

[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, as is shown in Patent Document 1, a manufacturing device
provided with a semiconductor package substrate cutting device that is used to cut a
semiconductor package substrate, and with a semiconductor package placement device
that places the semiconductor package after this has been cut by the semiconductor
15 package cutting device is employed in order to manufacture a semiconductor package
having sealed resin.

[0003]

This semiconductor package substrate cutting device transports a semiconductor
package substrate in an X-axial direction and then places it on a cutting table. While
20 this cutting table is then being moved in a Y-axial direction, the semiconductor package
substrate is cut by a rotating blade of a cutting mechanism so as to be separated into a
plurality of semiconductor packages. In addition, the semiconductor package placement
device stores the semiconductor packages after mounting them on a placement
component in the form of a mounting component having a bonding layer (i.e., an
25 adhesive layer).

[Documents of the Prior Art]

[Patent Documents]

[0004]

[Patent Document 1] Patent Publication No. 6626027

5 [0005]

However, in the above-described manufacturing device, not only is the semiconductor package substrate transported in the X-axial direction, but in addition the cutting table is moved in the Y-axial direction in order for the semiconductor package substrate to be cut. Because of this, the device ends up having a sizable footprint.

10 [0006]

Moreover, in order to protect a moving mechanism that is used to move the cutting table from cutting water or machining waste generated by the cutting, it is necessary that protective components be provided for the moving mechanism. A bellows component that is used to protect the moving mechanism, 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]

The present invention was therefore conceived in order to solve the above-described drawbacks, and it is a principal object thereof to enable an object being machined that has been cut into individual pieces to be mounted on a mounting component having an adhesive surface, while eliminating the need for any moving mechanism for moving a machining table holding the object being machined.

25

[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
5 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 transfer table onto which are transferred the individual pieces of the object being machined that have been cut by the machining mechanism, a second holding
10 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 transfer table, a transport moving mechanism that extends in a direction in which the machining table and the transfer table are aligned, and has a common transfer shaft that is used to move both the first holding mechanism and the
15 second holding mechanism, 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, a placement table on which is placed a mounting component having an adhesive surface on which are mounted the individual cut pieces of the object being machined, and a mounting transporting
20 mechanism that transports the individual cut pieces of the object being machined from the transfer table to the mounting component placed on the placement table.

[Effects of the Invention]

[0009]

According to the present invention that is formed in the manner described above,
25 it is possible to enable an object being machined that has been cut into individual pieces

to be mounted on a mounting component having an adhesive surface, while eliminating the need for any moving mechanism for moving a machining table holding the object being machined.

5

[Brief Description of the Drawings]

[0010]

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

10

[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 structure thereof.

15

[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 schematically showing a structure of a first holding mechanism and a transport moving mechanism of the same embodiment.

20

[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.

[FIG. 7] FIG. 7 is a view (i.e., a plan view) as seen from the Z-direction

25

schematically showing a transfer table as well as respective positions of a placement

table of the same embodiment.

[FIG. 8] FIG. 8 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.

5 [FIG. 9] FIG. 9 is a cross-sectional view schematically showing a structure of a rack and pinion mechanism of the same embodiment.

[FIG. 10] FIG. 10 is a view (i.e., a front view) as seen from the Y-direction schematically showing structures of the transfer table, the placement table, and a mounting transporting mechanism of the same embodiment.

10 [FIG. 11] FIG. 11 contains (a) a plan view, (b) a cross-sectional view, and (c) a partially enlarged cross-sectional view schematically showing a structure of a mounting component of the same embodiment.

[FIG. 12] FIG. 12 is a view (i.e., a front view) as seen from the Y-direction schematically showing structures of the transfer table, a mounting component storage
15 portion, and a mounting component transporting mechanism of the same embodiment.

[FIG. 13] FIG. 13 is a view schematically showing movement paths of the first holding mechanism and the second holding mechanism of the same embodiment.

[FIG. 14] FIG. 14 contains (a) a view (i.e., a front view) as seen from the Y-direction schematically showing structures of a transfer table, a mounting component
20 storage portion, and a mounting component transporting mechanism, (b) a schematic view showing a state in which a gap between upper guide rails has been widened, and (c) a schematic view showing a state in which the gap between the upper guide rails has been narrowed of a variant embodiment.

[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

5 description.

[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
10 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 transfer table onto which are transferred the individual pieces of the object being machined that have been cut by the machining mechanism, a second holding mechanism that holds the individual cut pieces of the object being machined in order for
15 these individual cut pieces of the object being machined to be transported from the machining table to the transfer table, a transport moving mechanism that extends in a direction in which the machining table and the transfer table are aligned, and has a common transfer shaft that is used to move both the first holding mechanism and the second holding mechanism, a machining moving mechanism that moves the machining
20 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, a placement table on which is placed a mounting component having an adhesive surface on which are mounted the individual cut pieces of the object being machined, and a mounting transporting mechanism that transports the individual cut pieces of the object being machined from
25 the transfer table to the mounting component placed on the placement table.

[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 transfer table 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, it is possible for the individual cut pieces of the object being machined to be transported by the mounting transporting mechanism from the transfer table to the mounting component that has been placed on the placement table, and for these individual cut pieces of the object being machined to be mounted on the adhesive surface of the mounting component. As a result, in a case in which post-machining such as sputtering machining or packaging machining is performed on the individual cut

pieces of the object being machined, it is sufficient to simply move the mounting component on which the individual cut pieces of the object being machined have been mounted so that the ease of handling is simplified.

[0014]

5 As a specific aspect of the placement of the transfer shaft and the machining 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
10 mechanism that moves along the transfer shaft to move above the machining moving 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
15 physically interfering with the machining moving mechanism.

[0015]

 In order to efficiently store the individual cut pieces of the object being machined, it is desirable that a plurality of the placement tables be provided.

[0016]

20 In order to enable the mounting component placed on the placement table to be replaced automatically, it is desirable that the machining apparatus of the present invention be provided with a storage portion that stores the mounting components, and with a mounting component transporting mechanism that transports the mounting components between the placement table and the storage portion.

25 [0017]

As a specific aspect for enabling the mounting components to be reliably loaded in and unloaded from the storage portion, it is desirable that there be further provided a guide rail that is used for loading the mounting components in the mounting component storage portion and unloading the mounting components from the mounting component storage portion.

[0018]

It is desirable that an upper guide rail and a lower guide rail be provided for each placement table.

If this type of structure is employed, then in a state in which a mounting component has been placed on a placement table, by placing an empty mounting component on one guide rail in advance, it becomes possible to shorten the time required to place an empty mounting component on a placement table. Note that a mounting component on which individual cut pieces of an object being machined have been mounted is placed on the other guide rail.

[0019]

In order to mount each one of the individual cut pieces of an object being machined in a desired position on a mounting component, it is desirable that the machining apparatus of the present invention be further provided with a first image acquisition portion that verifies positions of the individual cut pieces of an object being machined that are being held by the second holding mechanism, and a second image acquisition portion that verifies positions where the individual cut pieces of the object being machined have been mounted on the adhesive surface of the mounting component.

[0020]

In order to efficiently transport the individual cut pieces of an object being machined from a transfer table to a mounting component placed on a placement table, it

is desirable that there be provided a plurality of the mounting transporting mechanisms, and that each of these mounting transporting mechanisms be driven independently of each other.

[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, which is the first direction, and a Y-direction movement portion that
10 moves the machining mechanism rectilinearly in the Y-direction, which is the second 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 transfer table 5 onto which the plurality of products P are transferred, 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 the transfer table 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 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 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 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-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
5 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).

10 [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
15 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
20 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
25 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] [Transfer table 5]

As is shown in FIG. 1, the transfer table 5 of the present embodiment is a table onto which the plurality of products P that have been inspected by an inspection portion 13 (described below) are transferred. This transfer table 5 is what is known as an index table, and the plurality of products P are temporarily placed on this transfer table 13 prior to the plurality of products P being mounted on a mounting component 20 (described below). In addition, as is shown in FIG. 1 and FIG. 7, the transfer table 5 is provided so as to be able to move in the Y-direction, and moves between a transfer position X1 where the plurality of products P are placed thereon by the second moving mechanism 6, and an extraction position X2 to which the plurality of products P are transported by a mounting transporting mechanism 22. Note that the transfer position X1 is set on the near side of the transfer shaft 71 and is located on the same line on a horizontal plane in the X-

direction as the two cutting tables 2A and 2B. Note also that the extraction position X2 is set on the far side of the transfer shaft 71.

[0037] [Inspection Portion 13]

Here, as is shown in FIG. 1, the inspection portion 13 is provided between the cutting tables 2A and 2B and the transfer table 5, and is used to inspect the plurality of products P being held on the second holding mechanism 6. The inspection portion 13 of the present embodiment has a first inspection portion 131 that inspects the sealed surface (i.e., the package surface) of the products P, and a second inspection portion 132 that inspects the lead surface of the products P. The first inspection portion 131 is an image acquisition camera having an optical system that is used to inspect the package surface, while the second inspection portion 132 is an image acquisition camera having an optical system that is used to inspect the lead surface. Note that it is also possible for a single device to be used in common for both the first inspection portion 131 and the second inspection portion 132.

[0038]

Moreover, in order to enable both surfaces of the plurality of products P to be inspected by the inspection portion 13, an inverting mechanism 14 that inverts the plurality of products P is provided (see FIG. 1). This inverting mechanism 14 has a holding table 141 that holds the plurality of products P, and an inverting portion 142 such as a motor or the like that inverts the holding table 141 back to front.

[0039]

When the second holding mechanism 6 has received and is holding the plurality of products P from the machining tables 2A and 2B, the package surfaces of the products P are facing downwards. In this state, the package surface of each product P is inspected by the first inspection portion 131 during the transportation of the plurality of

products P from the machining tables 2A and 2B to the inverting mechanism 14.

Thereafter, the plurality of products P being held on the second holding mechanism 6 are inverted by the inverting mechanism 14, and the inverting mechanism 14 subsequently moves to the position of the transfer table 5. During this movement, the lead surface which is facing downwards of each product P is inspected by the second inspection portion 132. The products P are then delivered to the transfer table 5.

[0040] [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 the inverting mechanism 14. As is shown in FIG. 9, 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 holding table 141 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.

[0041] [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 holding table 141.

[0042]

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 transfer

table 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 mechanism 6.

[0043]

5 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 transfer table 5 (see FIG. 1). Furthermore, a mounting component transporting mechanism 26 (described below) extends over a range that enables it to move between a mounting
10 component transporting position X3 and guide rails 27. Moreover, the first holding mechanism 3, the second holding mechanism 6, the cutting tables 2A and 2B, and the transfer table 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, the inspection portion 13, the inverting mechanism 14, a placement table 21, a mounting component storage portion 25,
15 the mounting component transporting mechanism 26, and a first cleaning mechanism 18 and second cleaning mechanism 19 (described below) are also provided on the same side (i.e., on the near side) of the transfer shaft 71.

[0044]

 Furthermore, as is shown in FIG. 5, FIG. 6, and FIG. 9, the transport moving
20 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 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
25 mechanism 3 and the second holding mechanism 6 horizontally in the Y-direction relative

to the transfer shaft 71.

[0045]

As is shown in FIG. 5, FIG. 6, FIG. 8, and FIG. 9, the main moving mechanism 72 includes common guide rails 721 that are provided on the transfer shaft 71 and guide
5 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 mechanism 6 along the guide rails 721.

[0046]

The guide rails 721 extend rectilinearly in the X-direction along the transfer
10 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 the substrate supply mechanism 11, and allows the second holding mechanism 6 to move above the transfer table 5. A sliding component 723 on which the first holding mechanism 3 and the second holding mechanism 6 are provided via the vertical
15 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 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 sliding component 723 are provided individually for each of the first holding
20 mechanism 3 and the second holding mechanism 6.

[0047]

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
25 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 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. 8, 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 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 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.

[0048]

As is shown in FIG. 5 and FIG. 9, a vertical movement mechanism 73 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 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-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. 9, 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.

[0049]

As is shown in FIG. 5, FIG. 6, and FIG. 9, 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 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 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.

[0050]

Note that, as is shown in FIG. 9, the structure of the horizontal movement 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 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.

[0051] [Cutting Moving Mechanism 8 (Machining Moving Mechanism)]

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

[0052]

5 More specifically, as is shown in FIG. 2, FIG. 3, and FIG. 4, the cutting moving 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
10 rectilinearly in the Z-direction.

[0053]

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
15 disposed so as to extend in the X-direction on either side of the two cutting tables 2A and 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
20 extend in the X-direction. The supporting body 812 may be formed, for example, in a 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.

25 [0054]

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).

5 It is also possible to employ a structure in which the supporting body 812 is moved reciprocatingly by another type of linear motion mechanism such as a linear motor or the like.

[0055]

As is shown in FIG. 3, in particular, the Y-direction movement portion 82
10 includes Y-direction guide rails 821 that are disposed in the supporting body 812 so as to 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
15 correspond to the two spindle portions 42A and 42B. As a result, the two spindle 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.

20 [0056]

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
25 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.

5 [0057]

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.

10

[0058] [Machining Waste Collection Portion 17]

15 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.

[0059]

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.

20

25

[0060]

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
5 so as to surround the cutting tables 2A and 2B (see FIG. 3), it is difficult for any 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
10 which the rotation mechanisms 9A and 9B are protected from machining waste S and cutting water.

[0061]

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
15 machining waste collecting portion independently for each of the cutting tables 2A and 2B.

[0062]

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
20 FIG. 4 and the like, a collecting vessel 172 is provided respectively for each of the two 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
25 of the machining waste S or the like. Note that depending on the size of the sealed

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.

5 [0063]

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 S. 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
10 are provided in a bottom surface of the collecting vessels 172. By employing these separating portions 173, the machining waste S can be recovered without cutting water being accumulated in the collecting vessels 172.

[0064] [First Cleaning Mechanism 18]

Moreover, as is shown in FIG. 1 and FIG. 5, the cutting device 100 of the
15 present invention is additionally provided with a first cleaning mechanism 18 that cleans 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
20 products P that are being held on the cutting tables 2A and 2B.

[0065]

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
25 slides along the guide rails 721 provided on the transfer shaft 71. Here, a vertical

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.

[0066] [Second Cleaning Mechanism]

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 disposed between the cutting table 2B and the inspection portion 13, 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.

[0067] [Ring Storage Structure]

In addition, the cutting device 100 of the present embodiment is formed in such a way that it is possible to mount a plurality of the products P on the mounting component 20 which has an adhesive surface 20x in order to store this plurality of products P (also known as 'ring storage').

[0068]

More specifically, as is shown in FIG. 1 and FIG. 10, the cutting device 100 is provided with a placement table 21 on which is placed the mounting component 20 having the adhesive surface 20x on which the plurality of products P are mounted, and

the mounting transporting mechanism 22 that transports the plurality of products P from the transfer table 5 to the mounting component 20 that has been placed on the placement table 21.

[0069]

5 In the present embodiment, two placement tables 21 are provided so as to be aligned with each other in the X-direction (see FIG. 1), and a mounting component 20 is placed on each placement table 21. More specifically, the two placement tables 21 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).

10 [0070]

Moreover, as is shown in FIG. 1 and FIG. 7, the two placement tables 21 are provided in such a way that they are able to move in the Y-direction and are able to move between a mounting component transporting position X3 to which the mounting component 20 is transported by the mounting component transporting mechanism 26,
15 and a mounting position X4 to which a plurality of the products P are transported by the mounting transporting mechanism 22. The two placement tables 21 move independently of each other between the mounting component transporting position X3 and the mounting position X4. Note that the mounting component transporting position X3 is set on the near side of the transfer shaft 71, while mounting position X4 is set on
20 the far side of the transfer shaft 71. In addition, the placement table 21 when this is at the mounting position X4 and the transfer table 5 when this is at the extraction position X2 are aligned with each other in the X direction (see FIG. 1).

[0071]

Here, as is shown in FIG. 11, the mounting component 20 is provided with a
25 frame component 20a having, for example, either an annular shape or a rectangular

shape, and a resin sheet 20b having the adhesive surface 20x that is disposed on an inner side of the frame component 20a. The frame component 20a is formed from a metal such as, for example, stainless steel or the like. Moreover, the resin sheet 20b is provided, for example, with a sheet-shaped base material 20b1 made from resin, and a bonding layer (i.e., an adhesive layer) 20b2 that is formed by coating a bonding agent onto an upper surface of the sheet-shaped base material 20b1. Note that the upper surface of the bonding layer (i.e., the adhesive layer) 20b2 forms the adhesive surface 20x.

[0072]

The mounting transporting mechanism 22 transports a plurality of the products P from the transfer table 5 which has been moved to the extraction position X2 to the mounting component 20 placed on the placement table 21 which has been moved to the mounting position X4.

[0073]

More specifically, as is shown in FIG. 10, the mounting transporting mechanism 22 is provided with a product suctioning mechanism 221 that suctions, for example, each row one-by-one of the plurality of products P being held on the transfer table 5, and a suctioning moving mechanism 222 that moves the product suctioning mechanism 221 in the X-direction. In the present embodiment, two mounting transporting mechanisms 22 are provided (see FIG. 1), and the respective mounting transporting mechanisms 22 are formed so as to be able to be driven independently of each other.

[0074]

As is shown in FIG. 10, the product suctioning mechanism 221 includes a suction head 221A in which are provided a plurality of suctioning portions 221a that are used to hold the plurality of products P individually by means of suction, and a vacuum

pump or vacuum ejector (not shown in the drawings) that is connected to the suctioning portions 221a of this suction head 221A. This product suctioning mechanism 221 is formed so that each suctioning portion 221a suctions a single product P. Moreover, the plurality of suctioning portions 221a are formed so as to be able to move up and down independently of each other. By lowering a suctioning portion 221a, that suctioning portion is able to suction an individual product P.

[0075]

As is shown in FIG. 10, the suctioning moving mechanism 222 is provided with an X-direction movement portion 222a that moves the product suctioning mechanism 221 in the X-direction, and a Z-direction movement portion 222b that moves the product suctioning mechanism 221 in the Z-direction. Note that it is also possible for the suctioning moving mechanism 222 to be provided with a Y-direction movement portion that moves the product suctioning mechanism 221 in the Y-direction.

[0076]

The X-direction movement portion 222a includes an X-direction guide rail 222a1 that is disposed on the far side of the transfer shaft 71 so as to extend in the X-direction, and a supporting body 222a2 that moves along the X-direction guide rail 222a1 and supports the product suctioning mechanism 221 via the Z-direction movement portion 222b. In addition, the supporting body 222a2 is moved reciprocatingly in a straight line in the X-direction above the X-direction guide rail 222a1 by, for example, a ball screw mechanism (not shown in the drawings) that extends in the X-direction. This ball screw mechanism is 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 222a2 is moved reciprocatingly by another type of linear motion mechanism such as a linear motor or the like.

[0077]

As is shown in FIG. 10, the Z-direction movement portion 222b includes Z-direction guide rails 222b1 that are disposed in the supporting body 222a2 so as to extend in the Z-direction, and a Z-direction slider 222b2 that moves along these Z-direction guide rails 222b1 and supports the product suctioning mechanism 221. The Z-direction slider 222b2 may be moved reciprocatingly in a straight line in the Z-direction on the Z-direction guide rails 222b1 by, for example, a ball screw mechanism (not shown in the drawings) that extends in the Z-direction. It is also possible to employ a structure in which the Z-direction slider 222b2 is moved reciprocatingly by another type of linear motion mechanism such as a linear motor or the like.

[0078]

The positions where the products P are being held by suction on the mounting transporting mechanism 22 are verified by a first image acquisition portion 23 (see FIG. 1). The first image acquisition portion 23 is an image acquisition camera that acquires images from underneath the products P showing where the products P are being held by suction by the product suctioning mechanism 221 of the mounting transporting mechanism 22, and the first image acquisition portion 23 achieves this by acquiring images of the lower surface (i.e., the package surface) of the products P. The first image acquisition portion 23 is provided so as to be able to move in the front-rear direction (i.e., in the Y-direction). As a result, a structure is created in which the positions of the products P being held by suction respectively on the two mounting transporting mechanisms 22 are able to be verified.

[0079]

Furthermore, as is shown in FIG. 1, a second image acquisition portion 24 that verifies positions where the products P are mounted on the mounting component 20 is

also provided in each of the mounting transporting mechanisms 22. The second image acquisition portion 24 is an image acquisition camera that acquires images from above of the mounting component 20 that is on the placement table 21 which is located in the mounting position X4, and acquires images of an upper surface (i.e., of the adhesive surface 20x) of the mounting component 20. Based on the image acquisition data obtained by the first image acquisition portion 23 and the image acquisition data obtained by the second image acquisition portion 24, the products P are then positioned relative to the mounting component 20, and the mounting transporting mechanism 22 mounts the products P on the adhesive surface 20x of the mounting component 20. Note that the positioning of the products P can be performed by a rotation mechanism (not shown in the drawings) that is provided in the suction moving mechanism 222 of the mounting transporting mechanism 22 or in the mounting transporting mechanism 22 itself, or by a rotation mechanism (not shown in the drawings) that is provided in a moving mechanism (not shown in the drawings) of the placement table 21 or in the placement table 21 itself.

[0080]

Moreover, as is shown in FIG. 12, the cutting apparatus 100 of the present embodiment is also provided with a mounting component storage portion 25 that stores the mounting components 20, and a mounting component transporting mechanism 26 that transports the mounting component 20 between the placement table 21 and the mounting component storage portion 25.

[0081]

The mounting component storage portion 25 stores empty mounting components 20 on which no product P has yet been mounted, and also stores completed mounting components 20 on which the mounting of a product P has been completed. This mounting component storage portion 25 is located on the same line in the X-direction as

the placement table 21 which is positioned at the mounting component transporting position X3 (see FIG 1).

[0082]

As is shown in FIG. 1 and FIG. 12, a pair of guide rails 27 that are used when the mounting components 20 are being transported to or away from the mounting component storage portion 25 are provided in an aperture portion of the mounting component storage portion 25. The mounting components 20 are placed on this pair of guide rails 27, and the guide rails 27 are provided so as to extend in the X-direction from the front of the aperture portion of the mounting component storage portion 25.

[0083]

The mounting component transporting mechanism 26 transports the mounting components 20 between the placement table 21 which is located at the mounting component transporting position X3 and the mounting component storage portion 25. More specifically, as is shown in FIG. 12, the mounting component transporting mechanism 26 is provided with a third holding mechanism 261 that employs suction in order to hold the frame component 20a of the mounting component 20, and a moving mechanism 262 that moves the third holding mechanism 261 in at least the X-direction and the Z-direction.

[0084]

The third holding mechanism 261 includes a suction head 261A in which are provided a plurality of suctioning portions 261a that are used to hold the mounting components 20 by means of suction, and a vacuum pump or vacuum ejector (not shown in the drawings) that is connected to the suctioning portions 2261a of this suction head 261A. Moreover, the moving mechanism 262 is formed using the main moving mechanism 72 of the above-described transport moving mechanism 7 and, additionally,

includes a vertical movement mechanism 262a similar to the vertical movement mechanism 73 of the transport moving mechanism 7. Note that the moving mechanism 262 may additionally include a Y-direction moving mechanism that moves the third holding mechanism 261 in the Y-direction.

5 [0085] [Example of an Operation of the Cutting Device]

Next, an example of an operation of the cutting device 100 will be described with reference to FIG. 10, FIG. 12 and FIG. 13. Note that FIG. 13 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 also that, in
10 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 the sealed substrates W, the inspection of the products P, and the ring storage of the products P and the like are conducted by a control unit CTL (see FIG. 1).

[0086]

15 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 to a holding position RP where they are held by the first holding mechanism 3 (see FIG. 1).

[0087]

20 Next, as is shown in FIG. 13, the transport 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 transport moving mechanism 7 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-
25 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 by the horizontal movement mechanism 74. The sealed substrates W are then held by means of suction on the cutting tables 2A and 2B.

5 [0088]

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 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
10 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 transfer table 5 side, there is no need to raise the first holding mechanism 3 as is described above.

[0089]

15 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 individual pieces.

[0090]

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

25 [0091]

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.

[0092]

After this cleaning, the lower surface side (i.e., the package surface) of each of the plurality of products P being held on the second holding mechanism 6 is inspected, and the plurality of products P are then delivered to the inverting mechanism 14. Once the package surface of each of the plurality of products P is being held via suction by the inverting mechanism 14, the plurality of products P are inverted. After this inversion, the inverting mechanism 14 is moved such that the lead surface of each product P is inspected by the inspection portion 132. Once both surfaces have been inspected in this manner, the products P are delivered from the inverting mechanism 14 to the transfer table 5. Once the plurality of products P have been placed thereon, the transfer table 5 is moved to the extraction position X2 (see FIG. 1, FIG. 7, and FIG. 10).

[0093]

In contrast, the empty mounting component 20 is transported by the mounting component transporting mechanism 26 from the mounting component storage portion 25 to the placement table 21 which is located at the mounting component transporting position X3. Once the empty mounting component 20 has been transported thereto, the placement table 21 is moved to the mounting position X4 (see FIG. 7 and FIG. 10).

[0094]

In this state, as is shown in FIG. 10, the mounting transporting mechanism 22 takes over the suction-holding of the products P from the transfer table 5 which is located at the extraction position X2. The mounting transporting mechanism 22 is then moved to a location above the first image acquisition portion 23. Consequently, the positions of the products P on the mounting transporting mechanism 22 are confirmed by the first image acquisition portion 23. Next, the mounting transporting mechanism 22 is moved and the positions where the products P are mounted on the mounting component 20 on the placement table 21 which is located at the mounting position X4 are confirmed by the second image acquisition portion 24. The mounting transporting mechanism 22 then mounts the products P that it is holding on the mounting component 20. This operation is repeated a plurality of times until the permitted number of products P that can be mounted on the mounting component 20 have been mounted thereon, or until all of the plurality of products P on the transfer table 5 have been mounted on the mounting component 20.

[0095]

Thereafter, as is shown in FIG. 7 and FIG. 12, the placement table 21 is moved to the mounting component transporting position X3. Next, the mounting component transporting mechanism 26 transports the mounting component 20 on which the products P have been mounted and that is placed on the placement table 21 to the mounting component storage portion 25. More specifically, the mounting component transporting mechanism 26 places the mounting component 20 on which the products P have been mounted on the pair of guide rails 27 that are provided in the mounting component storage portion 25, and by pushing the mounting component 20 on which the products P have already been mounted that has been placed on the pair of guide rails 27, the mounting component 20 on which the products P have been mounted is stored in the

mounting component storage portion 25.

[0096]

Next, in a case in which an empty mounting component 20 is extracted from the mounting component storage portion 25, the mounting component transporting
5 mechanism 26 extracts the mounting component 20 within the mounting component storage portion 25, and places it on the pair of guide rails 27. The empty mounting component 20 placed on the pair of guide rails 27 is then held by suction and transported to the placement table 21 that is located at the mounting component transporting position X3.

10 [0097] [Effects of the Present Embodiment]

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 transfer table 5 are aligned, and the cutting
15 mechanism 4 is moved by the cutting moving mechanism 8 along the transfer shaft 71 in the X-direction and in the Y-direction which is orthogonal to the X-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
20 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.

[0098]

25 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.

5 [0099]

Furthermore, a plurality of the products P can be transported by the mounting transporting mechanism 22 from the transfer table 5 to the mounting component 20 that has been placed on the placement table 21, and this plurality of products P can be mounted on the adhesive surface 20x of this mounting component 20. As a result, in a case in which post-machining such as sputtering machining or packaging machining is performed on the plurality of products P, it is sufficient to simply move the mounting component 20 on which the plurality of products P have been mounted so that the ease of handling is simplified.

[0100] [Other Variant Embodiments]

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

[0101]

For example, in the foregoing embodiment a structure is described in which a plurality of (more specifically, two) placement tables 21 are provided, however, as is shown in FIG. 14 (a), it is also possible for only one placement table 21 to be provided. In this case, two upper guide rails 27A and two lower guide rails 27B may be provided in the aperture portion of the mounting component storage portion 25. In this structure, the upper guide rails 27A may be formed in such a way that the gap between them can be widened or narrowed by an expandable mechanism (not shown in the drawings).

25 [0102]

An operation that is performed in a case in which this two-level upper and lower structure using the guide rails 27A and 27B is employed will now be described.

[0103]

Firstly, the gap between the upper guide rails 27A is widened by the expansion
5 mechanism (see FIG. 14 (a)). Next, the mounting component transporting mechanism
26 is lowered down between the upper guide rails 27A and an empty mounting
component 20 is extracted from the mounting component storage portion 25 and
temporarily placed on the lower guide rails 27B. Thereafter, the mounting component
transporting mechanism 26 is moved to the placement table 21, which is located at the
10 mounting component transporting position X3, and receives a mounting component 20
that has completed the mounting process.

[0104]

Next, the gap between the upper guide rails 27A is narrowed by the expansion
mechanism (see FIG. 14 (c)). The mounting component transporting mechanism 26
15 then places the mounting component 20 that has completed the mounting process on the
upper guide rails 27A, and this mounting component 20 is pushed into the mounting
component storage portion 25.

[0105]

Thereafter, the gap between the upper guide rails 27A is widened by the
20 expansion mechanism. The mounting component transporting mechanism 26 is then
lowered down between the upper guide rails 27A and receives the empty mounting
component 20 that has been placed on the lower guide rails 27B. The mounting
component transporting mechanism 26 then transports this empty mounting component
20 to the placement table 21.

25 [0106]

Moreover, in the above-described embodiment a structure having two mounting transporting mechanisms 22 is employed, however, it is also possible to employ a structure having only one mounting transporting mechanism 22.

[0107]

5 Furthermore, the first image acquisition portion 23 is shared in common by both of the mounting transporting mechanisms 22, however, it is also possible for an image acquisition portion 23 to be provided individually for each of the two mounting transporting mechanisms 22.

[0108]

10 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.

15 [0109]

 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
20 mutually detachable) between the second cleaning mechanism 19 and the inspection portion 13. In this case, it is possible to add, for example, a module that performs a different type of inspection from that performed by the inspection portion 13 between the module on the second cleaning mechanism 19 side and the module on the inspection
portion 13 side. Note that, in addition to the structure illustrated here, it is also possible
25 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.

[0110]

5 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
10 foregoing description and is only limited by the scope of the appended claims.

[Industrial Applicability]

[0111]

According to the present invention, it is possible to enable an object being machined that has been cut into individual pieces to be mounted on an adhesive surface
15 and stored, while eliminating the need for any moving mechanism for moving a machining table.

[Description of the Reference Numerals]

[0112]

100 ... Cutting Device (Machining apparatus)
20 W ... Sealed Substrate (Object Being Machined)
P ... Product (Machined Article)
2A, 2B ... Cutting Tables (Machining Tables)
3 ... First Holding Mechanism
4 ... Cutting Mechanism (Machining Mechanism)
25 5 ... Transfer Table

	6 ...	Second Holding Mechanism
	7 ...	Transport Moving Mechanism
	71 ...	Transfer Shaft
	8 ...	Machining Moving Mechanism
5	81 ...	X-Direction Movement portion
	82 ...	Y-Direction Movement portion
	811 ...	X-Direction Guide Rail Pair
	812 ...	Supporting Body
	20 ...	Mounting Component
10	20x ...	Adhesive Surface
	21 ...	Placement Table
	22 ...	Mounting Transporting Mechanism
	23 ...	First Image Acquisition Portion
	24 ...	Second Image Acquisition Portion
15	25 ...	Mounting Component Storage Portion
	26 ...	Mounting Component Transporting Mechanism
	27 ...	Guide Rails
	27A, 27B ...	Guide Rails

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 transfer table onto which are transferred the individual pieces of the object being machined that have been cut by the machining mechanism;

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 transfer table;

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

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;

20 a placement table on which is placed a mounting component having an adhesive surface on which are mounted the individual cut pieces of the object being machined; and

a mounting transporting mechanism that transports the individual cut pieces of the object being machined from the transfer table to the mounting component placed on the placement table.

25 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.

3. The machining apparatus according to Claim 1 or 2, wherein a plurality of the placement tables are provided.

5 4. The machining apparatus according to any one of Claims 1 through 3, further comprising:

a mounting component storage portion that stores the mounting components;

and

10 a mounting component transporting mechanism that transports the mounting components between the placement table and the mounting component storage portion.

5. The machining apparatus according to Claim 4, further comprising a guide rail that is used for loading the mounting components in the mounting component storage portion and unloading the mounting components from the mounting component storage portion.

15 6. The machining apparatus according to Claim 5, wherein an upper guide rail and a lower guide rail are provided for each placement table.

7. The machining apparatus according to any one of Claims 1 through 6, further comprising:

20 a first image acquisition portion that verifies positions of the individual cut pieces of an object being machined that are being held on the mounting transporting mechanism; and

a second image acquisition portion that verifies positions where the individual cut pieces of the object being machined have been mounted on the adhesive surface of the mounting component.

25 8. The machining apparatus according to any one of Claims 1 through 7, wherein

there are provided a plurality of mounting transporting mechanisms, and each of these mounting transporting mechanisms are driven independently of each other.

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
5 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,
10 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.