

[Document Name] Specification

[Title of the Invention] MACHINING APPARATUS AND METHOD OF
MANUFACTURING MACHINED ARTICLE

[Technical Field]

5 [0001]

The present invention relates to a machining apparatus and a method of
manufacturing a machined article.

[Technical Background]

10 [0002]

Conventionally, a cutting device is used when electronic components such as
encapsulated substrates that have been resin-sealed are cut into individual pieces. A
separating device such as that shown, for example, in Patent Document 1 is widely
known.

15 [0003]

In this separating device, a machined article transporting device moves in a Y-
axial direction so as to transport a package substrate to a holding table. This holding
table is then moved in a machining feed direction (i.e., an X-axial direction) while the
package substrate is cut by a cutting blade so as to be separated into chip scale packages
20 (CSP). When this cutting is being performed, cutting water is supplied from a cutting
water supply nozzle onto the portion that is being cut by the cutting blade. In addition,
in this separating device, in order to reduce the size of the device compared to a structure
that collects a plurality of chip scale packages (CSP) by arranging them in rows on a tray,
there is provided a bulk collection device that drops a plurality of the chip scale packages
25 (CSP) into a chip collection container in order to collect these CSP in bulk.

[Documents of the Prior Art]

[Patent Documents]

[0004]

[Patent Document 1] Patent Publication No. 5947010

5 [0005]

However, in the above-described separating device, not only is the package substrate transported in the Y-axial direction, but in addition the holding table is moved in the machining feed direction (i.e., in the X-axial direction) in order for the package substrate to be cut. Because of this, the device ends up having a sizable footprint.

10 [0006]

Moreover, in order to protect the X-axial direction moving device from cutting water or machining waste generated by the cutting machining, it is necessary that protective components be provided for the X-axial direction moving device. A bellows component that is used to protect the X-axial direction moving device, and a covering component or the like that is used to protect this bellows component are used for these protective components. As a result, the device structure ends up becoming extremely complex.

[Disclosure of the Invention]

[Problems to be Solved by the Invention]

20 [0007]

Therefore, the present invention was conceived in order to solve the above-described drawbacks, and it is a principal object thereof to enable the device structure to be simplified and the footprint thereof to be reduced, while at the same time enabling the collection space required to collect objects being machined that have been cut into individual pieces to be reduced.

[Means for Solving the Problem]

[0008]

Namely, a machining apparatus according to the present invention is characterized in being provided with a machining table that holds an object being machined, a first holding mechanism that holds the object being machined in order for this object being machined to be transported to the machining table, a machining mechanism that cuts the object being machined held on the machining table into individual pieces, a collection box that, when the individual pieces of the object being machined that have been cut by the machining mechanism are dropped into the collection box, collects these individual pieces, a second holding mechanism that holds the individual cut pieces of the object being machined in order for these individual cut pieces of the object being machined to be transported from the machining table to the collection box, a transport moving mechanism that extends in a direction in which the machining table and the collection box are aligned, and has a common transfer shaft that is used to move both the first holding mechanism and the second holding mechanism, and a machining moving mechanism that moves the machining mechanism within a horizontal plane both in a first direction along the transfer shaft and in a second direction that is orthogonal to the first direction.

[Effects of the Invention]

[0009]

According to the present invention that is formed in the manner described above, it is possible to simplify the device structure and reduce the footprint thereof, while at the same time enabling the collection space required to collect objects being machined that have been cut into individual pieces to be reduced.

[Brief Description of the Drawings]

[0010]

[FIG. 1] FIG. 1 is a view schematically showing a structure of a cutting device
5 according to an embodiment of the present invention.

[FIG. 2] FIG. 2 is a perspective view schematically showing a cutting table of
the same embodiment as well as peripheral structure thereof.

[FIG. 3] FIG. 3 is a view (i.e., a plan view) as seen from a Z-direction
schematically showing the cutting table of the same embodiment as well as peripheral
10 structure thereof.

[FIG. 4] FIG. 4 is a view (i.e., a front view) as seen from a Y-direction
schematically showing the cutting table of the same embodiment as well as peripheral
structure thereof.

[FIG. 5] FIG. 5 is a view (i.e., a front view) as seen from the Y-direction
15 schematically showing a structure of a first holding mechanism and a transport moving
mechanism of the same embodiment.

[FIG. 6] FIG. 6 is a view (i.e., a side view) as seen from an X-direction
schematically showing the structure of the first holding mechanism and the transport
moving mechanism of the same embodiment.

20 [FIG. 7] FIG. 7 is a view (i.e., a front view) as seen from the Y-direction
schematically showing a structure of a second holding mechanism and the transport
moving mechanism of the same embodiment.

[FIG. 8] FIG. 8 is a cross-sectional view schematically showing a structure of a
rack and pinion mechanism of the same embodiment.

25 [FIG. 9] FIG. 9 is a view (i.e., a plan view) as seen from the Z-direction

schematically showing structure peripheral to a drying table and collection box of the same embodiment.

[FIG. 10] FIG. 10 is a view (i.e., a front view) as seen from the Y-direction schematically showing the structure peripheral to the drying table and collection box of the same embodiment.

[FIG. 11] FIG. 11 is a schematic view showing an operation of the cutting device of the same embodiment.

10 [Best Embodiments for Implementing the Invention]

[0011]

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

15 [0012]

As is described above, the machining apparatus of the present invention is characterized in being provided with a machining table that holds an object being machined, a first holding mechanism that holds the object being machined in order for this object being machined to be transported to the machining table, a machining mechanism that cuts the object being machined held on the machining table into individual pieces, a collection box that, when the individual pieces of the object being machined that have been cut by the machining mechanism are dropped into the collection box, collects these individual pieces, a second holding mechanism that holds the individual cut pieces of the object being machined in order for these individual cut pieces of the object being machined to be transported from the machining table to the collection

box, a transport moving mechanism that extends in a direction in which the machining table and the collection box are aligned with each other, and has a common transfer shaft that is used to move both the first holding mechanism and the second holding mechanism, and a machining moving mechanism that moves the machining mechanism within a horizontal plane both in a first direction along the transfer shaft and in a second direction that is orthogonal to the first direction.

[0013]

If this machining apparatus is employed, then a structure is created in which both the first holding mechanism and the second holding mechanism are moved by a common transfer shaft that extends in the direction in which the machining table and the collection box are aligned with each other, and the machining mechanism is moved by the machining moving mechanism within a horizontal plane in both a first direction along the transfer shaft and in a second direction that is orthogonal to the first direction. As a result, the object being machined can be cut into individual pieces without the machining table being moved in the first direction or the second direction. Because of this, the machining table does not need to be moved by a ball screw mechanism or the like so that the necessity of providing a bellows component in order to protect this ball screw mechanism or the like, and a cover component in order to protect this bellows component can be eliminated. As a result, the device structure of the machining apparatus can be simplified.

Moreover, because a structure in which the machining table does not move in the first direction or the second direction within a horizontal plane is employed, it is possible to reduce the space for movement required by the machining table as well as any unneeded space peripheral thereto so that the footprint of the machining apparatus can be reduced.

Furthermore, because the second holding mechanism that is holding the individually cut pieces of the object being machined is transported to the collection box, and the individually cut pieces of the object being machined are then dropped from the second holding mechanism and collected in the collection box, compared to a

5 conventional structure in which they are collected on a tray, it is possible to reduce the space needed for this collecting. Consequently, the footprint of the machining apparatus can be reduced because of this as well.

[0014]

As a specific aspect of the placement of the transfer shaft and the machining
10 moving mechanism, it is desirable that the transfer shaft be positioned above the machining moving mechanism in such a way as to extend across the machining moving mechanism.

By providing this type of structure it becomes possible to cause the first holding mechanism that moves along the transfer shaft to move above the machining moving
15 mechanism, so that the first holding mechanism can be prevented from physically interfering with the machining moving mechanism. Moreover, the second holding mechanism that moves along the transfer shaft can also be moved above the machining moving mechanism, so that the second holding mechanism can be prevented from physically interfering with the machining moving mechanism.

20 [0015]

As a specific aspect of the placement of the second holding mechanism, it is desirable that the second holding mechanism hold the individual cut pieces of the object being machined by means of suction.

[0016]

25 In order to ensure that the individual cut pieces of the object being machined

reliably fall from the second holding mechanism into the collection box, it is desirable that there be further provided a scraping component that scrapes the individual cut pieces of the object being machined from the second holding mechanism.

[0017]

5 In order to ensure that, using the motion of the second holding mechanism that is provided by the transport moving mechanism, the individual cut pieces of the object being machined are reliably scraped from the second holding mechanism and collected in the collection box, it is desirable that the scraping component be fixed to the collection box, and that the individual cut pieces of the object being machined be scraped off from
10 the second holding mechanism as a result of the transport moving mechanism causing the second holding mechanism to move relatively to the scraping component.

[0018]

 In order to dry the individual cut pieces of the object being machined, it is desirable that the machining apparatus of the present invention be further provided with a
15 drying table that is used to dry the individual cut pieces of the object being machined.

 In this structure, the transport moving mechanism moves the second holding mechanism from the machining table to the drying table, and from the drying table to the collection table.

[0019]

20 As a specific aspect for drying the individual cut pieces of the object being machined, it is desirable that the machining apparatus of the present invention be further provided with a drying mechanism that blows jets of air from above the drying table so as to dry the individual cut pieces of the object being machined, and a drying moving mechanism that moves the drying mechanism along the drying table.

25 [0020]

As a specific aspect of the drying mechanism, it is desirable that the drying mechanism blow jets of air in the direction of movement of the drying moving mechanism.

[0021]

5 As a specific aspect of a moving mechanism that moves the machining mechanism in at least an X-direction, which is a first direction, and a Y-direction, which is a second direction, it is desirable that the machining moving mechanism be provided with an X-direction movement portion that moves the machining mechanism rectilinearly in the X-direction, and a Y-direction movement portion that moves the machining
10 mechanism rectilinearly in the Y-direction, and that the X-direction movement portion be provided with a pair of X-direction guide rails that are disposed so as to extend in the X-direction on either side of the machining table, and a supporting body that moves along the pair of X-direction guide rails and supports the machining mechanism via the Y-direction movement portion.

15 By providing this type of structure, because a pair of X-direction guide rails that extend in the X-direction are provided on either side of the machining table, it is possible to increase the pitch between the pair of X-direction guide rails. As a result, it is possible to reduce the effects on the machining caused by any Z-direction positional errors between the X-direction guide rails. In other words, it is possible to reduce any
20 error in the orthogonality between a rotating tool (for example, a blade) and the machining table, so that the machining accuracy can be improved. In addition, lower specification X-direction guide rails than those currently required can be used.

[0022]

 Moreover, a method of manufacturing a machined article in which a machined
25 article is manufactured using the above-described machining apparatus is also an aspect

of the present invention.

[0023] [Embodiment of the Present Invention]

Hereinafter, an embodiment of the machining apparatus according to the present invention will be described with reference to the drawings. It should be noted that,

5 where appropriate, portions of the structure may be omitted from, or schematically enhanced in, the drawings described below in order to simplify understanding thereof.

Moreover, component elements that are the same in relevant drawings are given the same descriptive symbols and any duplicated description thereof is omitted.

[0024] [Machining apparatus Overall Structure]

10 A machining apparatus 100 of the present embodiment is a cutting device that cuts objects being machined in the form of sealed substrates W into a plurality of individual machined articles in the form of products P.

[0025]

Here, the sealed substrates W are resin molded products that are formed by
15 resin-sealing at least an electronic component such as a semiconductor chip, a resistive element, or a capacitor element or the like on a substrate to which that electronic component is connected. A lead frame or a printed board can be used as the substrate forming the sealed substrates W. In addition to these, a semiconductor substrate (including semiconductor wafers such as silicon wafers and the like), a metallic substrate,
20 a ceramic substrate, a glass substrate, or a resin substrate or the like may also be used. Wiring may either be provided or not provided on the substrate used to form the sealed substrates W.

[0026]

Moreover, the sealed substrates W and products P of the present embodiment
25 have a structure in which one surface of the substrate is resin-molded. In this type of

structure, the resin-molded surface is the surface on which the electronic elements that are connected to the substrate have been resin-sealed, and is referred to either as the 'sealed surface' or the 'package surface'. In contrast, the surface that is on the opposite side from the resin-molded surface and that is not resin-molded has exposed leads that function as external connection electrodes of a normal product, and is referred to as the 'lead surface'. In a case in which these leads are projecting electrodes that are used in electronic components such as BGA (Ball Grid Arrays), then they are referred to as a 'ball surface'. Furthermore, there are also cases in which no leads are formed on the surface that is on the opposite side from the resin-molded surface and that is not resin-molded and these may be referred to as the 'substrate surface'. In the description of the present embodiment, the resin-molded surface is described as the 'sealed surface' or the 'package surface', and the surface that is on the opposite side from the resin-molded surface and that is not resin-molded is described as the 'lead surface'.

[0027]

More specifically, as is shown in FIG. 1, the cutting device 100 is provided with two cutting tables (i.e., machining tables) 2A and 2B that hold the sealed substrates W, a first holding mechanism 3 that holds the sealed substrates W in order to transport the sealed substrates W to the cutting tables 2A and 2B, a cutting mechanism (i.e., a machining mechanism) 4 that cuts the sealed substrates W that are held on the cutting tables 2A and 2B, a second holding mechanism 6 that holds a plurality of the products P in order to transport the plurality of products P from the cutting tables 2A and 2B to a collection box 5, a transport moving mechanism 7 having a common transfer shaft 71 that is used to move both the first holding mechanism 3 and the second holding mechanism 6, and a cutting moving mechanism (i.e., a machining moving mechanism) 8 that moves the cutting mechanism 4 relatively to the sealed substrates W being held on

the cutting tables 2A and 2B. Note that a transporting mechanism (i.e., a loader) that transports the sealed substrates W is formed by the first holding mechanism 3 and the transport moving mechanism 7, and a transporting mechanism (i.e., an unloader) that transports the plurality of products P is formed by the second holding mechanism 6 and
5 the transport moving mechanism 7.

[0028]

In the following description, two directions that are mutually orthogonal to each other within a plane (i.e., a horizontal plane) extending across an upper surface of the cutting tables 2A and 2B are taken as the X-direction, which is the first direction, and the
10 Y-direction, which is the second direction. A vertical direction that is orthogonal to both the X-direction and the Y-direction is taken as the Z-direction. More specifically, when looking at FIG. 1, a left-right direction is the X-direction while a top-bottom direction is the Y-direction. As is described below, the X-direction is the direction of movement of a supporting body 812, and extends orthogonally relative to a longitudinal
15 direction of a beam portion (i.e., to the direction in which the beam portion extends) that spans a gap between a pair of leg portions of the gantry-shaped supporting body 812 (see FIG. 2 and FIG. 3).

[0029] [Cutting Tables 2A and 2B]

The two cutting tables 2A and 2B are provided so as to be fixed in the X-
20 direction, the Y-direction, and the Z-direction. Note that the cutting table 2A is able to be rotated in a θ -direction by a rotation mechanism 9A that is provided underneath the cutting table 2A, while the cutting table 2B is able to be rotated in the θ -direction by a rotation mechanism 9B that is provided underneath the cutting table 2B.

[0030]

These two cutting tables 2A and 2B are provided so as to be mutually aligned in a row extending in the X-direction within a horizontal plane. More specifically, the two cutting tables 2A and 2B are disposed in such a way that upper surfaces thereof are positioned on the same horizontal plane (i.e., are positioned at the same height in the Z-direction) (see FIG. 4), and are also disposed in such a way that centers of the upper surfaces thereof (more specifically, centers of rotation of the rotation mechanisms 9A and 9B) are positioned on the same straight line extending in the X-direction (see FIG. 2 and FIG. 3).

[0031]

Moreover, the two cutting tables 2A and 2B employ suction in order to hold the sealed substrates W and, as is shown in FIG. 1, two vacuum pumps 10A and 10B that are used to supply the suction force are provided so as to correspond to the two cutting tables 2A and 2B. The respective vacuum pumps 10A and 10B may each be formed, for example, by a liquid ring vacuum pump.

[0032]

Here, because the cutting tables 2A and 2B are fixed in the X, Y, and Z directions, the pipes (not shown in the drawings) that are connected from the vacuum pumps 10A and 10B to the cutting tables 2A and 2B can be shortened, so that pressure loss inside the pipes can be reduced and any reduction in the suction force can be prevented. As a result, it is possible to reliably supply suction to the cutting tables 2A and 2B even, for example, when the object being machined is an extremely small package of 1 mm square or less. Moreover, because any reduction in the suction force due to a loss of pressure in the pipes can be prevented, the volume of the vacuum pumps 10A and 10B can be reduced so that reductions in both the size and cost of the device can be achieved.

[0033] [First Holding Mechanism 3]

As is shown in FIG. 1, the first holding mechanism 3 is a device that holds the sealed substrates W in order to transport the sealed substrates W from a substrate supply mechanism 11 to the cutting tables 2A and 2B. As is shown in FIG. 5 and FIG. 6, the first holding mechanism 3 includes a suction head 31 in which are provided a plurality of suctioning portions 311 that are used to hold the sealed substrates W by means of suction, and a vacuum pump (not shown in the drawings) that is connected to the suctioning portions 311 of the suction head 31. The sealed substrates W are transported from the substrate supply mechanism 11 to the cutting tables 2A and 2B as a result of the suction head 31 being moved to a desired position by the transport moving mechanism 7 (described below) or the like.

[0034]

As is shown in FIG. 1, the substrate supply mechanism 11 includes a substrate storage portion 111 in which a plurality of sealed substrates W are stored from the outside, and a substrate supply portion 112 that causes the sealed substrates W stored in the substrate storage portion 111 to be moved to a holding position RP where they are held by means of suction by the first holding mechanism 3. The holding position RP is set on the same line in the X-direction as the two cutting tables 2A and 2B. Note that it is also possible for the substrate supply mechanism 11 to be provided with a heating portion 113 that is used to heat the sealed substrates W being suctioned by the first holding mechanism 3 in order to make them more pliable so as to enable the suctioning to be performed more easily.

[0035] [Cutting Mechanism 4]

As is shown in FIG. 1, FIG. 2, and FIG. 3, the cutting mechanism 4 that is serving as a machining mechanism includes two rotation tools 40 that are formed by

blades 41A and 41B and by two spindle portions 42A and 42B. The two spindle portions 42A and 42B are disposed in such a way that the axes of rotation thereof extend in the Y-direction, and the blades 41A and 41B that are attached thereto are disposed so as to be mutually facing each other (see FIG. 3). The blade 41A of the spindle portion 42A and the blade 41B of the spindle portion 42B cut the sealed substrates W that are being held on the respective cutting tables 2A and 2B as a result of being rotated within a plane that includes both the X-direction and the Z-direction. Note that, as is shown in FIG. 4, a liquid supply mechanism 12 having spray nozzles 121 that spray jets of cutting water (i.e., machining liquid) in order to suppress any friction heat generated by the blades 41A and 41B is provided in the cutting device 100 of the present embodiment. The spray nozzles 121 may be supported, for example, on a Z-direction movement portion 83 (described below).

[0036] [Second Holding Mechanism 6]

As is shown in FIG. 1, the second holding mechanism 6 is a device that holds a plurality of the products P in order to transport the plurality of products P from the cutting tables 2A and 2B to a drying table 13 or to the collection box 5. As is shown in FIG. 8, the second holding mechanism 6 includes a suction head 61 in which are provided a plurality of suctioning portions 611 that are used to hold the plurality of products P by means of suction, and a vacuum pump (not shown in the drawings) that is connected to the suctioning portions 611 of the suction head 61. The plurality of products P are transported from the cutting tables 2A and 2B to the drying table 13, and then from the drying table 13 to the collection box 5 as a result of the suction head 61 being moved to a desired position by the transport moving mechanism 7 (described below) or the like.

[0037] [Transport Moving Mechanism 7]

As is shown in FIG. 1, the transport moving mechanism 7 moves the first holding mechanism 3 between at least the substrate supply mechanism 11 and the cutting tables 2A and 2B, and also moves the second holding mechanism 6 between at least the cutting tables 2A and 2B and the collection box 5.

5 [0038]

In addition, as is shown in FIG. 1, the transport moving mechanism 7 extends rectilinearly in the direction in which the two cutting tables 2A and 2B and the collection box 5 are aligned (i.e., in the X-direction), and has a common transfer shaft 71 that is used in common to move both the first holding mechanism 3 and the second holding
10 mechanism 6.

[0039]

The transfer shaft 71 is disposed within a range that allows the first holding mechanism 3 to move above the substrate supply portion 112 of the substrate supply mechanism 11, and allows the second holding mechanism 6 to move above the collection
15 box 5 (see FIG. 1). Furthermore, the first holding mechanism 3, the second holding mechanism 6, the cutting tables 2A and 2B, and the collection box 5 are each provided on the same side (i.e., on the near side) when looked at in plan view of the transfer shaft 71. In addition to these, a first cleaning mechanism 18, a second cleaning mechanism 19, and a drying table 13 (each of which is described below) are also provided on the same side
20 (i.e., on the near side) of the transfer shaft 71.

[0040]

Furthermore, as is shown in FIG. 5, FIG. 6, and FIG. 8, the transport moving mechanism 7 includes a main moving mechanism 72 that moves the first holding mechanism 3 and the second holding mechanism 6 in the X-direction along the transfer
25 shaft 71, a vertical movement mechanism 73 that raises or lowers the first holding

mechanism 3 and the second holding mechanism 6 in the Z-direction relative to the transfer shaft 71, and a horizontal movement mechanism 74 that moves the first holding mechanism 3 and the second holding mechanism 6 horizontally in the Y-direction relative to the transfer shaft 71.

5 [0041]

As is shown in FIG. 5 through FIG. 8, the main moving mechanism 72 includes common guide rails 721 that are provided on the transfer shaft 71 and guide the first holding mechanism 3 and the second holding mechanism 6, and a rack and pinion mechanism 722 that moves the first holding mechanism 3 and the second holding
10 mechanism 6 along the guide rails 721.

[0042]

The guide rails 721 extend rectilinearly in the X-direction along the transfer shaft 71 and, in the same way as the transfer shaft 71, are disposed within a range that allows the first holding mechanism 3 to move above the substrate supply portion 112 of
15 the substrate supply mechanism 11, and allows the second holding mechanism 6 to move above the collection box 5. A sliding component 723 on which the first holding mechanism 3 and the second holding mechanism 6 are provided via the vertical movement mechanism 73 and the horizontal movement mechanism 74 is provided so as to be able to slide along the guide rails 721. Here, the guide rails 721 are used in
20 common by both the first holding mechanism 3 and the second holding mechanism 6, however, a vertical movement mechanism 73, a horizontal movement mechanism 74, and a slide component 723 are provided individually for each of the first holding mechanism 3 and the second holding mechanism 6.

[0043]

25 The rack and pinion mechanism 722 includes a cam rack 722a that is used in

common by both the first holding mechanism 3 and the second holding mechanism 6, and pinion gears 722b that are provided individually for each of the first holding mechanism 3 and the second holding mechanism 6 and are rotated by an actuator (not shown in the drawings). The cam rack 722a is provided on the common transfer shaft

5 71 and the length of the cam rack 722 can be changed to various lengths by linking together a plurality of cam rack elements. The pinion gears 722b are provided on the sliding component 723 so as to form what is known as a roller pinion. As is shown in FIG. 7, each pinion gear 722b is provided with a pair of roller main bodies 722b1 that rotate in conjunction with a rotation shaft of a motor, and with a plurality of roller pins 10 722b2 that are provided equidistantly from each other in a circumferential direction between the pair of roller main bodies 722b1 and that are able to roll relative to the roller main bodies 722b1. Because the rack and pinion mechanism 722 of the present embodiment utilizes the above-described roller pinions, two or more roller pins 722b2 are in contact with the cam rack 722a. As a result, there is no backlash in the forward or 15 reverse directions, and the positioning accuracy is improved when the first holding mechanism 3 and the second holding mechanism 6 are moved in the X-direction.

[0044]

As is shown in FIG. 5 and FIG. 8, a vertical movement mechanism 73 is provided individually for each of the first holding mechanism 3 and the second holding 20 mechanism 6. As is shown in FIG. 5 and FIG. 6, the vertical movement mechanism 73 of the first holding mechanism 3 is interposed between the transfer shaft 71 (more specifically, the main moving mechanism 72) and the first holding mechanism 3, and includes Z-direction guide rails 73a that are disposed so as to extend in the Z-direction, and an actuator portion 73b that moves the first holding mechanism 3 along the Z- 25 direction guide rails 73a. Note that any of, for example, a ball screw mechanism, an air

cylinder, or a linear motor may be used to form the actuator portion 73b. Note also that, as is shown in FIG. 8, the structure of the vertical movement mechanism 73 of the second holding mechanism 6 is similar to that of the vertical movement mechanism 73 of the first holding mechanism 3.

5 [0045]

As is shown in FIG. 5, FIG. 6, and FIG. 8, a horizontal movement mechanism 74 is provided individually for each of the first holding mechanism 3 and the second holding mechanism 6. As is shown in FIG. 5 and FIG. 6, the horizontal movement mechanism 74 of the first holding mechanism 3 is interposed between the transfer shaft
10 71 (more specifically, the vertical movement mechanism 73) and the first holding mechanism 3, and includes Y-direction guide rails 74a that are disposed so as to extend in the Y-direction, elastic bodies 74b that impart force to the first holding mechanism 3 on one side of the Y-direction guide rails 74a, and a cam mechanism 74c that moves the first holding mechanism 3 to the other side of the Y-direction guide rails 74a. Here, an
15 eccentric cam is used for the cam mechanism 74c, and the amount of movement in the Y-direction of the first holding mechanism 3 can be adjusted by rotating this eccentric cam using an actuator such as a motor or the like.

[0046]

Note that, as is shown in FIG. 8, the structure of the horizontal movement
20 mechanism 74 of the second holding mechanism 6 is similar to that of the vertical movement mechanism 73 of the first holding mechanism 3. Moreover, it is also possible to employ a structure in which the horizontal movement mechanism 74 is not provided in the second holding mechanism 6, or a structure in which the horizontal movement mechanism 74 is not provided in either the first holding mechanism 3 or the
25 second holding mechanism 6. Furthermore, in the same way as the vertical movement

mechanism 73, instead of using the cam mechanism 74c, it is also possible for the horizontal movement mechanism 74 to employ any of, for example, a ball screw mechanism, an air cylinder, or a linear motor.

[0047] [Cutting Moving Mechanism 8 (Machining Moving Mechanism)]

5 The cutting moving mechanism 8 independently moves each of the two spindle portions 42A and 42B rectilinearly in each of the X-direction, the Y-direction, and the Z-direction.

[0048]

 More specifically, as is shown in FIG. 2, FIG. 3, and FIG. 9, the cutting moving
10 mechanism 8 is provided with an X-direction movement portion 81 that moves the spindle portions 42A and 42B rectilinearly in the X-direction, a Y-direction movement portion 82 that moves the spindle portions 42A and 42B rectilinearly in the Y-direction, and Z-direction movement portions 83 that move the spindle portions 42A and 42B rectilinearly in the Z-direction.

15 [0049]

 The X-direction movement portion 81 is used in common by the two cutting tables 2A and 2B. As is shown, in particular, in FIG. 2 and FIG. 3, the X-direction movement portion 81 is provided with a pair of X-direction guide rails 811 that are disposed so as to extend in the X-direction on either side of the two cutting tables 2A and
20 2B, and a supporting body 812 that moves along this pair of X-direction guide rails 811 and supports the spindle portions 42A and 42B via the Y-direction movement portion 82 and the Z-direction movement portions 83. The pair of X-direction guide rails 811 are disposed on the sides of the two cutting tables 2A and 2B which are disposed so as to extend in the X-direction. The supporting body 812 may be formed, for example, in a
25 gantry shape and is configured so as to extend in the Y-direction. More specifically, the

supporting body 812 includes a pair of leg portions that extend upwards from the pair of X-direction guide rails 811, and a beam portion that extends in the Y-direction so as to span the gap between this pair of leg portions.

[0050]

5 The supporting body 812 is moved reciprocatingly in a straight line in the X-direction above the pair of X-direction guide rails 811 by, for example, ball screw mechanisms 813 that extend in the X-direction. The ball screw mechanisms 813 are driven by a drive source such as a servomotor or the like (not shown in the drawings). It is also possible to employ a structure in which the supporting body 812 is moved
10 reciprocatingly by another type of linear motion mechanism such as a linear motor or the like.

[0051]

As is shown in FIG. 3, in particular, the Y-direction movement portion 82 includes Y-direction guide rails 821 that are disposed in the supporting body 812 so as to
15 extend in the Y-direction, and Y-direction sliders 822 that move along these Y-direction guide rails 821. The Y-direction sliders 822 may be driven, for example, by a linear motor 823 so as to move reciprocatingly in a straight line on top of the Y-direction guide rails 821. In the present embodiment, two Y-direction sliders 822 are provided so as to correspond to the two spindle portions 42A and 42B. As a result, the two spindle
20 portions 42A and 42B are able to move in the Y direction independently of each other. It is also possible to employ a structure in which the Y-direction sliders 822 are moved reciprocatingly by another type of linear motion mechanism that uses a ball screw mechanism.

[0052]

25 As is shown in FIG. 2 through FIG. 4, the Z-direction movement portion 83

includes Z-direction guide rails 831 that are disposed in the respective Y-direction sliders 822 so as to extend in the Z-direction, and Z-direction sliders 832 that move along these Z-direction guide rails 831 and support the spindle portions 42A and 42B. In other words, a Z-direction movement portion 83 is provided respectively for each one of the spindle portions 42A and 42B. The Z-direction sliders 832 may be driven, for example, by an eccentric cam mechanism (not shown in the drawings) so as to move reciprocatingly in a straight line along the Z-direction guide rails 831. It is also possible to employ a structure in which the Z-direction sliders 832 are moved reciprocatingly by another type of linear motion mechanism such as a ball screw mechanism or the like.

10 [0053]

As is shown in FIG. 1 and FIG. 4, the positional relationship between the cutting moving mechanism 8 and the transfer shaft 71 is such that the transfer shaft 71 is disposed above the cutting moving mechanism 8 so as to extend across the cutting moving mechanism 8. More specifically, the transfer shaft 71 is disposed above the supporting body 812 so as to extend across the supporting body 812, and the transfer shaft 71 and the supporting body 812 are in a mutually intersecting positional relationship with each other.

[0054] [Machining Waste Collection Portion 17]

As is shown in FIG. 1, the cutting device 100 of the present embodiment is also provided with a machining waste collection portion 17 that collects machining waste S such as end material generated by the cutting of the sealed substrates W.

[0055]

As is shown in FIG. 2 through FIG. 4, the machining waste collecting portion 17 is disposed below the cutting tables 2A and 2B, and includes a guide chute 171 that has an upper portion aperture 171X that surrounds the cutting tables 2A and 2B when looked

at in plan view, and collecting vessels 172 that collect the machining waste S guided thereto by the guide chute 171. By locating the machining waste collecting portion 17 underneath the cutting tables 2A and 2B, the machining waste S collection efficiency is improved.

5 [0056]

The guide chute 171 guides the machining waste S that has been scattered or dropped from the cutting tables 2A and 2B to the collecting vessels 172. In the present embodiment, because the upper portion aperture 171X of the guide chute 171 is formed so as to surround the cutting tables 2A and 2B (see FIG. 3), it is difficult for any

10 machining waste S to escape being collected so that the machining waste S collection efficiency is improved even further. Moreover, the guide chute 171 is provided in such a way as to also surround the rotation mechanisms 9A and 9B that are disposed underneath the cutting tables 2A and 2B (see FIG. 4), so that a structure is created in which the rotation mechanisms 9A and 9B are protected from machining waste S and
15 cutting water.

[0057]

In the present embodiment, the machining waste collecting portion 17 is used in common by the two cutting tables 2A and 2B, however, it is also possible to provide a machining waste collecting portion independently for each of the cutting tables 2A and
20 2B.

[0058]

The collecting vessels 172 collect machining waste S that has fallen through the guide chute 171 due to its own weight and, in the present embodiment, as is shown in FIG. 4 and the like, a collecting vessel 172 is provided respectively for each of the two
25 cutting tables 2A and 2B. The two collecting vessels 172 are disposed on the near side

of the transfer shaft and are formed in such a way that they are each able to be removed independently from the near side of the cutting device 100. By employing this type of structure, it is possible to improve the ease of performing maintenance such as disposing of the machining waste S or the like. Note that depending on the size of the sealed
5 substrates W, the size and quantity of the machining waste S, and the ease of workability and the like, it is also possible for a single collecting vessel 172 that covers the entire underside of all of the cutting tables to be provided, or for the collecting vessels 172 to be separated into three or more collecting vessels.

[0059]

10 Moreover, as is shown in FIG. 4 and the like, the machining waste collecting portion 17 additionally has separating portions 173 that separate cutting water from the machining waste. These separating portions 173 may have a structure in which, for example, filters such as porous plates or the like that allow cutting water to pass through are provided in a bottom surface of the collecting vessels 172. By employing these
15 separating portions 173, the machining waste S can be recovered without cutting water being accumulated in the collecting vessels 172.

[0060] [First Cleaning Mechanism 18]

Moreover, as is shown in FIG. 1 and FIG. 5, the cutting device 100 of the present invention is additionally provided with a first cleaning mechanism 18 that cleans
20 an upper surface side (i.e., the lead surface) of the plurality of products P that are being held on the cutting tables 2A and 2B. This first cleaning mechanism 18 cleans the upper surface side of the products P using spray nozzles 18a (see FIG. 5) that spray jets of washing solution and/or compressed air onto the upper surfaces of the plurality of products P that are being held on the cutting tables 2A and 2B.

25 [0061]

As is shown in FIG. 5, the first cleaning mechanism 18 is formed so as to be able to move along the transfer shaft 71 together with the first holding mechanism 3.

Here, the first cleaning mechanism 18 is provided on the sliding component 723 that slides along the guide rails 721 provided on the transfer shaft 71. Here, a vertical

5 movement mechanism 181 that is used to raise or lower the first cleaning mechanism 18 in the Z-direction is provided between the first cleaning mechanism 18 and the sliding component 723. Note that any of, for example, a rack and pinion mechanism, a ball screw mechanism, or an air cylinder or the like may be used to form the vertical movement mechanism 181.

10 [0062] [Second Cleaning Mechanism 19]

Furthermore, as is shown in FIG. 1, the cutting device 100 of the present invention is additionally provided with a second cleaning mechanism 19 that cleans a lower surface side (i.e., the package surface) of the plurality of products P that are being held on the second holding mechanism 6. This second cleaning mechanism 19 is

15 disposed between the cutting table 2B and the collection box 5 (more specifically, the drying table 13 (described below)), and cleans the lower surface side of the products P by spraying jets of washing solution and/or compressed air onto the lower surfaces of the plurality of products P that are being held on the second holding mechanism 6. In other words, the second cleaning mechanism 19 cleans the lower surface side of the products P as the second holding mechanism 6 is being moved along the transfer shaft 71.

[0063] [Drying Function of the Cutting Device 100]

The cutting device 100 of the present embodiment has a function of additionally drying the plurality of products P that have been cleaned by the second cleaning mechanism 19. More specifically, as is shown in FIG. 1, FIG. 9, and FIG. 10, the

25 cleaning device 100 is provided with the drying table 13 that is used to dry the plurality

of products P, a drying mechanism 14 that dries the plurality of products P that have been placed on the drying table 13, and a drying moving mechanism 15 that moves the drying mechanism 14 across the drying table 13.

[0064]

5 The drying table 13 is a table on which are placed the plurality of products P that have been transported by the second holding mechanism 6 and the transport moving mechanism 7. This drying table 13 holds the plurality of products P by means of suction. Moreover, the drying table 13 is arranged on the same line in the X-direction on a horizontal plane as the two cutting tables 2A and 2B. When looked at in plan view,
10 the drying table 13 of the present embodiment may be formed having a rectangular shape, or having another shape.

[0065]

 The drying mechanism 14 dries the plurality of products P that are being held by suction on the drying table 13 by blowing a gas in the form of compressed air onto the
15 drying table 13 from above. The drying mechanism 14 has a blow nozzle 14a that blows jets of compressed air onto the plurality of products P that are being held on the drying table 13. The blow nozzle 14a of the present embodiment is disposed so as to face towards the drying table 13 and has an aperture that is formed in a rectilinear slit shape (see FIG. 9), however, it may instead have a plurality of apertures that are provided
20 intermittently in the X-direction.

[0066]

 The drying mechanism 14 of the present embodiment is formed in such a way as to blow compressed air towards the direction of movement of the drying moving mechanism 15 (see FIG. 9). In other words, a structure is employed in which the
25 direction in which the compressed air is blown by the blow nozzle 14a faces towards the

direction of movement of the drying moving mechanism 15 (here, this direction is from the near side towards the far side in the Y-direction).

[0067]

Moreover, as is shown in FIG. 9, the blow nozzle 14a of the drying mechanism 14 is placed on an inclination of, for example, 30 degrees or less relative to the direction in which the plurality of products P that are being held on the drying table 13 are aligned in the X-direction. Here, the plurality of products P are arranged in a matrix formation in the X-direction and the Y-direction on the drying table 13, and the blowing nozzle 14a of the drying mechanism 14 blows jets of compressed air diagonally towards one side in the X-direction of each product P. As a result, any moisture remaining between mutually adjacent products P can be blown away from the products P. This enables the drying of the plurality of products P to be accelerated. In addition, it is also possible for the slit-shaped aperture of the nozzle 14a of the drying mechanism 14 to be provided at a slight inclination relative to the drying table 13 so that compressed air is blown towards the direction of movement of the drying mechanism 14.

[0068]

The drying moving mechanism 15 moves the drying mechanism 14 in the Y-direction above the drying table 13. The drying moving mechanism 15 of the present embodiment moves the drying mechanism 14 reciprocatingly in the Y-direction relative to the drying table 13. More specifically, as is shown in FIG. 9 and FIG. 10, the drying moving mechanism 15 is provided with a Y-direction guide rail 151 that extends in the Y-direction, a sliding component 152 that holds the drying mechanism 14 and moves along the Y-direction guide rail 151, and a drive portion (not shown in the drawings) that moves the sliding component 152 along the Y-direction guide rails 151. Note that any of, for example, a ball screw mechanism, an air cylinder, or a linear motor may be used to form

the drive portion.

[0069] [Example of a Drying Operation]

Next, a drying operation performed by the drying mechanism 14 and the drying moving mechanism 15 will be described.

5 [0070]

Prior to a plurality of the products P being placed on the drying table 13, the drying moving mechanism 15 retracts the drying mechanism 14 towards one side (for example towards the near side) in the Y-direction of the drying table 13 so that there is no interference with the placement of the plurality of products P. Once the plurality of products P have been placed on the drying table 13 and are being held thereon, the drying mechanism 14 starts blowing the jets of compressed air and the drying moving mechanism 15 moves the drying mechanism 14 towards the other side (for example, the far side) in the Y-direction. As a result, drying of the plurality of products P held on the drying table 13 takes place. Note that, when the drying moving mechanism 15 moves the drying mechanism 14 from the other side (i.e., the far side) in the Y-direction towards the one side (i.e., the near side) in the Y-direction, the blowing of gas by the drying mechanism 14 is stopped. Note also that it is also possible to employ a structure in which the drying mechanism 14 blows compressed air not only during a movement towards one side, but during movements to both sides.

20 [0071] [Collection Box 5 and Scraping Component 16]

As is shown in FIG. 1, FIG. 9, and FIG. 10, the collection box 5 collects the plurality of products P in a scattered state (this is referred to as bulk collection of the products P). The collection box 5 is arranged on the same line in the X-direction as the two cutting tables 2A and 2B and on the same horizontal plane as these. The collection box 5 is additionally provided with a scraping component 16 that scrapes the plurality of

products P from the second holding component 6.

[0072]

The collection box 5 has an upper portion aperture 5X that has a rectangular configuration when looked at in plan view (see FIG. 9). The scraping component 16 is
5 fixed to one side of the upper portion aperture 5X of the collection box 5. As a result of the second holding mechanism 6 being moved in the X-direction relative to the scraping component 16, the products P are scraped off so as to fall into the collection box 5.

[0073]

Moreover, the collection box 5 of the present embodiment is disposed in the X-
10 direction between the drying table 13 and a plate housing portion 20 that houses a holding plate (not shown in the drawings), and the scraping component 16 is disposed along the drying table 13 side of the upper portion aperture 5X of the collection box 5. As a result, a structure is created that prevents the second holding mechanism 6 from interfering with the plate housing portion 20 when the products P are being scraped off.

15 [0074]

Note that the holding plate housed in the plate housing portion 20 is used to hold either the sealed substrates W or the products P and may be, for example, a holding plate for the cutting tables 2A and 2B that are used to cut the sealed substrates W, a holding plate for the drying table 13 that is used to dry the products P, or a holding plate for the
20 second holding mechanism 6 that is used to transport the products P.

[0075]

The scraping component 16 is disposed so as to extend upwards from the drying table 13 side of the upper portion aperture 5X of the collection box 5 (see FIG. 9).

Moreover, any component that is able to scrape off products P that remain on the second
25 holding mechanism 6 after the suctioning thereof has been terminated may be used as the

scraping component 16 and, for example, a component that is made of resin such as a PEEK material and has a brush-shaped configuration or a flat plate-shaped configuration may be used.

[0076]

5 In the present embodiment a structure is employed in which the collection box 5 is placed on the near side of the transfer shaft 71, and a handle 51 (see FIG. 9) is provided on an outer surface on the near side of the collection box 5 so that the collection box 5 can be removed from the near side of the cutting device 100. By employing this type of structure, it is possible to improve the ease of performing maintenance such as
10 removing and collecting the products P. Note that the direction in which the collection box 5 is extracted is not limited to the near side and it is also possible to employ a structure in which, for example, the collection box 5 is extracted from a left or right side of the cutting device 100, or from the far side of the cutting device 100.

[0077] [Example of an Operation of the Cutting Device 100]

15 Next, an example of an operation of the cutting device 100 will be described. FIG. 11 shows a path of movement of the first holding mechanism 3 and also a path of movement of the second holding mechanism 6 during an operation of the cutting device 100. Note that, in the present embodiment, all of the operations and control of the cutting device 100, for example, the transporting of the sealed substrates W, the cutting of
20 the sealed substrates W, the drying of the products P, and the scraping off of the products P and the like are conducted by a control unit CTL (see FIG. 1).

[0078]

 The substrate supply portion 112 of the substrate supply mechanism 11 causes sealed substrates W that are being stored in the substrate storage portion 111 to be moved
25 to a holding position RP where they are held by the first holding mechanism 3.

[0079]

Next, the transporting moving mechanism 7 moves the first holding mechanism 3 to the holding position RP, and the first holding mechanism 3 holds the sealed substrates W by means of suction. Thereafter, the transporting moving mechanism 7
5 moves the first holding mechanism 3 holding the sealed substrates W to the cutting tables 2A and 2B. The first holding mechanism 3 then releases the suction-holding, and the sealed substrates W are placed on the cutting tables 2A and 2B. At this time, the position in the X-direction of the sealed substrates W is adjusted by the main moving mechanism 72, and the position in the Y-direction of the sealed substrates W is adjusted
10 by the horizontal movement mechanism 74. The sealed substrates W are then held by means of suction on the cutting tables 2A and 2B.

[0080]

Here, in a case in which the first holding mechanism 3 that is holding a sealed substrate W is moved to the cutting table 2B, the vertical movement mechanism 73 raises
15 the first holding mechanism 3 to a position where it is unable to physically interfere with the cutting moving mechanism 8 (i.e., with the supporting body 812). Note that when the first holding mechanism 3 that is holding a sealed substrate W is being moved to the cutting table 2B, in a case in which the supporting body 812 is retracted from the cutting table 2B to the drying table 13 side, there is no need to raise the first holding mechanism
20 3 as is described above.

[0081]

In this state, if the cutting moving mechanism 8 moves the two spindle portions 42A and 42B sequentially in the X-direction and the Y-direction while the cutting tables 2A and 2B are rotating, then the sealed substrate W can be cut in a lattice shape into
25 individual pieces.

[0082]

After the sealed substrate W has been cut, the transport moving mechanism 7 moves the first cleaning mechanism 18 so as to clean the upper-surface side (i.e., the lead surface) of the plurality of products P that are being held on the cutting tables 2A and 2B.

5 After this cleaning, the transport moving mechanism 7 retracts the first holding mechanism 3 and the first cleaning mechanism 18 to a predetermined position.

[0083]

Next, the transport moving mechanism 7 moves the second holding mechanism 6 to the cutting tables 2A and 2B, and the second holding mechanism 6 holds the plurality of products P by means of suction. Thereafter, the transport moving mechanism 7 moves the second holding mechanism 6 that is holding the plurality of products P to the second cleaning mechanism 19. As a result, the second cleaning mechanism 19 cleans the lower-surface side (i.e., the package surface) of the plurality of products P that are being held on the second holding mechanism 6.

15 [0084]

After this cleaning, the transport moving mechanism 7 moves the second holding mechanism 6 to the drying table 13. The suction used to hold the second holding mechanism 6 is then released and the plurality of products P are placed on the drying table 13. The drying table 13 then holds the sealed substrate W by means of suction. At this time, the transport moving mechanism 7 retracts the second holding mechanism 6 to a position where it will not interfere with the movement of the drying mechanism 14.

[0085]

In this state, the drying moving mechanism 15 moves the drying mechanism 14 reciprocatingly in the Y-direction. In addition, the drying mechanism 14 blows out jets

25

of compressed air so that the plurality of products P are dried. Note that the number of times the drying mechanism 14 is moved back and forth by the drying moving mechanism 15 can be set as is appropriate, and may be set to one time, or to a plurality of times.

5 [0086]

After the plurality of products P have been dried, the transport moving mechanism 7 moves the second holding mechanism 6 to the drying table 13, and the second holding mechanism 6 takes over the suction-holding of the plurality of products P from the drying table 13. Thereafter, the transport moving mechanism 7 moves the
10 second holding mechanism 6 that is holding the plurality of products P to the collection box 5.

[0087]

Next, the second holding mechanism 6 releases the suction-holding of the plurality of products P above the upper portion aperture 5X of the collection box 5.

15 Thereafter, the transport moving mechanism 7 moves the second holding mechanism 6 towards the drying table 13 side relative to the scraping component 16 in such a way that any products P remaining on the second holding mechanism 6 are able to come up against the scraping component 16 without falling off the second holding mechanism 6. In the present embodiment, in order to ensure the products P are scraped off reliably, the
20 second holding component 6 is moved relative to the scraping component 16 in such a way that the scraping component 16 comes into contact with the lower surface, which is the suctioning surface, of the second holding mechanism 6. As a result, the plurality of products P fall into the collection box 5 and are collected.

[0088] [Effects of the Present Embodiment]

25 According to the cutting device 100 of the present embodiment, because a

structure is employed in which the first holding mechanism 3 and the second holding mechanism 6 are moved by the shared transfer shaft 71 that extends in the direction in which the cutting tables 2A and 2B and the collection box 5 are aligned, and the cutting mechanism 4 is moved by the cutting moving mechanism 8 along the transfer shaft 71 in the X-direction and in the Y-direction when looked at in plan view, it is possible to cut the sealed substrate W into individual pieces without having to move the cutting tables 2A and 2B in the X-direction or the Y-direction. Because of this, the cutting tables 2A and 2B are not moved by a ball screw mechanism or the like, so that neither a bellows component for protecting the ball screw mechanism or the like, nor a cover component for protecting this bellows component are required. As a result, it is possible for the device structure of the cutting device 100 to be simplified.

[0089]

Moreover, because a structure is employed in which the cutting tables 2A and 2B do not move in the X-direction or the Y-direction, it is possible to reduce the space that would otherwise be required for the cutting tables 2A and 2B to move in, as well as any unnecessary peripheral space. Consequently, the footprint of the cutting device 100 can be reduced.

[0090]

Furthermore, because the second holding mechanism 6 that is holding the plurality of products P is transported to the collection box 5, and the plurality of products P are then dropped from the second holding mechanism 6 and collected in the collection box 5, compared to a conventional structure in which they are collected on a tray, it is possible to reduce the space needed for this collecting. Consequently, the footprint of the cutting device 100 can be reduced because of this as well.

[0091] [Other Variant Embodiments]

It should be noted that the present invention is not limited to the above-described embodiment.

[0092]

For example, the structure described in the foregoing embodiment is provided
5 with the drying table 13, however, it is also possible to employ a structure in which the drying table 13 is not provided.

[0093]

Moreover, it is also possible to employ a structure in which, instead of providing the scraping component 16, after the suction-holding has been released by the second
10 holding mechanism 6, gas is blown from the second holding mechanism 6 so that the plurality of products P are made to fall into the collection box 5.

[0094]

Furthermore, in addition to a structure in which the scraping component 16 is fixed to the collection box 5, it is also possible to employ a structure in which the
15 scraping component 16 is fixed to another component, or a structure in which the scraping component 16 is movable so that by moving the scraping component 16 relative to the second holding component 6, the plurality of products P can be scraped into the collection box 5.

[0095]

20 In the above-described embodiment, a cutting device employing a twin-cut table system and having a twin spindle structure is described, however, the present invention is not limited to this and it is also possible to use a cutting device employing a single-cut table system and having a single spindle structure, or a cutting device employing a single-cut table system and having a twin spindle structure.

25 [0096]

Moreover, because it is also possible to link together a plurality of cam rack elements to form the transfer shaft 71, it is also possible to form the cutting device (i.e., machining apparatus) 100 as, for example, a modular structure in which a plurality of modules are able to be connected together or disconnected from each other (i.e., are mutually detachable) between the second cleaning mechanism 19 and the drying table 13. In this case, it is possible to add, for example, a module that is used to inspect the products P between the module on the second cleaning mechanism 19 side and the module on the drying table 13 side. Note that, in addition to the structure illustrated here, it is also possible for the cutting device (machining apparatus) 100 to have a modular structure that can be connected together or disconnected at any point of its structure, or for the modules that are added to be modules having a variety of functions other than those of an inspection module.

[0097]

While preferred embodiments of the invention have been described and illustrated above, it should be understood that these are exemplary of the invention and are not to be considered as limiting. Additions, omissions, substitutions, and other modifications can be made without departing from the spirit or scope of the present invention. Accordingly, the invention is not to be considered as limited by the foregoing description and is only limited by the scope of the appended claims.

[Industrial Applicability]

[0098]

According to the present invention it is possible to enable the device structure to be simplified and the footprint thereof to be reduced, while at the same time enabling the collection space required to collect objects being machined that have been cut into individual pieces to be reduced.

[Description of the Reference Numerals]

[0099]

- 100 ... Cutting Device (Machining apparatus)
- W ... Sealed Substrate (Object Being Machined)
- 5 P ... Product (Machined Article)
- 2A, 2B ... Cutting Tables (Machining Tables)
- 3 ... First Holding Mechanism
- 4 ... Cutting Mechanism (Machining Mechanism)
- 5 ... Collection Box
- 10 6 ... Second Holding Mechanism
- 7 ... Transport Moving Mechanism
- 71 ... Transfer Shaft
- 8 ... Machining Moving Mechanism
- 81 ... X-Direction Movement portion
- 15 82 ... Y-Direction Movement portion
- 811 ... X-Direction Guide Rail Pair
- 812 ... Supporting Body
- 13 ... Drying Table
- 14 ... Drying Mechanism
- 20 15 ... Drying Moving Mechanism
- 16 ... Scraping Component

What is claimed is:

1. A machining apparatus comprising:

a machining table that holds an object being machined;

5 a first holding mechanism that holds the object being machined in order for this object being machined to be transported to the machining table;

a machining mechanism that cuts the object being machined held on the machining table into individual pieces;

10 a collection box that, when the individual pieces of the object being machined that have been cut by the machining mechanism are dropped into the collection box, collects these individual pieces;

a second holding mechanism that holds the individual cut pieces of the object being machined in order for these individual cut pieces of the object being machined to be transported from the machining table to the collection box;

15 a transport moving mechanism that extends in a direction in which the machining table and the collection box are aligned, and has a common transfer shaft that is used to move both the first holding mechanism and the second holding mechanism; and

20 a machining moving mechanism that moves the machining mechanism within a horizontal plane both in a first direction along the transfer shaft and in a second direction that is orthogonal to the first direction.

2. The machining apparatus according to Claim 1, wherein the transfer shaft is positioned above the machining moving mechanism in such a way as to extend across the machining moving mechanism.

25 3. The machining apparatus according to Claim 1 or 2, wherein the second holding

mechanism holds the individual cut pieces of the object being machined by means of suction.

4. The machining apparatus according to any one of Claims 1 through 3, further comprising a scraping component that scrapes the individual cut pieces of the object
5 being machined from the second holding mechanism.

5. The machining apparatus according to Claim 4, wherein the scraping component is fixed to the collection box, and

the individual cut pieces of the object being machined are scraped off from the second holding mechanism as a result of the transport moving mechanism causing the
10 second holding mechanism to move relatively to the scraping component.

6. The machining apparatus according to any one of Claims 1 through 5, further comprising a drying table that is used to dry the individual cut pieces of the object being machined, wherein

the transport moving mechanism moves the second holding mechanism from the
15 machining table to the drying table, and from the drying table to the collection table.

7. The machining apparatus according to Claim 6, further comprising:

a drying mechanism that blows jets of air from above the drying table so as to dry the individual cut pieces of the object being machined; and

a drying moving mechanism that moves the drying mechanism along the drying
20 table.

8. The machining apparatus according to Claim 7, wherein the drying mechanism blows jets of air in the direction of movement of the drying moving mechanism.

9. The machining apparatus according to any one of Claims 1 through 8, wherein the machining moving mechanism comprises an X-direction movement portion that
25 moves the machining mechanism rectilinearly in the X-direction, which is the first

direction, and a Y-direction movement portion that moves the machining mechanism rectilinearly in the Y-direction, which is the second direction, and

the X-direction movement portion comprises a pair of X-direction guide rails that are disposed so as to extend in the X-direction on either side of the machining table,
5 and a supporting body that moves along the pair of X-direction guide rails and supports the machining mechanism via the Y-direction movement portion.

10. A method of manufacturing a machined article in which a machined article is manufactured using the machining apparatus according to any one of Claims 1 through 9.