly according to claim 7, wherein the mounting
15 the heads includes locating the arms attached to the sleeve of the bearing portion, the suspensions, the signal wires, and the board unit having the connecting end portion thereof connected to the signal wires are located in a clean room, and then mounting the heads
20 on the suspensions in the clean room.

9. The method of manufacturing a head actuator assembly according to claim 8, wherein the bearing unit is loaded into the sleeve after the heads are mounted on the suspensions.

25 10. The method of manufacturing a head actuator assembly according to claim 7, wherein the mounting the heads includes tacking the arms attached to the

sleeve in positions staggered by a margin larger than the width of each head in the rotating direction of the heads, and after mounting the heads on the suspensions, locating the arms in opposite positions and fixing to the sleeve.

11. The method of manufacturing a head actuator assembly according to claim 6, wherein the heads are mounted on the suspensions after a bearing unit which constitutes the bearing portion is attached to the arms.

12. The method of manufacturing a head actuator assembly according to claim 6, wherein the heads are mounted on the suspensions after a bearing unit which constitutes the bearing portion is attached to the arms in a clean room.

13. The method of manufacturing a head actuator assembly according to claim 11, wherein the mounting the heads includes tacking the arms attached to the bearing unit in positions staggered by a margin larger than the width of each head in the rotating direction of the heads, and after mounting the heads on the suspensions, locating the arms in opposite positions and fixing to the bearing unit.

14. A method of manufacturing a disk device, which has a case, a disk-shaped recording medium located in the case, a drive unit which supports and drives the recording medium, a magnetic head, and

a head actuator assembly, the method comprising:

manufacturing the head actuator assembly by the method of manufacturing a head actuator assembly according to claim 1; and

5 locating the head actuator assembly in a predetermined position in the case in a clean room.