

[Document Name] Specification

[Title of the Invention] GRINDING MECHANISM AND GRINDING APPARATUS

[Technical Field]

[0001]

5 The present invention relates to a grinding mechanism and a grinding apparatus.

[Technical Background]

[0002]

 In a case in which a grinding object such as, for example, a resin-sealed substrate
10 or the like is being ground, in some cases, the grinding object firstly undergoes rough
grinding and subsequently undergoes finishing grinding.

[0003]

 Conventionally, the rough grinding and finishing grinding are performed
respectively using mutually separate grinding apparatuses. Alternatively, using a
15 semiconductor strip grinder equipped with two tables such as that described in Patent
Document 1, rough grinding may be performed using one table, and finishing grinding
may be performed using the other table.

[Documents of the Prior Art]

[Patent Documents]

20 [0004]

[Patent Document 1] Japanese Patent Publication No. 6181799

[Disclosure of the Invention]

[Problems to be Solved by the Invention]

[0005]

25 However, in cases in which the rough grinding and the finishing grinding are

performed using separate grinding apparatuses, and also in cases in which, as is described in Patent Document 1, the rough grinding and the finishing grinding are performed on separate tables, after the rough grinding it is necessary to relocate the grinding object to the separate table. In this case, after being relocated, the grinding object must then be
5 repositioned on the new table. Moreover, even after this repositioning, because the horizontality of the table is not exactly the same before and after the relocation, the flatness of the grinding object that is fixed onto the table in order to be ground is adversely affected, so that the flatness of the grinding object during the rough grinding is different from the flatness of the grinding object during the finishing grinding. As a result of this, there is a
10 concern that the precision of the grinding will deteriorate. Particularly in cases in which the grinding object is a thin object (for example, 5 mm or less, or 1 mm or less), this flatness (i.e., grinding precision) is a serious problem.

[0006]

For this reason, a principal object of the present invention is to enable a uniform
15 flatness to be obtained during both rough grinding and finishing grinding of a grinding object.

[Means for Solving the Problem]

[0007]

Namely, a grinding mechanism according to the present invention is characterized
20 in being provided with a table that holds a planar grinding object, a table moving unit that moves the table reciprocatingly in a straight line within a predetermined range in one direction, a rough grinding unit that is moved to within the range of movement within which the grinding object can be moved by the table moving unit, and performs rough grinding on the grinding object, and a finishing grinding unit that is moved to within the
25 range of movement within which the grinding object can be moved by the table moving

unit, and performs finishing grinding on the grinding object.

[Effects of the Invention]

[0008]

According to the present invention which is configured in the above-described
5 manner, it is possible to obtain a uniform flatness during rough grinding and finishing
grinding of a grinding object.

[Brief description of the drawings]

10 [0009]

[FIG. 1] FIG. 1 is a plan view schematically showing a structure of an embodiment
of a grinding apparatus according to the present invention.

[FIG. 2] FIG. 2 is a rear view schematically showing the structure of the grinding
mechanism of the same embodiment.

15 [FIG. 3] FIG. 3 is a plan view schematically showing: (A) a state in which rough
grinding is being performed; and (B) a state in which finishing grinding is being performed
in the same embodiment.

[FIG. 4] FIG. 4 is a plan view schematically showing a structure of a variant
embodiment of the grinding apparatus according to the present invention.

20 [FIG. 5] FIG. 5 is a plan view schematically showing a structure of a variant
embodiment of the grinding apparatus according to the present invention.

[FIG. 6] FIG. 6 contains a front view and a side view schematically showing a
structure of a belt grinding unit of a variant embodiment.

[FIG. 7] FIG. 7 is a schematic view showing a structure of a casing of the belt
25 grinding unit.

[FIG. 8] FIG. 8 is a view schematically showing mounting structures for mounting a rough grinding unit, a finishing grinding unit, and a belt grinding unit onto a Z-direction slider.

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[Best Embodiments for Implementing the Invention]

[0010]

Next, the present invention will be described in greater detail using examples. It should be noted that the present invention is not limited to the following description.

10 [0011]

As is described above, the grinding mechanism of the present invention is characterized in being provided with a table that holds a planar grinding object, a table moving unit that moves the table reciprocatingly in a straight line within a predetermined range in one direction, a rough grinding unit that is moved to within a range of movement within which the grinding object can be moved by the table moving unit, and performs rough grinding on the grinding object, and a finishing grinding unit that is moved to within the range of movement within which the grinding object can be moved by the table moving unit, and performs finishing grinding on the grinding object.

By providing this type of grinding mechanism, because each of a rough grinding unit and a finishing grinding unit is able to be moved to within the range of movement within which the grinding object can be moved by the table moving unit, and perform grinding on the grinding object, it is possible to perform both rough grinding and finishing grinding while the grinding object is being held on a single table. Consequently, it is not necessary to relocate a grinding object to a different table, so that the task of repositioning the grinding object on the different table is also unnecessary, and the flatness of the rough

grinding and the finishing grinding of the grinding object can be kept uniform. As a result, the grinding precision when grinding a grinding object can be improved. In addition to this, because the range of movement of the table is the same for both the rough grinding unit and the finishing grinding unit, it is possible to reduce the footprint occupied by the grinding mechanism.

[0012]

As a specific aspect of the movement of the rough grinding unit and the finishing grinding unit, a structure in which the rough grinding unit and the finishing grinding unit move in a direction that crosses the direction in which the table is moved reciprocatingly by the table moving unit may be considered. Preferably, a structure in which the rough grinding unit and the finishing grinding unit move in a direction that is orthogonal to the direction in which the table is moved reciprocatingly may be considered.

[0013]

Because a considerable quantity of rough grinding is performed, clogging of the grindstone used for the rough grinding becomes a problem. Because of this, it is desirable that the rough grinding unit be a horizontal axis type of grinding unit having a grindstone for rough grinding. Note that a horizontal axis type of grinding unit performs grinding in which an axis of rotation of the grindstone is parallel to the table surface.

According to this structure, it is possible to reduce clogging of the grindstone for rough grinding.

[0014]

Moreover, it is also desirable that the finishing grinding unit be a vertical axis type of grinding unit having a grindstone for finishing grinding. Note that a vertical axis type of grinding unit performs grinding in which an axis of rotation of the grindstone is perpendicular to the table surface.

According to this structure, highly precise grinding is possible, and productivity can be increased due to the increased grinding surface area.

[0015]

Depending on the type of grinding object, clogging of the grindstone used for the rough grinding and of the grindstone used for the finishing grinding may be a serious problem. Moreover, there are also grinding objects for which a high level of grinding precision is not absolutely necessary such as, for example, objects that are only being ground in order to expose a copper wiring portion or a solder portion thereof. In the case of a grinding object such as this, if both a grindstone for rough grinding and a grindstone for finishing grinding are used, then this leads to an increase in running costs.

In order to appropriately solve this problem, it is desirable that either the rough grinding unit or the finishing grinding unit be a belt-grinding type of grinding unit that uses an endless belt type of grinding belt. A grinding belt is lower in cost compared to a grindstone for rough grinding and a grindstone for finishing grinding, and enables a major cost reduction to be achieved. In addition, the task of replacing a grinding belt is also easier compared to a grindstone for rough grinding and a grindstone for finishing grinding.

[0016]

In order to enable a mode of grinding to be selected in accordance with the type of grinding object, and to also improve the versatility of the grinding mechanism, it is desirable that the rough grinding unit be configured so as to be able to be switched between a horizontal axis type of grinding unit having a grindstone for rough grinding, and a belt-grinding type of grinding unit that uses an endless belt type of grinding belt, and for the finishing grinding unit to be configured so as to be able to be switched between a vertical axis type of grinding unit having a grindstone for finishing grinding, and a belt-grinding type of grinding unit that uses an endless belt type of grinding belt.

[0017]

More specifically, the grinding mechanism is provided with a rough grinding unit moving unit that moves the rough grinding unit, a finishing grinding unit moving unit that moves the finishing grinding unit, and a control unit that controls the rough grinding unit moving unit and the finishing grinding unit moving unit.

In this structure, in order to ensure that the two grinding units are controlled such that they do not interfere with each other, it is desirable that, when either one of the rough grinding unit or the finishing grinding unit is grinding a grinding object, the control unit retract the other one of the rough grinding unit or the finishing grinding unit to a position outside the range of movement of the grinding object.

[0018]

In order to improve the grinding precision by stably supporting the rough grinding unit and the finishing grinding unit, it is desirable that the grinding mechanism be further provided with a pair of leg portions that are disposed on either side of the table moving unit, and a connecting beam portion that spans a gap between the pair of leg portions, and that the rough grinding unit and the finishing grinding unit be movably supported on the connecting beam.

[0019]

Here, in order to create a structure that prevents the rough grinding unit and the finishing grinding unit from interfering with each other, it is desirable that one of the rough grinding unit or the finishing grinding unit be supported on the nearer side of the connecting beam, while the other one of the rough grinding unit or the finishing grinding unit be supported on the further side of the connecting beam.

[0020]

In addition, in order to improve the versatility of the grinding mechanism, it is

desirable that there be further provided a belt-grinding unit that uses an endless belt type of grinding belt and is separate from the rough grinding unit and the finishing grinding unit, and that is moved to within the range of movement within which the grinding object can be moved by the table moving unit.

5 [0021]

In order to inhibit grinding defects caused by burring, and to improve the quality of a grinding object, it is desirable that the grinding mechanism be further provided with a deburring unit that is moved to within the range of movement within which the grinding object can be moved by the table moving unit, and performs deburring on a grinding object.

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[0022]

A grinding apparatus that is provided with the above-described grinding mechanism is an additional aspect of the present invention.

[0023]

15 [Embodiments of the Present Invention]

Hereinafter, embodiments of the grinding apparatus according to the present invention will be described with reference to the drawings. Note that, in order to make each of the drawings described below easier to understand, the drawings are illustrated in schematic form with portions either omitted or given prominence as is appropriate.

20 Moreover, component elements having the same structure are given the same descriptive symbols and, when appropriate, any duplicated description thereof is omitted.

[0024]

In the following description, a resin-sealed substrate (i.e., a sealed substrate) is described as an example of a planar grinding object. Examples of the substrate include
25 general substrates such as glass epoxy substrates, ceramic substrates, resin substrates, and

metal substrates and the like, and lead frames and the like. In addition to these, the planar grinding object may be an object other than a substrate.

[0025]

[Overall Structure of a Grinding Apparatus 100]

5 A grinding apparatus 100 of the present embodiment performs surface grinding on a surface of a sealed substrate W (hereinafter, referred to simply as a 'substrate W'). As a result, the grinding apparatus 100 adjusts the height (i.e., adjusts the thickness) of the substrate W, or makes modifications to the substrate such as, for example, improving the heat dissipation of electrical components mounted on the substrate W or the like.

10 [0026]

More specifically, as is shown in FIG. 1, the grinding apparatus 100 is provided with various component elements including a substrate storage module 100A that stores substrates W, a substrate grinding module 100B that grinds the substrates W, and a substrate cleaning module 100C that cleans substrates W after they have been ground.

15 Each of the respective component elements 100A through 100C can be assembled with, or disassembled from each of the other component elements, and can also be replaced.

Moreover, the transporting of the substrates W between each of the modules 100A through 100C is performed by a substrate transporting mechanism 100D and/or a robot arm (not shown in the drawings). Overall operations of the grinding apparatus 100 of the present
20 embodiment are controlled by a controller CTL that includes a control unit 9 (described below).

[0027]

The substrate storage module 100A supplies substrates W before they are ground (i.e., pre-grinding substrates), and also stores the substrates W after they have been ground
25 (i.e., post-grinding substrates). More specifically, the substrate storage module 100A is

provided with a pre-grinding substrate supply unit 11 that supplies the pre-grinding substrates W, and a post-grinding substrate storage unit 12 that stores the post-grinding substrates W. Note that the pre-grinding substrate supply unit 11 and the post-grinding substrate storage unit 12 may be formed using the same unit (for example, a magazine rack).

[0028]

The substrate grinding module 100B performs surface grinding on a surface of a substrate W that has been transported by the substrate transporting mechanism 100D.

More specifically, the substrate grinding module 100B performs both rough grinding and finishing grinding. This is described below in more detail.

[0029]

The substrate cleaning module 100C cleans the post-grinding substrates W after they have been ground by the substrate grinding module 100B. In the grinding apparatus 100 of the present embodiment, the substrates W are transported by a robot arm (not shown in the drawings) from a table 2 of the substrate grinding module 100B to the substrate cleaning module 100C and are then cleaned. More specifically, the substrate cleaning module 100C includes a cleaning unit 13 that cleans the post-grinding substrates W by spraying jets of a cleaning liquid such as, for example, water or the like onto the post-grinding substrates W, and a drying unit 14 that dries the cleaned post-grinding

substrates W. In addition to these, it is also possible to provide an inspection unit 15 that is used to determine whether any faults or the like are present in the post-grinding substrates W in the substrate cleaning module 100C. Note that this inspection unit 15 may also be provided as a separate inspection module independently of the substrate cleaning module 100C.

[0030]

The post-grinding substrates W that have been cleaned by the substrate cleaning module 100C, are transported by the robot arm (not shown in the drawings) and the substrate transporting mechanism 100D to the substrate storage module 100A, and are stored in the post-grinding substrate storage unit 12.

5 [0031]

[Substrate Grinding Module 100B (Grinding Mechanism)]

Next, the substrate grinding module 100B (i.e., the grinding mechanism) will be described in detail.

[0032]

10 As is shown in FIG. 1 and FIG. 2, the substrate grinding module 100B is provided with a table 2 that holds the substrates W, a table moving unit 3 that moves the table 2 reciprocatingly in a straight line, a rough grinding unit 4 that performs rough grinding on the substrates W, and a finishing grinding unit 5 that performs finishing grinding on the substrates W.

15 [0033]

The table 2 holds a substrate W by means of suction, and multiple suction holes (not shown in the drawings) that are used to suction the substrate W are formed in an upper surface thereof. Note that the multiple suction holes are connected to a vacuum pump VP. The table 2 of the present embodiment is formed having a rectangular parallelepiped shape when looked at in plan view so as to correspond to the substrate W which also has a rectangular parallelepiped shape when looked at in plan view.

[0034]

The table moving unit 3 moves the table 2 reciprocatingly in a straight line within a predetermined range in one direction (i.e., a Y direction). More specifically, the table moving unit 3 moves the table 2 reciprocatingly in a straight line between a first position P

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that is set on a nearer side in the Y direction, and a second position Q that is set on a further side in the Y direction. Here, the first position P is the position to which the substrate W is supplied and from which it is removed, however, the first position P may also be set to a different position from the position to which the substrate W is supplied and from which it is removed.

In order to achieve a high level of grinding precision, it is preferable that the table moving unit 3 not be provided with a mechanism for rotating the table 2. In this case, the grinding apparatus 100 is provided with an alignment mechanism for aligning the orientation of the substrate W on the substrate transporting mechanism 100D with the alignment of the substrate W on the table moving unit 3 (see FIG. 1). The alignment mechanism may be, for example, a rotation mechanism that is provided in the substrate transporting mechanism 100D, or may be a transporting mechanism such as a robot arm or the like that moves a substrate W from the substrate transporting mechanism 100D to the table 2 while simultaneously rotating the substrate W to the correct orientation.

[0035]

The table moving unit 3 of the present embodiment is configured so as to move the table 2 in such a way that a longitudinal direction of the table 2 matches the direction in which the table 2 is moved reciprocatingly (i.e., the Y direction). For example, the table moving unit 3 is provided with a Y-direction rail that is provided so as to extend in the Y direction, a Y-direction slider that slides along the Y-direction rail and to which the table 2 is fixed, and a Y-direction drive unit that drives the Y-direction slider. Note that as a result of the Y-direction drive unit being controlled by the control unit 9 (described below), the table 2 is moved reciprocatingly in a straight line along the Y-direction rail.

[0036]

The rough grinding unit 4 is moved to within the range of movement within which

the substrate W can be moved by the table moving unit 3, and performs rough grinding on an upper surface of the substrate W. The rough grinding unit 4 is a horizontal axis type of grinding unit having a grindstone 41 for rough grinding, and a rotation shaft of a spindle 42 that causes the grindstone 41 for rough grinding to rotate is set so as to be parallel to the table surface. The grindstone 41 for rough grinding has a circular plate shape, and an outer-side circumferential surface thereof forms a working surface that is used for grinding.

[0037]

The finishing grinding unit 5 is moved to within the range of movement within which the substrate W can be moved by the table moving unit 3, and performs finishing grinding on the substrate W. The finishing grinding unit 5 is a vertical axis type of grinding unit having a grindstone 51 for finishing grinding, and a rotation shaft of a spindle 52 that causes the grindstone 51 for finishing grinding to rotate is set so as to be perpendicular to the table surface. Here, the grindstone 51 for finishing grinding is a finer-grained grindstone than the grindstone 41 for rough grinding. Moreover, the grindstone 51 for finishing grinding has a toroidal shape or a circular plate shape, and one end surface in the axial direction thereof forms a working surface that is used for grinding. In addition, the grindstone 51 for finishing grinding has a radius that is larger than the width dimension of the substrate W.

[0038]

More specifically, the rough grinding unit 4 and the finishing grinding unit 5 are configured so as to move in a direction that crosses the direction in which the table 2 is moved reciprocatingly (i.e., the Y direction) by the table moving unit 3. In the present embodiment, the rough grinding unit 4 and the finishing grinding unit 5 are configured so as to move in an X direction, which is orthogonal to the Y direction, between the first

position P and the second position Q.

[0039]

The substrate grinding module 100B of the present embodiment is provided with a flat-arch shaped supporting portion 6 that supports the rough grinding unit 4 and the finishing grinding unit 5 such that these are able to move. As is shown in FIG. 2, the supporting portion 6 is provided with a pair of leg portions 61 that are provided on two sides of the table moving unit 3, and a connecting beam portion 62 that spans the gap between the pair of leg portions 61, and the rough grinding unit 4 and the finishing grinding unit 5 are movably supported on the connecting beam portion 62. The connecting beam portion 62 is disposed so as to extend in the X direction between the first position P and the second position Q. In the present embodiment, a structure is employed in which both the rough grinding unit 4 and the finishing grinding unit 5 are supported on the further side of the connecting beam portion 62.

[0040]

Here, as is shown in FIG. 2, a rough grinding unit moving unit 7 is provided between the connecting beam portion 62 and the rough grinding unit 4, and a finishing grinding unit moving unit 8 is provided between the connecting beam portion 62 and the finishing grinding unit 5. Note that the rough grinding unit moving unit 7 and the finishing grinding unit moving unit 8 are not shown in FIG. 1.

[0041]

The rough grinding unit moving unit 7 moves the rough grinding unit 4 in the X direction, and is provided, for example, with an X-direction rail that is provided on the connecting beam portion 62 so as to extend in the X direction, an X-direction slider that moves along the X-direction rail, and an X-direction drive unit that drives the X-direction slider. The X-direction drive unit is controlled by the control unit 9 (described below) so

that the rough grinding unit 4 is moved in the X-direction.

[0042]

Moreover, the rough grinding unit moving unit 7 is also configured so as to be able to move the rough grinding unit 4 in a Z direction, and is provided with a Z-direction rail that is provided on the connecting beam portion 62 so as to extend in the Z direction, a Z-direction slider that moves along the Z-direction rail, and a Z-direction drive unit that drives the Z-direction slider. The Z-direction drive unit is controlled by the control unit 9 (described below) so that the rough grinding unit 4 is moved in the Z-direction.

[0043]

The finishing grinding unit moving unit 8 moves the finishing grinding unit 5 in the X direction, and is provided, for example, with an X-direction rail that is provided on the connecting beam portion 62 so as to extend in the X direction, an X-direction slider that moves along the X-direction rail, and an X-direction drive unit that drives the X-direction slider. The X-direction drive unit is controlled by the control unit 9 (described below) so that the finishing grinding unit 5 is moved in the X-direction. Note that the X-direction rail may be shared in common by the rough grinding unit moving unit 7 and the finishing grinding unit moving unit 8.

[0044]

Moreover, the finishing grinding unit moving unit 8 is also configured so as to be able to move the finishing grinding unit 5 in the Z direction, and is provided with a Z-direction rail that is provided on the connecting beam portion 62 so as to extend in the Z direction, a Z-direction slider that moves along the Z-direction rail, and a Z-direction drive unit that drives the Z-direction slider. The Z-direction drive unit is controlled by the control unit 9 (described below) so that the finishing grinding unit 5 is moved in the Z-direction.

[0045]

In the above-described structure, as a result of the control unit 9 controlling each unit, rough grinding and finishing grinding are performed on the substrate W.

[0046]

5 More specifically, when the substrate W is to undergo rough grinding, as is shown in FIG. 3 (A), the control unit 9 causes the rough grinding unit 4 to move to within the range of movement of the substrate W, and performs the rough grinding in a predetermined sequence.

[0047]

10 The control unit 9 performs rough grinding on the entire upper surface of the substrate W by controlling the table moving unit 3 so as to move the substrate W reciprocatingly in a straight line, while simultaneously controlling the rough grinding unit moving unit 7 so that the rough grinding unit 4 is moved in the X direction. For example, the control unit 9 causes the table 2 to move at least once in a straight line, so that rough
15 grinding is performed on the necessary portions of the substrate W in the longitudinal direction thereof. Thereafter, the rough grinding unit 4 is shifted sideways in the X direction so that the rough grinding unit 4 is in contact with portions of the substrate W that have not yet been ground, and the table 2 is made to move at least once in a straight line, so that rough grinding is performed in the longitudinal direction once again on the necessary
20 portions of the substrate W. By repeating this process, rough grinding is performed on the entire upper surface of the substrate W.

[0048]

In the above-described rough grinding, the control unit 9 adjusts the amount of rough grinding performed on the substrate W by performing feedback control on the
25 position in the Z direction of the rough grinding unit 4.

[0049]

More specifically, based on detected signals from either one or a plurality of contact sensors 10 (see FIG. 1) that are in contact with the substrate W, the control unit 9 performs feedback control on the position in the Z direction of the rough grinding unit 4 such that the thickness of the substrate W reaches a predetermined target value. Here, the thickness of the substrate W may be determined from a difference between the position in the Z direction of the upper surface of the table and the position in the Z direction of the upper surface of the substrate W, or alternatively, may be determined based on the amount of grinding which is determined from the position in the Z direction of the upper surface of the substrate W before grinding and the position in the Z direction of the upper surface of the substrate W after grinding. Note that the sensors used to detect the thickness of the substrate W or the amount of grinding are not limited to being contact sensors, and may instead be another type of displacement sensor such as an optical sensor or the like.

[0050]

In contrast, when the substrate W is to undergo finishing grinding after completing the rough grinding, as is shown in FIG. 3 (B), the control unit 9 causes the finishing grinding unit 5 to move to within the range of movement of the substrate W, and performs the finishing grinding in a predetermined sequence.

[0051]

The control unit 9 performs finishing grinding on the entire upper surface of the substrate W by controlling the finishing grinding unit moving unit 8 so that the grindstone 51 for finishing grinding of the finishing grinding unit 5 is disposed at a position where it is in contact with the substrate W, and controlling the table moving unit 3 so that the substrate W is moved in a straight line. For example, the control unit 9 controls the finishing grinding unit moving unit 8 so that, after the grindstone 51 for finishing grinding has been

disposed at a position where it is in contact with the substrate W over the entire width direction thereof, the control unit 9 controls the table moving unit 3 so that the substrate W is moved at least once in a straight line, and finishing grinding is performed on the substrate W in the longitudinal direction thereof.

5 [0052]

In the above-described finishing grinding, the control unit 9 adjusts the amount of finishing grinding performed on the substrate W by performing feedback control on the position in the Z direction of the finishing grinding unit 5. More specifically, based on detected signals from the contact sensors 10 that are in contact with the substrate W, the control unit 9 performs feedback control on the position in the Z direction of the finishing grinding unit 5 such that the thickness of the substrate W reaches a predetermined target value. Here, the thickness of the substrate W may be determined from a difference between the position in the Z direction of the upper surface of the table and the position in the Z direction of the upper surface of the substrate W, or alternatively, may be determined based on the amount of grinding which is determined from the position in the Z direction of the upper surface of the substrate W before the grinding and the position in the Z direction of the upper surface of the substrate W after the grinding.

[0053]

Here, in the above-described control, when one of the rough grinding unit 4 or finishing grinding unit 5 is grinding a substrate W, the control unit 9 retracts the other one of the rough grinding unit 4 or finishing grinding unit 5 to a position outside the range of movement of the substrate W (see FIG. 3). Here, this retraction may involve either retracting the other one of the rough grinding unit 4 or finishing grinding unit 5 to a predetermined retraction position outside the range of movement, or may be a retraction to a position within the range of movement where the other one of the rough grinding unit 4

or finishing grinding unit 5 does not obstruct the movement of the one of the rough grinding unit 4 or finishing grinding unit 5 that is performing the grinding. For example, after the control unit 9 has moved one of the rough grinding unit 4 or finishing grinding unit 5 to the retraction position outside the range of movement and stopped it in this position, the control unit 9 moves the other one of the rough grinding unit 4 or finishing grinding unit 5 to within the range of movement and commences the grinding.

[0054]

[Effects Obtained from the Present Embodiment]

According to the grinding apparatus 100 of the present embodiment, because the rough grinding unit 4 and the finishing grinding unit 5 are moved respectively to within the range of movement within which the substrate W is able to be moved by the table moving unit 3, and then grind the substrate W, it is possible to perform both rough grinding and finishing grinding on a substrate W while that substrate W is being held on a single table 2. As a result, it is unnecessary for a substrate W to have to be relocated to a different table, so that is it also unnecessary for the task of repositioning the substrate W on the new table to be performed. As a consequence, the flatness of the rough grinding and the finishing grinding performed on the substrates W can be uniformized. As a result, it is possible to improve the precision of the grinding of the substrates W.

[0055]

Moreover, because the range of movement of the table 2 is the same for both the rough grinding unit 4 and the finishing grinding unit 5, it is possible to reduce the footprint occupied by the substrate grinding module 100B (i.e., the grinding mechanism). In the present embodiment, because the direction in which the table 2, which is formed in a rectangular parallelepiped shape when looked at in plan view, is moved reciprocatingly matches the longitudinal direction of the table 2, it is also possible to reduce the footprint

in the width direction of the grinding mechanism.

[0056]

[Additional Variant Embodiments]

Note that the present invention is not limited to the above-described embodiment.

5 [0057]

For example, as is shown in FIG. 4, it is also possible to employ a structure in which one of the rough grinding unit 4 or the finishing grinding unit 5 is supported on the nearer side of the connecting beam portion 62, and the other one of the rough grinding unit 4 or the finishing grinding unit 5 is supported on the further side of the connecting beam
10 portion 62. By employing this structure, it is possible to configure both the rough grinding unit 4 and the finishing grinding unit 5 such that they do not interfere with each other physically. In addition, the rough grinding unit moving unit 7 and the finishing grinding unit moving unit 8 are disposed on both sides of the connecting cross beam 62, so that the degree of freedom when designing these structures can be increased.

15 [0058]

Furthermore, in addition to the above-described embodiment, as is shown in FIG. 5, it is also possible to provide a deburring unit 16 that is moved to within the range of movement within which the substrates W can be moved by the table moving unit 3, and performs deburring on the substrates W. In the same way as the rough grinding unit 4 and
20 the finishing grinding unit 5, a structure in which the deburring unit 16 is also movably supported on the connecting beam portion 62 may be considered. A structure in which the deburring unit 16 is formed, for example, by brushes may be considered. Note that, in FIG. 5, the deburring unit 16 is supported on the nearer side of the connecting beam portion 62, however, it may also be supported on the further side thereof.

25 [0059]

The rough grinding unit 4 of the above-described embodiment uses the grindstone 41 for rough grinding, while the finishing grinding unit 5 uses the grindstone 51 for finishing grinding, however, as is shown in FIG. 6, it is also possible for the rough grinding unit 4 or the finishing grinding unit 5 to be a belt grinder (hereinafter, referred to as a 'belt grinding unit 17') that utilizes an endless belt type of grinding belt 171. Note that the grinding belt 171 is formed by joining together both ends of a belt-shaped abrasive cloth on whose surface abrasive grains have been adhered, so as to form a loop-shaped belt. This grinding belt 171 is low in cost compared to the grindstone 41 for rough grinding and the grindstone 51 for finishing grinding, so that a considerable cost reduction can be achieved. In addition, the task of replacing the grinding belt 171 is easier compared to replacing the grindstone 41 for rough grinding and the grindstone 51 for finishing grinding. Furthermore, the grinding belt 171 is effective in cases in which the grinding object is one that does not require a high level of grinding precision such as, for example, substrates W that would have a serious clogging problem were the grindstone 41 for rough grinding or the grindstone 51 for finishing grinding to be used, and substrates W that are only being ground in order, for example, to expose a copper wiring portion or a solder portion, or in cases in which burring created on the grinding object needs to be removed.

[0060]

The belt grinding unit 17 has a drive wheel 174 that is driven to rotate by a drive shaft 173 of a spindle 172, a contact wheel 175, and the endless belt type of grinding belt 171 that is entrained between the wheels 174 and 175. Note that it is also possible for there to be additionally provided a tension wheel 176 that imparts tension to the grinding belt 171. Each of these components 172 to 176 is supported on a base component 170.

[0061]

Moreover, as is shown in FIG. 7, the belt grinding unit 17 also has a cover body

177 that covers the grinding belt 171 such that a portion of the grinding belt 171 is exposed. A lower wall portion 177a of the cover body 177 (i.e., a wall surface thereof that faces the substrate W) is formed having a planar shape, and an aperture portion 177H through which the grinding belt 171 is exposed is formed in the lower wall portion 177a. Here, because
5 the lower wall portion 177a of the cover body 177 is formed having a planar shape that faces the substrate W, any grinding liquid such as water that is supplied from the outside flows through a space formed between a lower surface of the lower wall portion 177a and the upper surface of the substrate W, and can be efficiently supplied to the portion being ground.

10 [0062]

In addition, a discharge hole 177c that enables grinding liquid that has penetrated the interior of the cover body 177 to be discharged to the outside is formed in the lower wall portion 177a or in a lower-side portion of a side wall portion 177b that is connected to the lower wall portion 177a of the cover body 177. Note that, in the same way as for the
15 belt grinding unit 17, it is also possible for cover bodies that cover the rough grinding unit 4 and the finishing grinding unit 5 in such a way that a portion of the grindstones 41 and 51 are exposed to be provided.

[0063]

As an alternative to a structure in which the belt grinding unit 17 is used for the
20 rough grinding unit 4 or the finishing grinding unit 5, it is also possible for the substrate grinding module 100B (i.e., the grinding mechanism) to be additionally provided with the belt grinding unit 17 which uses the endless belt type of grinding belt 171 as well as with the rough grinding unit 4 and the finishing grinding unit 5. This belt grinding unit 17 is formed so as to be able to be moved to within the range of movement within which the
25 substrate W can be moved by the table moving unit 3, and, in the same way as the rough

grinding unit 4 and the finishing grinding unit 5, may be movably supported on the connecting beam portion 62.

[0064]

In addition, it is also possible to employ a structure in which the rough grinding unit 4 can be switched between a horizontal axis type of grinding unit having the grindstone 41 for rough grinding and a belt-grinding type of grinding unit that uses the endless belt type of grinding belt 171, and in which the finishing grinding unit 5 can also be switched between a vertical axis type of grinding unit having the grindstone 51 for finishing grinding and a belt-grinding type of grinding unit that uses the endless belt type of grinding belt 171. By making it possible to switch between these different types of grinding units, it becomes possible to select a grinding mode in accordance with the type of substrate W, and to thereby improve the versatility of the substrate grinding module 100B (i.e., the grinding mechanism).

[0065]

In this case, as is shown in FIG. 8, it is possible to employ a structure in which a Z-direction moving portion of the rough grinding unit 4 and the finishing grinding unit 5 is attached using an attachment component 19a or 19b to the Z-direction slider 18. For example, the rough grinding unit 4 may be attached to the Z-direction slider 18 via the attachment component 19a for a rough grinding unit 4. In the same way, the finishing grinding unit 5 may be attached to the Z-direction slider via the attachment component 19b for a finishing grinding unit 5. Note that, in FIG. 8, an example is shown in which the belt grinding unit 17 is attached to the Z-direction slider 18 without using an attachment component, however, it is also possible for the belt grinding unit 17 to be attached to the Z-direction slider 18 using an attachment component for a belt grinding unit. By using the attachment components 19a and 19b that correspond to the respective grinding units 4 and

5 in this way, it is possible to switch between a rough grinding unit 4 (i.e., a horizontal axis type) and a belt grinding unit 17, and to also switch between a finishing grinding unit 5 (i.e., a vertical axis type) and a belt grinding unit 17. In FIG. 8, because both the rough grinding unit 4 and the finishing grinding unit 5 use the same Z-direction slider 18 of the Z-direction moving unit, it is possible to switch between a rough grinding unit 4 (i.e., a horizontal axis type), a finishing grinding unit 5 (i.e., a vertical axis type), and a belt grinding unit 17. In addition to this, it is also possible to employ a structure in which the same spindle is used in common as both the horizontal axis type spindle 42 and the spindle 172 of the belt grinding unit 17, and the grindstone 41 for rough grinding and the grinding belt 171 are mutually interchangeable on this common spindle.

[0066]

Furthermore, in addition to the above-described embodiments, it is also possible to provide a polishing grinding unit that has a finer grained polishing grindstone than the grindstone 51 for finishing grinding of the finishing grinding unit 5. This polishing grinding unit is formed so as to be able to be moved to within the range of movement within which the substrate W can be moved by the table moving unit 3 and, in the same way as the rough grinding unit 4 and the finishing grinding unit 5, may be movably supported on the connecting beam portion 62.

[0067]

Furthermore, in addition to the above-described embodiment, it is also possible to provide a polishing unit that has a finer grained polishing grindstone than the grindstone 51 for finishing grinding of the finishing grinding unit 5. In the same way as the rough grinding unit 4 and the finishing grinding unit 5, this polishing unit may be movably supported on the connecting beam portion 62.

[0068]

Moreover, the rough grinding unit 4 of the above-described embodiments is a horizontal axis type of grinding unit, however, it may instead be a vertical axis type of grinding unit. In the same way, the finishing grinding unit 5 of the above-described embodiment is a vertical axis type of grinding unit, however, it may instead be a horizontal axis type of grinding unit.

[0069]

Moreover, it is also possible for a rotating unit that rotates the grinding units to be provided between each grinding unit and grinding unit moving unit. This rotating unit rotates the axis of rotation of the grinding unit 90 degrees so as to switch the grinding unit between being a horizontal axis type and a vertical axis type of grinding unit.

[0070]

In addition, the supporting portion 6 of the above-described embodiments is shaped as a flat arch, however, it may instead be formed in a cantilever shape having a single leg portion and a beam portion that extends out from this leg portion.

[0071]

In the above-described embodiment, the substrates W are supplied from the substrate storage module 100A, and after undergoing grinding and cleaning, are once again stored in the substrate storage module 100A. However, it is also possible to provide a module that supplies substrates (i.e., a supply module) and a module that stores substrates after they have been ground and washed (i.e., a storage module) independently of each other, and to dispose the supply module and the storage module, for example, in mutually facing positions.

[0072]

Furthermore, it should be understood that the present invention is not limited to the above-described embodiments, and that various modifications and the like may be

made thereto insofar as they do not depart from the spirit or scope of the present invention.

[Description of the Reference Numerals]

[0073]

- 100 ... Grinding Apparatus
- 5 W ... Planar Grinding object
- 100B .. Substrate Grinding Module (Grinding Mechanism)
- 2 ... Table
- 3 ... Table Moving Unit
- 4 ... Rough Grinding Unit
- 10 41 ... Grindstone for Rough Grinding
- 5 ... Finishing Grinding Unit
- 51 ... Grindstone for Finishing Grinding
- 61 ... Pair of Leg Portions
- 62 ... Connecting Beam Portion
- 15 7 ... Rough Grinding Unit Moving Unit
- 8 ... Finishing Grinding Unit Moving Unit
- 9 ... Control Unit
- 16 ... Deburring Unit
- 17 ... Belt Grinding Unit
- 20 171 ... Grinding Belt

What is claimed is:

1. A grinding mechanism comprising:
 - a table that holds a planar grinding object;
 - 5 a table moving unit that moves the table reciprocatingly in a straight line within a predetermined range in one direction;
 - a rough grinding unit that is moved to within a range of movement within which the grinding object can be moved by the table moving unit, and performs rough grinding on the grinding object; and
 - 10 a finishing grinding unit that is moved to within the range of movement within which the grinding object can be moved by the table moving unit, and performs finishing grinding on the grinding object.
2. The grinding mechanism according to Claim 1, wherein the rough grinding unit and the finishing grinding unit move in a direction that crosses the direction in which the
15 table is moved reciprocatingly by the table moving unit.
3. The grinding mechanism according to Claim 1 or Claim 2, wherein the rough grinding unit is a horizontal axis type of grinding unit having a grindstone for rough grinding, and
 - the finishing grinding unit is a vertical axis type of grinding unit having a
20 grindstone for finishing grinding.
4. The grinding mechanism according to Claim 1 or Claim 2, wherein either the rough grinding unit or the finishing grinding unit is a belt-grinding type of grinding unit that uses an endless belt type of grinding belt.
5. The grinding mechanism according to Claim 1 or Claim 2, wherein the rough
25 grinding unit is configured so as to be able to be switched between a horizontal axis type of

grinding unit having a grindstone for rough grinding, and a belt-grinding type of grinding unit that uses an endless belt type of grinding belt, and

the finishing grinding unit is configured so as to be able to be switched between a vertical axis type of grinding unit having a grindstone for finishing grinding, and a

5 belt-grinding type of grinding unit that uses an endless belt type of grinding belt.

6. The grinding mechanism according to any one of Claim 1 through Claim 5, comprising:

a rough grinding unit moving unit that moves the rough grinding unit;

a finishing grinding unit moving unit that moves the finishing grinding unit; and

10 a control unit that controls the rough grinding unit moving unit and the finishing grinding unit moving unit, wherein,

when either one of the rough grinding unit or the finishing grinding unit is grinding the grinding object, the control unit retracts the other one of the rough grinding unit or the finishing grinding unit to a position outside the range of movement of the grinding object.

15

7. The grinding mechanism according to any one of Claim 1 through Claim 6, further comprising:

a pair of leg portions that are provided on either side of the table moving unit; and

a connecting beam portion that spans a gap between the pair of leg portions,

20 wherein

the rough grinding unit and the finishing grinding unit are movably supported on the connecting beam.

8. The grinding mechanism according to Claim 7, wherein one of the rough grinding unit or the finishing grinding unit is supported on the nearer side of the connecting beam,

25 while the other one of the rough grinding unit or the finishing grinding unit is supported on

the further side of the connecting beam.

9. The grinding mechanism according to any one of Claim 1 through Claim 8,
further comprising a belt-grinding unit that uses an endless belt type of grinding belt and is
separate from the rough grinding unit and the finishing grinding unit, and that is moved to
5 within the range of movement within which the grinding object can be moved by the table
moving unit.

10. The grinding mechanism according to any one of Claim 1 through Claim 9,
further comprising a deburring unit that is moved to within the range of movement within
which the grinding object can be moved by the table moving unit, and performs deburring
10 on a grinding object.

11. A grinding apparatus comprising the grinding mechanism according to any one of
Claim 1 through Claim 10.