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TITLE OF THE INVENTION

ASSEMBLY METHOD AND ASSEMBLY APPARATUS FOR DISK
RECORDING APPARATUS

BACKGROUND OF THE INVENTION

5 The present invention relates to a method of
assembling a disk recording apparatus and an
assembling apparatus for the same.

 A wide variety of modern computers, such as
personal computers, desktop computers, notebook-type
10 computers, etc., use disk recording apparatuses as
memories for storing a great deal of information.

 A disk recording apparatus, e.g., a magnetic disk
drive, generally comprises a plurality of magnetic
disks arranged in layers, magnetic head assemblies,
15 and a head actuator. Each of the magnetic head
assembly includes a magnetic head for recording on and
reproducing information from the magnetic disk. The
head actuator supports the magnetic head assemblies
for movement relative to the magnetic disks and serves
20 to move them to desired tracks on the disks.

 The magnetic disks are fitted on the cylindrical
hub of a spindle motor and are supported coaxially
with one another and in spaced layers. The magnetic
disks are rotated at a given speed by driving the
25 spindle motor. The spindle motor, head actuator,
etc., are mounted on a base.

 The spindle motor has the hub that serves as

a rotor, and a flange is formed on one end side of the hub. The magnetic disks are fitted on the hub and sandwiched between the flange of the hub and a clamper that is screwed to the upper end of the hub.

5 Since a rotating part that includes the hub of the spindle motor, clamper, and magnetic disks rotates at high speed, its center of gravity must be coincident with the center of rotation. If the center of gravity of the rotating part and the center of
10 rotation are not coincident, vibration is caused during the rotation, so that the data write/read accuracy for the magnetic disks inevitably drops.

 In a notebook-type computer, moreover, a magnetic disk drive is often located under a keyboard or palm
15 rest, so that the vibration of the disk drive may be transmitted directly to a user's body in some cases.

 Usually, the non-coincidence of the center of gravity of the rotating part and the center of rotation is removed during the assembly of the
20 magnetic disk drive. Described in Jpn. Pat. Appln. KOKAI Publication No. 6-342578, for example, is an assembly method for a magnetic disk drive in which a weight for adjustment is placed on a clamper for magnetic disks. In this case, however, the
25 eccentricity is measured by means of a measuring device separate from the adjusting device.

 Further, a correcting mechanism for dislocation

of disks is described in Jpn. Pat. Appln. KOKAI
Publication No. 6-302099. In this correcting
mechanism, servo position information that is written
on a recording medium is used for the measurement of
5 eccentricity, and the disks themselves are moved to
adjust the eccentricity.

Described in Jpn. Pat. Appln. KOKAI Publication
No. 2000-268533, furthermore, is a method in which
each disk is moved and centered by means of four
10 actuators.

However, the conventional methods of assembly and
adjustment described above require independent
adjusting and measuring devices or a large number of
actuators, so that the adjusting operation is
15 troublesome, and the whole equipment is inevitably
large-scaled.

BRIEF SUMMARY OF THE INVENTION

The present invention has been contrived in
consideration of these circumstances, and its object
20 is to provide an assembly method and an assembly
apparatus for a disk recording apparatus, capable of
easily adjusting eccentricity of a rotating part.

In order to achieve the above object, a method of
assembling a disk recording apparatus according to an
25 aspect of the invention is provided as an assembly
method for a disk recording apparatus, which comprises
a base, a spindle motor fixed to the base, a disk

mounted on a rotor of the spindle motor, and a clamper
fastening the disk to the rotor, the method
comprising: driving the spindle motor to rotate a
rotating part, including the rotor, disk, and clamper,
5 in a manner such that the disk recording apparatus is
supported for movement with one degree of freedom of
translation in a direction substantially in parallel
to surfaces of the disk; measuring vibration of the
disk recording apparatus in the direction of the one
10 degree of freedom of translation caused by the
rotation of the rotating part; detecting the angular
position of the disk at which vibration of a maximum
amplitude is generated; analyzing the eccentricity and
the direction of eccentricity of the rotating part in
15 accordance with the measured vibration and the
detected angular position; and relatively moving the
base and the rotating part to correct the eccentricity
in accordance with the result of the analysis.

Further, an assembly apparatus for a disk
20 recording apparatus according to another aspect of the
invention is an assembly apparatus for a disk
recording apparatus, which comprises a base, a spindle
motor fixed to the base, a disk mounted on a rotor of
the spindle motor, and a clamper fastening the disk to
25 the rotor, the assembly apparatus comprising: a linear
guide mechanism configured to support the disk
recording apparatus for movement with one degree of

freedom of translation in the surface direction of the disk; a measuring mechanism configured to measure vibration of the disk recording apparatus in the direction of the one degree of freedom of translation
5 caused when the spindle motor of the disk recording apparatus supported by the linear guide mechanism is driven to rotate a rotating part, including the rotor, disk, and clamper; an angular position detecting mechanism configured to detect the angular position of
10 the disk at which vibration of a maximum amplitude is generated; an analysis element configured to analyze the eccentricity and the direction of eccentricity of the rotating part in accordance with the measured vibration and the detected angular position; and a
15 relative movement mechanism configured to relatively moving the base and the rotating part to correct the eccentricity in accordance with the result of the analysis by the analysis element.

Additional objects and advantages of the
20 invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the
25 instrumentalities and combinations particularly pointed out hereinafter.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

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

FIG. 1A is a plan view schematically showing a hard disk drive as an object of assembly by means of an assembly apparatus and an assembly method according to an embodiment of the invention;

FIG. 1B is a side view of the hard disk drive;

FIG. 2 is a view typically showing an outline of the assembly apparatus;

FIG. 3 is a side view showing a holding mechanism of the assembly apparatus;

FIG. 4 is a plan view of the holding mechanism;

FIG. 5A is a front view of a fastening mechanism of the assembly apparatus;

FIG. 5B is a side view of the fastening mechanism;

FIG. 6 is a view showing an eccentricity measuring process using the assembly apparatus;

FIG. 7 is an enlarged view of a screen of an oscilloscope of the assembly apparatus;

FIG. 8 is a view showing an eccentricity

adjusting process using the assembly apparatus;

FIG. 9 is a flowchart showing an assembly method according to another embodiment of the invention;

FIG. 10 is a flowchart showing an assembly method according to still another embodiment of the invention; and

FIG. 11 is a view typically showing a mass-production apparatus to which the assembly apparatus according to the embodiment of the invention is applied.

DETAILED DESCRIPTION OF THE INVENTION

An assembly method and an assembly apparatus for a disk recording apparatus according to an embodiment of the present invention will now be described in detail with reference to the accompanying drawings.

The following is a description of a hard disk drive (hereinafter referred to as an HDD) for use as a disk recording apparatus to which the assembly method and the assembly apparatus are applied. As shown in FIGS. 1A and 1B, the HDD 10 comprises a case body 12 in the form of a rectangular plate that serves as a base.

Mounted on the case body 12 are two magnetic disks 14a and 14b for use as recording media, a spindle motor 16 for supporting and rotating these magnetic disks, and magnetic heads 18 for recording on and reproducing information from the magnetic disks,

a head actuator 20, and a board unit 21 having
a preamplifier or the like. The head actuator 20
supports the magnetic head for rotation and can be
moved to a desired position relative to the magnetic
5 disks. The head actuator 20 includes a voice coil
motor 23.

The spindle motor 16 is provided with a stator
(not shown) fixed to the case body 12 and a rotatable
cylindrical hub 22 that serves as a rotor. The
10 magnetic disks 14a and 14b are mounted on the hub 22
and held between a flange of the hub and a disk-shaped
clammer 24 that is fastened to the upper end of the
hub by means of a screw 27. A spacer ring 25, which
is fitted on the hub 22, is sandwiched between the two
15 magnetic disks 14a and 14b. A reference mark 28 is
formed on the clamper 24.

As shown in FIG. 2, the assembly apparatus
comprises a measuring mechanism 100 for measuring
the eccentricity of a rotating part of the HDD 10,
20 a relative movement mechanism 200 for relatively
moving the magnetic disks 14a and 14b and the case
body 12 to adjust the eccentricity, and a control
element 80 for controlling these mechanisms.

The measuring mechanism 100 comprises a linear
25 guide mechanism 50, an angular position detecting
mechanism 101 for detecting the rotational angle of
each magnetic disk, and a vibration amplitude

detecting mechanism 150 for detecting the vibration amplitude. The linear guide mechanism 50 has one degree of freedom of translation in the horizontal direction indicated by arrow C, for example.

5 The linear guide mechanism 50 constitutes a common component for the relative movement mechanism 200.

The linear guide mechanism 50 has a rectangular stage 48 that can be translated in the direction of arrow C on a floor surface. The HDD 10 is fixedly
10 mounted on the stage 48 by fixing jigs 51. The HDD 10 fixed on the stage 48 is movable together with the stage 48 in the surface direction of the magnetic disks 14a and 14b, i.e., in the direction in parallel to the surfaces of the magnetic disks.

15 The angular position detecting mechanism 101 comprises a photoreflector sensor 110 as a first sensor for detecting the reference mark 28 and a driver 111 for driving the same. The sensor 110 is located over the clamper 24 of the HDD 10 that is
20 mounted on the stage 48. The driver 111 is connected to the control element 80 through an oscilloscope 81 and a fast Fourier transformer (hereinafter referred to as FFT) analyzer 82.

The vibration amplitude detecting mechanism 150
25 comprises an acceleration pickup 151 that is attached to one end of the stage 48 with respect to its moving direction. The acceleration pickup 151, which serves

as a second sensor, is connected to the control
element 80 through an amplifier 152, the oscilloscope
81, and the FFT analyzer 82. The control element 80
controls the respective operations of the mechanisms,
5 and serves as an analysis element of the present
invention.

Further, the relative movement mechanism 200
includes a holding mechanism 230, fastening mechanism
201, feed mechanism 250, and contact sensor 251.
10 The holding mechanism 230 can simultaneously hold
the two magnetic disks 14a and 14b. The fastening
mechanism 201 serves to tighten and loosen the screw
27 of the clamper 24. The feed mechanism 250 can move
the stage 48, having the HDD 10 thereon, in its moving
15 direction. The contact sensor 251 is used to detect
contact between the feed mechanism and the stage 48.
The holding mechanism 230, fastening mechanism 201,
and stage 48 are connected to the control element 80
through a driver 204. Likewise, the feed mechanism
20 250 and the contact sensor 251 are connected to the
control element 80.

As shown in FIGS. 3 and 4, the holding mechanism
230 includes a disk-shaped support frame 231 that
extends in the horizontal direction and three holding
25 rods 232 that extend in a direction parallel to the
axis of rotation of the disks or the vertical
direction. The holding rods 232 are arranged at equal

spaces of, e.g., 120 degrees on the circumference of a circle. Each holding rod 232 is fixed to a horizontally extending support rod 234, which is supported for reciprocation in its axial direction by means of a guide 236 that is mounted on the support frame 231. The holding rods 232 may be more than three in number.

Further, the proximal end portion of each holding rod 232 is connected to a movement mechanism 238 that is provided on the support frame 231. As the support rods 234 are reciprocated by means of the movement mechanisms 238, therefore, the holding rods 232 move in the radial direction to be pressed against the respective outer peripheral edges of the two magnetic disks 14a and 14b. Thus, the disks can be simultaneously held or released by means of the three holding rods 232. Alternatively, the holding mechanism 230 may be designed to be rotatable around its center so that it can hold each magnetic disk on the same spots on each occasion.

As shown in FIGS. 3, 5A and 5B, the fastening mechanism 201 is provided with a pin face wrench 202 and a stepping motor 203 for rotating the same. It is mounted on the central portion of the support frame 231 of the holding mechanism 230. The wrench 202 is opposed to the clamper 24 of the HDD 10 fixed on the stage 48 so that it can tighten and loosen

the screw 27 with the clamper held in place.

The following is a description of the method for assembling the HDD 10 by means of the assembly apparatus constructed in this manner, especially, the way of adjusting the eccentricity between the center of gravity and the center of rotation. This adjustment is based on two methods, an eccentricity measuring method and an eccentricity correcting method, which will be described below.

The eccentricity measuring method will be described first. As shown in FIG. 6, the HDD 10 is mounted on the stage 48 of the linear guide mechanism 50 by means of the fixing jigs 51. In this state, the rotating part of the HDD 10, which includes the magnetic disks 14a and 14b, clamper 24, and hub 22, is rotated by the spindle motor 16 of the HDD itself.

If the center of gravity of the rotating part and the center of rotation are eccentric with respect to each other, the linear guide mechanism 50 vibrates with an acceleration α , urged by the whirling center of gravity. In this case, α is given by

$$\begin{aligned}\alpha &= (me\omega^2/M)\cos(\omega t + \phi) = \alpha_0\cos(\omega t + \phi), \\ \alpha_0 &= me\omega^2/M, \quad \dots (1)\end{aligned}$$

where e is the eccentricity, m is the mass of the rotating part, M is the total mass of the parts that are moved by means of the linear guide mechanism 50,

that is, the stage 48, HDD 10, etc., ω is the angular velocity, and ϕ is settled depending on the way of timing and the phase of the position eccentric to the linear guide mechanism 50. The acceleration α is detected by subjecting an acceleration detected by means of the acceleration pickup 151 to acceleration-voltage conversion by the amplifier 152. The eccentricity e can be obtained from the amplitude of the observed acceleration.

In order to obtain the phasic relation between the linear guide mechanism 50 and the eccentric position of the rotating part, the reference mark 28 on the clamper 24 is detected by means of the photoreflector sensor 110, and the phase of the eccentric position is detected according to the time when the reference mark 28 passes under the photoreflector sensor 110 and the behavior of vibrational motion of the linear guide mechanism 50 at that time. The oscilloscope 81 or the FFT analyzer 82 is used for the analysis of the behavior of the vibrational motion.

The following is a description of a case where the behavior of the vibrational motion is detected by means of the acceleration pickup 151 and analyzed by means of the oscilloscope 81. When a line that passes through the eccentric center of the rotating part and the center of rotation is aligned with a moving

direction C of the linear guide mechanism 50 and the line passes in front of the acceleration pickup 151, the acceleration of the vibration has its minimum (negative and having a maximum absolute value) and corresponds to the troughs of the cosine (or sine) waveform of the acceleration wave a that is displayed on the oscilloscope 81, as shown in FIG. 7. In every cycle of the acceleration wave, the reference mark 28 on the clamper 24 never fails to pass once in front of the photorelector sensor 110. The sensor 110 detects the reference mark 28 and delivers an index signal b to the oscilloscope 81.

The phase difference between a trough of the acceleration wave a and the index signal b indicates the time at which the eccentric center passes in front of the acceleration pickup 151 after the reference mark 28 passes the photorelector sensor 110. Based on this, the control element 80 detects the phasic relation between the reference mark 28 and the eccentric point.

Let it now be supposed that the clamper 24 is unfastened to shift the respective positions of the magnetic disks 14a and 14b with respect to the hub 22, thereby canceling the eccentricity.

In order to obtain the eccentricity $e = 0$, it is necessary only that adjustable parts (magnetic disk, clamper, and spacer ring) be moved for e_1 according to

$$\begin{aligned} e &= (m_1 e_1 + m_2 e_2) / m, \\ e_2 &= 0, \end{aligned} \quad \dots (2)$$

where $\underline{m}$ is the mass of the rotating part; m_1 , the mass of the adjustable parts; m_2 , the mass of unadjustable parts (motor rotor and hub); $\underline{e}$, the eccentricity of the rotating part; e_1 , the eccentricity of the adjustable parts; and e_2 , the eccentricity of the unadjustable parts, based on $m = m_1 + m_2$ (rotating part = adjustable parts + unadjustable parts), and

$$\begin{aligned} e &= (m_1 / m) e_1, \\ e &= \alpha_0 M / m \omega^2, \\ (m_1 / m) e_1 &= \alpha_0 M / m \omega^2, \\ e_1 &= \alpha_0 M / m_1 \omega^2, \end{aligned} \quad \dots (3)$$

(every eccentricity is supposed to be caused by a gap attributable to the fitting of assemblies).

The behavior of the vibrational motion may be detected in the form of speed by means of a laser Doppler speedometer, solenoid, or microphone sensor, as well as the acceleration pickup 151. Alternatively, it may be detected in the form of displacement by means of a displacement gauge such as a laser displacement gauge.

In these cases, amplitudes V and X of the speed and displacement are given by

$$\begin{aligned} V &= (m e \omega / M) \sin(\omega t + \phi), \\ X &= -(m e / M) \cos(\omega t + \phi), \end{aligned} \quad \dots (4)$$

respectively.

The following is a description of a correcting method for correcting the eccentricity measured by the measuring method described above. Here let it be
5 supposed that the angle between the reference mark 28 and the eccentric position and the eccentricity e_1 to be adjusted are known values obtained by the aforesaid eccentricity measurement.

First, as shown in FIG. 8, the rotating part is
10 rocked with reference to the reference mark 28 and the angle between the reference mark and the eccentric position so that the eccentric position is on the opposite side from the feed mechanism 250 on the X-axis in the moving direction C of the stage 48. As
15 this is done, the rotating part is rotated by means of the pin face wrench 202.

After rocking the rotating part is finished, the two magnetic disks 14a and 14b are simultaneously held and fixed on absolute coordinates by means of the
20 holding mechanism 230. The magnetic disks 14a and 14b are unfastened from the hub 22 by arresting the rotation of the clamper 24 and loosening the screw 27 by means of the pin face wrench 202. Thereupon, the relative positions of the magnetic disks 14a and 14b
25 and the case body 12 can be changed.

Subsequently, the stage 48 of the linear guide mechanism 50 is pressed and moved by the feed

mechanism 250 that is provided with the contact sensor 251. As this is done, the stage 48 is moved for the eccentricity e_1 to be adjusted after the contact sensor 251 detects contact with the stage 48.

5 Since the magnetic disks 14a and 14b are unfastened from the hub 22 in the preceding process, the relative positions of the magnetic disks and the case body 12 can be adjusted by moving the stage 48.

By relatively moving the magnetic disks 14a and 14b and the case body 12 for the eccentricity e_1 in this manner, the center of gravity of the rotating part and the center of rotation can be made to coincide to cancel out the eccentricity. After the movement of the stage 48 is finished, the screw 27 of the clamper 24 is tightened by means of the pin face wrench 202 to fasten the magnetic disks 14a and 14b to the hub 22. Then, the magnetic disks 14a and 14b are released from the hold by the holding mechanism 230. Thereafter, the HDD 10 is removed from the stage 48.

15
20 Thus, the HDD can be obtained free from eccentricity.

Alternatively, the respective centers of a plurality of magnetic disks may be aligned with one another by simultaneously holding the disks by means of the holding mechanism 230. In consideration of the variation in roundness of the outside diameter of each magnetic disk, moreover, the magnetic disk may be held by rocking the holding mechanism 230 with reference to

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the reference mark 28 of the clamper 24 so that the holding rods 232 of the holding mechanism hold the magnetic disk on the same spot without fail.

According to the assembly method and the assembly apparatus arranged in this manner, the eccentricity measurement and eccentricity adjustment can be carried out by means of one and the same apparatus, and an eccentricity-free HDD designed so that the center of gravity of the rotating part and the center of rotation are coincident can be assembled with ease.

Since fastening the magnetic disks and the eccentricity measurement can be performed by means of the one apparatus, moreover, the apparatus can also be used as an inspection apparatus if the eccentricity measurement is conducted again after the magnetic disks are fastened. In doing this, as shown in FIG. 10, temporary assembly may be carried out with the clamper loosely bound in the initial stage of assembly. In this case, the eccentricity inspection is conducted again after the clamper is additionally tightened if the inspection is passed when the eccentricity measurement is repeated after the first eccentricity measurement and the eccentricity adjustment.

Since the assembly apparatus described above is provided with the linear guide mechanism, furthermore, it is applicable to an assembly apparatus for

mass-production shown in FIG. 11. More specifically,
the assembly apparatus comprises first and second
lines A and B for supplying HDDs, two stages X and Y
that constitute first and second linear guide
5 mechanisms, respectively, an assembly area, and first
and second jig removal areas I and J that are situated
on the opposite sides of the assembly area,
individually.

The assembly area is provided with the measuring
10 mechanism 100 and the relative movement mechanism 200.
The stage X, which is provided with fixing jigs, can
reciprocate between the assembly area and the first
jig removal area I. The stage Y, which is also
provided with fixing jigs, can reciprocate between the
15 assembly area and the second jig removal area J.
While an HDD is being assembled by means of the one
stage in the assembly area, another HDD is mounted on
the other stage or the completed HDD is removed in the
jig removal area I or J.

20 Additional advantages and modifications will
readily occur to those skilled in the art. Therefore,
the invention in its broader aspects is not limited to
the specific details and representative embodiments
shown and described herein. Accordingly, various
25 modifications may be made without departing from the
spirit or scope of the general inventive concept as
defined by the appended claims and their equivalents.

For example, the invention is applicable to a disk recording apparatus that is provided with one or three or more disks, as well as to a disk recording apparatus that is provided with two disks.

WHAT IS CLAIMED IS:

1. A method of assembling a disk recording apparatus, which comprises a base, a spindle motor fixed to the base, a disk mounted on a rotor of the spindle motor, and a clamper fastening the disk to the
5 rotor, the method comprising:

driving the spindle motor to rotate a rotating part, including the rotor, disk, and clamper, in a manner such that the disk recording apparatus is
10 supported for movement with one degree of freedom of translation in a direction substantially in parallel to surfaces of the disk;

measuring vibration of the disk recording apparatus in the direction of the one degree of
15 freedom of translation caused by the rotation of the rotating part;

detecting the angular position of the disk at which vibration of a maximum amplitude is generated;

analyzing the eccentricity and the direction of
20 eccentricity of the rotating part in accordance with the measured vibration and the detected angular position; and

relatively moving the base and the rotating part to correct the eccentricity in accordance with the
25 result of the analysis.

2. A method of assembling a disk recording apparatus according to claim 1, wherein the rotating

part is rotated in accordance with the result of the analysis so that the direction of eccentricity and the direction of the one degree of freedom of translation are coincident,

5 the disk is held to fix the rotating part on absolute coordinates after the rotating part is rotated, the disk is unfastened from the rotor with the rotating part fixed,

 the base is moved relative to the rotating part
10 in accordance with the eccentricity obtained by the analysis in the direction of the one degree of freedom of translation, thereby making the center of gravity of the rotating part and the center of rotation coincident, after the disk is unfastened, and

15 the disk is fastened to the rotor after the relative movement.

 3. A method of assembling a disk recording apparatus according to claim 1, wherein the rotating part is released from fixation, and rotation of the
20 rotating part, measurement of vibration, and analysis of the eccentricity and the direction of eccentricity are repeated after the disk is fastened to the rotor, and the eccentricity is corrected again if the eccentricity is not in conformity with a given
25 reference value.

 4. A method of assembling a disk recording apparatus, which comprises a base, a spindle motor

fixed to the base, a disk mounted on a rotor of the spindle motor, and a clamper fixed to the rotor by means of a screw and fastening the disk to the rotor, the method comprising:

5 driving the spindle motor to rotate a rotating part, including the rotor, disk, and clamper, in a manner such that the disk recording apparatus is supported for movement with one degree of freedom of translation in a direction substantially in parallel
10 to surfaces of the disk;

 measuring vibration in the direction of the one degree of freedom of translation caused by the rotation of the rotating part of the disk recording apparatus;

15 detecting the angular position of the disk at which vibration of a maximum amplitude is generated;

 analyzing the eccentricity and the direction of eccentricity of the rotating part in accordance with the measured vibration and the detected angular
20 position;

 rotating the rotating part in accordance with the result of the analysis so that the direction of eccentricity and the direction of the one degree of freedom of translation are coincident;

25 holding the disk to fix the rotating part on absolute coordinates after the rotating part is rotated;

loosening the screw of the clamper to unfasten
the disk from the rotor with the rotating part fixed;

moving the base relative to the rotating part in
accordance with the eccentricity obtained by the
5 analysis in the direction of the one degree of freedom
of translation, thereby making the center of gravity
of the rotating part and the center of rotation
coincident, after the disk is unfastened; and

tightening the screw of the clamper to fasten
10 the disk to the rotor after the relative movement.

5. An assembly apparatus for a disk recording
apparatus, which comprises a base, a spindle motor
fixed to the base, a disk mounted on a rotor of
the spindle motor, and a clamper fastening the disk to
15 the rotor, the assembly apparatus comprising:

a linear guide mechanism configured to support
the disk recording apparatus for movement with one
degree of freedom of translation in a direction
substantially in parallel to surfaces of the disk;

20 a measuring mechanism configured to measure
vibration of the disk recording apparatus in the
direction of the one degree of freedom of translation
caused when the spindle motor of the disk recording
apparatus supported by the linear guide mechanism is
25 driven to rotate a rotating part, including the rotor,
disk, and clamper;

an angular position detecting mechanism

configured to detect the angular position of the disk at which vibration of a maximum amplitude is generated;

an analysis element configured to analyze the eccentricity and the direction of eccentricity of the rotating part in accordance with the measured vibration and the detected angular position; and

a relative movement mechanism configured to relatively moving the base and the rotating part to correct the eccentricity in accordance with the result of the analysis by the analysis element.

6. An assembly apparatus for a disk recording apparatus according to claim 5, wherein the relative movement mechanism includes a fastening mechanism configured to rotate the rotating part so that the direction of eccentricity and the direction of the one degree of freedom of translation are coincident and to tighten and loosen the clamper, a holding mechanism configured to hold the disk to fix the rotating part on absolute coordinates after the rotating part is rotated, and a feed mechanism configured to move the linear guide mechanism relative to the rotating part in the direction of the one degree of freedom of translation.

7. An assembly apparatus for a disk recording apparatus according to claim 6, wherein the holding mechanism includes a plurality of holding rods,

extending parallel to the axis of rotation of the disk
and movable relative to the disk in the radial
direction, and movement mechanisms configured to press
the holding rods against the outer peripheral edge of
5 the disk to hold the disk.

8. An assembly apparatus for a disk recording
apparatus according to claim 5, wherein the angular
position detecting mechanism includes a first sensor
configured to detect a reference mark on the clamper
10 and output an index signal, the measuring mechanism
includes a second sensor configured to detect the
amplitude of the vibration of the disk recording
apparatus, and the analysis element includes means for
analyzing the angular position for the maximum
15 amplitude according to the phase difference between
detection signals from the first and second sensors.

9. An assembly apparatus for a disk recording
apparatus according to claim 5, which further
comprises an assembly area provided with the measuring
20 mechanism, angular position detecting mechanism,
analysis element, and relative movement mechanism,
first and second jig removal areas situated on the
opposite sides of the assembly area, individually,
a first linear guide mechanism movable between the
25 assembly area and the first jig removal area and
capable of attaching and detaching the disk recording
apparatus in the first jig removal area, a second

linear guide mechanism movable between the assembly area and the second jig removal area and capable of attaching and detaching the disk recording apparatus in the second jig removal area, a first line
5 configured to supply the disk recording apparatus to the first linear guide mechanism situated in the first jig removal area, and a second line configured to supply the disk recording apparatus to the second linear guide mechanism situated in the second jig
10 removal area.

10. An assembly apparatus for a disk recording apparatus, which comprises a base, a spindle motor fixed to the base, a disk mounted on a rotor of the spindle motor, and a clamper fixed to the rotor by
15 means of a screw and fastening the disk to the rotor, the assembly apparatus comprising:

a linear guide mechanism configured to support the disk recording apparatus for movement with one degree of freedom of translation in a direction
20 substantially in parallel to surfaces of the disk;

a measuring mechanism configured to measure vibration of the disk recording apparatus in the direction of the one degree of freedom of translation caused when the spindle motor of the disk recording
25 apparatus supported by means of the linear guide mechanism is driven to rotate a rotating part, including the rotor, disk, and clamper;

an angular position detecting mechanism
configured to detect the angular position on the disk
in which vibration of a maximum amplitude is
generated;

5 an analysis element configured to analyze the
eccentricity and the direction of eccentricity of the
rotating part in accordance with the measured
vibration and the detected angular position; and

 a relative movement mechanism configured to
10 relatively moving the base and the rotating part to
correct the eccentricity in accordance with the result
of the analysis by the analysis element,

 the relative movement mechanism including
a fastening mechanism configured to rotate the
15 rotating part so that the direction of eccentricity
and the direction of the one degree of freedom of
translation are coincident and configured to tighten
and loosen the clamper.