

DESCRIPTION

Title of Invention: CUTTING APPARATUS, AND METHOD FOR MANUFACTURING CUT PRODUCT

5 Technical Field

[0001] The present invention relates to a cutting apparatus and a method for manufacturing a cut product.

Background Art

10 [0002] JP 2013-120794A (Patent Document 1) discloses a dicing apparatus that performs groove machining and cutting on a workpiece such as a wafer. In this dicing apparatus, a dicing blade that rotates at high speed is used to perform various machining processes on a workpiece. Dressing is performed on the dicing blade by cutting a groove in a dressing member with the dicing blade. In this dicing apparatus, replacement of the
15 dressing member is performed automatically (see Patent Document 1).

Citation List

Patent Document

[0003] Patent Document 1: JP 2013-120794A
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Summary of Invention

Technical Problem

[0004] The technology disclosed in the above Patent Document 1 relates to a dicing apparatus that performs groove machining and cutting on a workpiece such as a wafer.
25 It is not appropriate to apply this technology as it is to a cutting apparatus configured to cut an object to be cut not appropriate for a dicing apparatus, such as a resin-sealed substrate.

[0005] The present invention has been made to solve such a problem, and an object of the present invention is to provide a cutting apparatus configured to cut object to be cuts including a sealed substrate and also capable of automatically replacing a dress board, as well as a method for manufacturing a cut product.

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Solution to Problem

[0006] A cutting apparatus according to an aspect of the present invention includes a cutting table, a cutting mechanism, a dressing table, a storage mechanism, and a transport mechanism. The cutting table is configured to hold an object to be cut. The cutting
10 mechanism is configured to cut, using a blade, the object to be cut held by the cutting table. The dressing table is configured to hold a dress board for dressing the blade. The storage mechanism is configured to store a plurality of dress boards in a stacked manner. The transport mechanism includes a substrate transport unit and a dress board transport unit configured to move together with the substrate transport unit. The
15 substrate transport unit is further configured to suction the object to be cut and transport the suctioned object to be cut to the cutting table. The dress board transport unit is configured to transport the dress board between the storage mechanism and the dressing table.

[0007] Also, a method for manufacturing a cut product according to another aspect
20 of the present invention is a method for manufacturing a cut product using the above-described cutting apparatus. The method for manufacturing a cut product includes: suctioning the object to be cut and transporting the suctioned object to be cut to the cutting table; transporting the dress board between the storage mechanism and the dressing table; dressing the blade using the dress board held by the dressing table; and cutting, using the
25 dressed blade, the object to be cut held by the cutting table to manufacture the cut product.

Advantageous Effects of Invention

[0008] According to the present invention, it is possible to provide a cutting apparatus configured to cut objects to be cut including a sealed substrate and also capable of automatically replacing a dress board, as well as a method for manufacturing a cut product.

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Brief Description of Drawings

[0009] FIG. 1 is a plan view schematically showing a cutting apparatus.

FIG. 2 is a diagram schematically showing a hardware configuration of a computer.

10 FIG. 3 is a perspective view schematically showing a storage mechanism and the periphery thereof.

FIG. 4 is a diagram schematically showing a transport mechanism as viewed obliquely from below.

15 FIG. 5 is a diagram schematically showing the transport mechanism as viewed obliquely from above.

FIG. 6 is a diagram for describing a relationship between a substrate transport unit, an attachment loader, and a suction source.

FIG. 7 is a schematic side view of a portion of the transport mechanism.

20 FIG. 8 is a diagram schematically showing a cutting table and a dressing table as viewed obliquely from above.

FIG. 9 is a diagram schematically showing a plan view of a dress board arrangement member.

FIG. 10 is a diagram schematically showing a cross section taken along line X-X in FIG. 9.

25 FIG. 11 is a flowchart showing a procedure of automatic dress board replacement processing.

FIG. 12 is a flowchart showing processing executed in step S110 of FIG. 11.

FIG. 13 is a diagram showing a positional relationship between the transport mechanism and the dressing table when a dress board held on the dressing table is to be collected.

FIG. 14 is a flowchart showing processing executed in step S120 of FIG. 11.

5 FIG. 15 is a diagram showing a positional relationship between the transport mechanism and the dressing table when a new dress board is arranged on the dressing table.

FIG. 16 is a flowchart showing an example in which dress board collection processing and attachment processing are performed in parallel.

10 FIG. 17 is a perspective view schematically showing a new dress holder and a periphery thereof in another embodiment.

Description of Embodiments

[0010] Embodiments according to aspects of the present invention (hereinafter also referred to as “present embodiment”) will be described in detail below with reference to the drawings. In the drawings, identical or corresponding elements are denoted by the same reference numerals, and descriptions of those elements are not repeated. Also, the illustrations in the drawings are schematic illustrations with elements omitted or exaggerated as appropriate to facilitate understanding.

20 [0011] [1. Configuration]

<1-1. Overall configuration of cutting apparatus>

FIG. 1 is a plan view schematically showing a cutting apparatus 1 according to the present embodiment. The cutting apparatus 1 is configured to cut a package substrate (an example of an object to be cut) to divide the package substrate into a plurality of individual electronic components (package components). Examples of package substrates include resin-sealed lead frames or substrates on which semiconductor chips are mounted, as well as resin-sealed capacitors, resistors, and the like. Also, the object

to be cut is a package substrate in the present embodiment, the object to be cut may also be a substrate or a wafer that is not sealed with resin.

[0012] Examples of package substrates include a BGA (Ball Grid Array) package substrate, an LGA (Land Grid Array) package substrate, a CSP (Chip Size Package) package substrate, an LED (Light Emitting Diode) package substrate, and a QFN (Quad Flat No-leaded) package substrate.

[0013] The cutting apparatus 1 is also configured to inspect each of the separated electronic components. In the cutting apparatus 1, images of the electronic components are captured, and the electronic components are inspected based on the captured images.

Inspection data is generated through the inspection, and each electronic component is classified as a “good component” or a “defective component”.

[0014] In this example, a package substrate P1 is the object to be cut, and the cutting apparatus 1 divides the package substrate P1 into a plurality of individual electronic components S1. Hereinafter, regarding the two main surfaces of the package substrate P1, the resin-sealed surface will be referred to as the mold surface, and the surface opposite to the mold surface will be referred to as the ball/lead surface.

[0015] As shown in FIG. 1, the cutting apparatus 1 includes a cutting module A1 and an inspection/storage module B1 as constituent elements. The cutting module A1 is configured to cut the package substrate P1 to produce a plurality of electronic components S1.

[0016] Furthermore, in the cutting module A1, dressing is performed on a blade 6a (described later) for cutting the package substrate P1. Here, dressing the blade 6a means sharpening the blade 6a. The blade 6a is dressed by forming a groove in a dress board D1 (described later) with the blade 6a. In the cutting module A1, replacement of the dress board D1 is performed automatically. Automatic replacement of the dress board D1 will be described in detail later.

[0017] The inspection/storage module B1 is configured to inspect each of the

manufactured electronic components S1, and then store the electronic components S1 in trays. Various constituent elements of the cutting apparatus 1 can be removed from the other constituent elements and replaced.

[0018] The cutting module A1 mainly includes a substrate supply unit 3, a positioning unit 4, cutting tables 5, spindle units 6, and a transport unit 7.

[0019] A magazine M1 stores a plurality of package substrates P1, and the substrate supply unit 3 supplies the package substrates P1 one by one to the positioning unit 4 by pushing out the package substrates P1 one by one from the magazine M1. At this time, the package substrates P1 are each arranged such that the ball/lead surface faces upward.

[0020] The positioning unit 4 includes rail portions 4a, a transport mechanism 4b, and a storage mechanism 43. A package substrate P1 pushed out from the substrate supply unit 3 is placed on the rail portions 4a, and the package substrate P1 is positioned on the rail portions 4a. The transport mechanism 4b then transports the positioned package substrate P1 to the tables 5. The storage mechanism 43 stores a plurality of dress boards D1 (FIG. 3) in a stacked manner. The transport mechanism 4b transports dress boards D1 stored in the storage mechanism 43 to the tables 5 as necessary. The transport mechanism 4b and the storage mechanism 43 will be described in detail later.

[0021] Each of the tables 5 holds a package substrate P1 that is to be cut. Here, the illustrated cutting apparatus 1 has a twin cut table configuration including two cutting tables 5. Each of the cutting tables 5 includes a cutting table 5a, a dressing table 5f, a rotating mechanism 5b, and a moving mechanism 5c.

[0022] The cutting table 5a holds the package substrate P1 transported by the transport mechanism 4b by suctioning the package substrate P1 from below. The dressing table 5f holds a dress board D1 (FIG. 3) transported by the transport mechanism 4b by suctioning the dress board D1 from below. Although this will be described in detail later, the dress board D1 held on the dressing table 5f is automatically replaced by the transport mechanism 4b.

[0023] The rotating mechanism 5b is capable of rotating the cutting table 5a and the dressing table 5f in a $\theta 1$ direction shown in the figure (i.e., capable of rotating them in a horizontal plane). The moving mechanism 5c is capable of moving the cutting table 5a and the dressing table 5f along the Y axis shown in the figure. More specifically, the moving mechanism 5c is capable of moving the package substrate P1 between a set position of being held on the cutting table 5a (hereinafter also simply referred to as the “set position”) and a processing position where cutting processing is performed on the package substrate P1 (hereinafter also simply referred to as the “processing position”).

[0024] The spindle unit 6 divides the package substrate P1 into a plurality of electronic components S1 by cutting the package substrate P1. Here, the illustrated cutting apparatus 1 has a twin spindle configuration including two spindle units 6. The spindle units 6 can be moved along the X axis and the Z axis shown in the figure. Note that the cutting apparatus 1 may have a single spindle configuration including only one spindle unit 6.

[0025] Each of the spindle units 6 includes a blade 6a and a rotation shaft 6c. The blade 6a cuts the package substrate P1 by rotating at high speed, and thus divides the package substrate P1 into a plurality of electronic components S1. The blade 6a is attached to the rotation shaft 6c so as to be clamped between first and second flanges (not shown). The first and second flanges are fixed to the rotation shaft 6c by fastening members (not shown) such as nuts. The first flange is also called an inner flange, and the second flange is also called an outer flange. Moreover, dressing of the blade 6a is performed by rotating the blade 6a at high speed and forming a groove in the dress board D1 held on the dressing table 5f. The blade 6a is thus sharpened.

[0026] Each of the spindle units 6 includes a cutting water nozzle, a cooling water nozzle, a waste removal water nozzle, and the like. The cutting water nozzle sprays cutting water toward the blade 6a rotating at high speed. The cooling water nozzle sprays cooling water toward the cut region of the package substrate P1. The waste

removal water nozzle sprays waste removal water for removing cutting waste and the like.

[0027] While the cutting table 5a suctions the package substrate P1, an image of the package substrate P1 is captured by a first position checking camera 5d, and the position of the package substrate P1 is checked. The checking performed using the first position checking camera 5d is, for example, checking of the position of a mark provided on the package substrate P1. The mark indicates a cutting position of the package substrate P1, for example.

[0028] After that, the table 5 moves along the Y axis in the figure toward a corresponding one of the spindle units 6. After the table 5 moves to a position below the spindle unit 6, the package substrate P1 is cut by moving the table 5 and the spindle unit 6 relative to each other. After that, if necessary, an image of the package substrate P1 is captured by a second position checking camera 6b provided in the spindle unit 6, and the position or the like of the package substrate P1 is checked. The checking performed using the second position checking camera 6b is, for example, the checking of a cutting position and a cutting width of the package substrate P1.

[0029] After the cutting of the package substrate P1 is complete, the table 5 moves away from the spindle unit 6 along the Y axis in the figure while suctioning the separated electronic components S1. During this moving process, a first cleaner 5e cleans and dries the upper surfaces (ball/lead surfaces) of the electronic components S1. The first cleaner 5e is provided in a region between the set position and the processing position. The cleaning performed in the first cleaner 5e may be performed by, for example, directly spraying cleaning water (one example of a liquid) onto the upper surfaces of the electronic components S1, or supplying cleaning water to the upper surfaces of the electronic components S1 via a brush or the like.

[0030] Note that although the cutting apparatus 1 includes two first cleaners 5e arranged side by side in the X-axis direction in the figure, the number of first cleaners 5e is not limited to this. In the cutting apparatus 1, the dress board D1 held on the dressing

table 5f may be cleaned by the first cleaner 5e. In this case, for example, cleaning of the dress board D1 may be performed by directly spraying cleaning water onto the upper surface of the dress board D1. Also, two fluids including a liquid and a gas may be directly sprayed onto the upper surface of the dress board D1. As a result, even if processing debris produced during the cutting of the package substrate P1 adheres to the dress board D1, for example, the dress board D1 can be cleaned, and dressing of the blade 6a can be performed using the cleaned dress board D1.

[0031] The transport unit 7 suctions the electronic components S1 held on the cutting table 5a from above, and transports the electronic components S1 to the inspection table 11 of the inspection/storage module B1. During this transportation process, a second cleaner 7a cleans and dries the lower surfaces (mold surfaces) of the electronic components S1. This cleaning may be performed by, for example, directly spraying cleaning water onto the lower surfaces of the electronic components S1, or supplying cleaning water to the lower surfaces of the electronic components S1 via a brush or the like.

[0032] The inspection/storage module B1 mainly includes the inspection table 11, a first optical inspection camera 12, a second optical inspection camera 13, an arrangement unit 14, and an extraction unit 15. Note that the first optical inspection camera 12 may be provided in the cutting module A1.

[0033] The inspection table 11 holds the electronic components S1 for optical inspection of the electronic components S1. The inspection table 11 can be moved along the X axis in the figure. Furthermore, the inspection table 11 can be vertically inverted. The inspection table 11 includes a holding member that holds an electronic component S1 by suctioning the electronic component S1.

[0034] The first optical inspection camera 12 and the second optical inspection camera 13 capture images of the two surfaces (ball/lead surface and mold surface) of the electronic component S1. Based on the captured images (image data) generated by the

first optical inspection camera 12 and the second optical inspection camera 13, various aspects of the electronic component S1 are inspected. The first optical inspection camera 12 and the second optical inspection camera 13 are each arranged in the vicinity of the inspection table 11 so as to capture an image of the upper portion of the image capturing target.

[0035] The first optical inspection camera 12 captures an image of the mold surface of the electronic component S1 that has been transported to the inspection table 11 by the transport unit 7. After that, the transport unit 7 places the electronic component S1 on the holding member of the inspection table 11. After the holding member suctions the electronic component S1, the inspection table 11 is vertically inverted. The inspection table 11 moves to a position above the second optical inspection camera 13, and an image of the ball/lead surface of the electronic component S1 is captured by the second optical inspection camera 13.

[0036] The inspected electronic components S1 are then disposed on the arrangement unit 14. The arrangement unit 14 can be moved along the Y axis in the figure. The inspection table 11 disposes the inspected electronic components S1 on the arrangement unit 14.

[0037] The electronic components S1 that were disposed on the arrangement unit 14 are transferred to a tray by the extraction unit 15. The electronic components S1 are classified as a “good component” or a “defective component” based on the results of the inspections performed using the first optical inspection camera 12 and the second optical inspection camera 13. The extraction unit 15 transfers each of the electronic components S1 to a good component tray 15a or a defective component tray 15b based on the classification results. In other words, good components are stored in the good component tray 15a, and defective components are stored in the defective component tray 15b. When the good component tray 15a or the defective component tray 15b is completely full with electronic components S1, it is replaced with a new tray.

[0038] The cutting apparatus 1 further includes a computer 50 and a monitor 20. The monitor 20 is configured to display images. The monitor 20 is constituted by a display device such as a liquid crystal monitor or an organic EL (Electro Luminescence) monitor.

5 [0039] The computer 50 controls the operations of various units of the cutting module A1 and the inspection/storage module B1, for example. For example, the computer 50 controls the operations of the substrate supply unit 3, the positioning unit 4, the tables 5, the spindle units 6, the transport unit 7, the inspection table 11, the first optical inspection camera 12, the second optical inspection camera 13, the arrangement unit 14, the
10 extraction unit 15, and the monitor 20.

[0040] <1-2. Hardware configuration of computer>

FIG. 2 is a diagram schematically showing the hardware configuration of the computer 50. As shown in FIG. 2, the computer 50 includes a control unit 70, an input/output I/F (interface) 90, an acceptance unit 95, and a storage unit 80, and these
15 elements are electrically connected to each other via a bus.

[0041] The control unit 70 includes a CPU (Central Processing Unit) 72, a RAM (Random Access Memory) 74, a ROM (Read Only Memory) 76, and the like. The control unit 70 is configured to control constituent elements of the computer 50 and constituent elements of the cutting apparatus 1 according to information processing.

20 [0042] The input/output I/F 90 is configured to communicate with various constituent elements included in the cutting apparatus 1 via signal lines. The input/output I/F 90 is used in the transmission of data from the computer 50 to various constituent elements of the cutting apparatus 1 and in the reception of data transmitted from various constituent elements of the cutting apparatus 1 to the computer 50. The acceptance unit 95 is
25 configured to accept instructions from the user (worker). The acceptance unit 95 includes one or more of the following: a touch panel, a keyboard, a mouse, and a microphone, for example.

[0043] The storage unit 80 is an auxiliary storage device such as a hard disk drive or a solid state drive, for example. The storage unit 80 is configured to store a control program 81, for example. Various operations in the cutting apparatus 1 are realized by execution of the control program 81 by the control unit 70. When the control unit 70 is to execute the control program 81, the control program 81 is loaded to the RAM 74. The control unit 70 then controls various constituent elements by using the CPU 72 to interpret and execute the control program 81 loaded to the RAM 74.

[0044] <1-3. Detailed configuration of mechanisms related to automatic dress board replacement>

As described above, the cutting apparatus 1 includes the dressing table 5f configured to hold a dress board D1, and the dress board D1 held by the dressing table 5f is replaced automatically. The reason for this will be described below.

[0045] For example, in the case where the dressing table 5f is not provided, it is conceivable to place a dress board D1 on the cutting table 5a and dress the blade 6a. It is also possible to place the dress board D1 manually. In such a case, a worker needs to temporarily stop the cutting apparatus 1 and manually place the dress board D1 on the cutting table 5a. Since this operation takes a certain amount of time, dressing the dress board D1 in this way is time-consuming.

[0046] In the cutting apparatus 1 according to the present embodiment, the dressing table 5f for holding the dress board D1 is provided separately from the cutting table 5a, and replacement of the dress board D1 held on the dressing table 5f is performed automatically by the transport mechanism 4b. Therefore, according to the cutting apparatus 1, in general, the dress board D1 is held on the dressing table 5f, and even when replacement of the dress board D1 becomes necessary, replacement of the dress board D1 is performed automatically, thus shortening the time required for dressing the dress board D1. Hereinafter, mechanisms related to automatic replacement of the dress board D1 will be described in detail.

[0047] (1-3-1. Structure of storage mechanism)

FIG. 3 is a perspective view schematically showing the storage mechanism 43 and the periphery thereof. As shown in FIG. 3, the storage mechanism 43 is provided at a position adjacent to the rail portions 4a. The storage mechanism 43 includes a new
5 dress holder 43a and a used dress box 43b.

[0048] The new dress holder 43a is configured to store a plurality of new dress boards D1 in a stacked manner. The new dress holder 43a is attached to a base portion 436, and includes a movable block 432 and a fixed block 433. The base portion 436 is a plate-like member supported by leg portions.

10 [0049] The fixed block 433 is fixed on the base portion 436. Each of the two ends of the fixed block 433 in the Y-axis direction is provided with a protrusion portion 437 that protrude towards the movable block 432 in the X-axis direction. The distance between the two protrusion portions 437 is approximately the same as the length of one corresponding side of the dress board D1. The position of the dress board D1 in the Y-
15 axis direction is determined with high precision by the two protrusion portions 437.

[0050] The movable block 432 has a range of motion in the X-axis direction on the base portion 436. The movable block 432 can be fixed at a desired position within the range of motion. By setting the position of the movable block 432, the position of the dress board D1 in the X-axis direction can be determined with high precision.

20 [0051] A sensor 434 is attached to the lower surface of the base portion 436. The sensor 434 is a reflective-type sensor, for example. The dress board D1 housed at the bottom among the dress boards D1 housed in the new dress holder 43a is exposed to the sensor 434. The sensor 434 detects whether or not any dress boards D1 remain in the new dress holder 43a by, for example, emitting light toward the new dress holder 43a and
25 detecting the presence or absence of reflected light. For example, the cutting apparatus 1 may emit a warning sound when the new dress holder 43a becomes empty.

[0052] The used dress box 43b is configured to store a plurality of used dress boards

D1 in a stacked manner. For example, when the number of dress boards D1 stored in the used dress box 43b reaches a predetermined number, the used dress box 43b is replaced with an empty box. The used dress box 43b is a box-shaped member with an open top. The used dress box 43b is placed on the base portion 436.

5 [0053] The used dress box 43b includes a bottom portion 430 and side wall portions 431a, 431b, 431c, and 431d. A plurality of used dress boards D1 are stored in the space surrounded by the side wall portions 431a, 431b, 431c, and 431d. The side wall portions 431a and 431c face each other, and the side wall portions 431b and 431d face each other. A cutout portion C1 is formed at the upper end of each of the side wall portions 431b and
10 431d. The reason why the cutout portion C1 is formed at the upper ends of the side wall portions 431b and 431d will be described later.

[0054] A sensor 435 is attached to the lower surface of the base portion 436. The sensor 435 is a reflective-type sensor, for example. At least a portion of the lower surface of the used dress box 43b is exposed to the sensor 435. The sensor 435 detects
15 whether the used dress box 43b is present at a predetermined position by, for example, emitting light toward the used dress box 43b and detecting the presence or absence of reflected light. For example, the cutting apparatus 1 may emit a warning sound if the used dress box 43b is not present at a predetermined position.

[0055] (1-3-2. Configuration of transport mechanism)

20 FIG. 4 is a diagram schematically showing the transport mechanism 4b as viewed obliquely from below. FIG. 5 is a diagram schematically showing the transport mechanism 4b as viewed obliquely from above. As shown in FIGS. 4 and 5, the transport mechanism 4b includes a substrate transport unit 42 and a dress board transport unit 41. Note that in FIGS. 4 and 5, for ease of understanding, an attachment loader 41a
25 and a collection loader 41b are each shown holding a dress board D1, and in particular, the dress board D1 held by the collection loader 41b is shown in a see-through manner.

[0056] The substrate transport unit 42 is configured to suction the package substrate

P1 positioned on the rail portions 4a (FIG. 1) and transport the suctioned package substrate P1 to the cutting table 5a. The substrate transport unit 42 is connected to a suction source 65 (FIG. 6), such as a vacuum ejector, via a connection member 66. The suction source 65 will be described later.

5 [0057] The dress board transport unit 41 includes an attachment loader 41a and a collection loader 41b. The attachment loader 41a and the collection loader 41b are adjacent to each other in the X-axis direction (see FIG. 1). The dress board transport unit 41 is integrated with the substrate transport unit 42 and configured to move together with the substrate transport unit 42 in the X direction.

10 [0058] The attachment loader 41a is configured to suction the uppermost dress board D1 among the dress boards D1 stored in the new dress holder 43a (FIG. 3) and transport the suctioned dress board D1 from the new dress holder 43a to the dressing table 5f. The attachment loader 41a is connected to the suction source 65 (e.g., vacuum ejector) via the connection member 66.

15 [0059] FIG. 6 is a diagram for describing the relationship between the substrate transport unit 42, the attachment loader 41a, and the suction source 65. As shown in FIG. 6, the substrate transport unit 42 and the attachment loader 41a are both connected to the same suction source 65 via a switching valve V1. The switching valve V1 is switched by a state of connecting the substrate transport unit 42 to the suction source 65 and a state of connecting the attachment loader 41a to the suction source 65, under control
20 of the control unit 70 (FIG. 2), for example. According to the cutting apparatus 1, the suction source for suctioning the package substrate P1 and the suction source for suctioning the dress board D1 are the same suction source, thus making it possible to suppress an increase in the number of suction sources. As a result, with the cutting
25 apparatus 1, it is possible to prevent an increase in the apparatus size.

[0060] The attachment loader 41a includes an air cylinder 411a and a vacuum pad 44. The air cylinder 411a can extend and retract in the up-down direction, and is

configured to move the vacuum pad 44 in the up-down direction. When the vacuum pad 44 is lowered and brought into contact with the dress board D1, the dress board D1 is suctioned to the vacuum pad 44. As a result, the dress board D1 is held by the attachment loader 41a. Furthermore, by connecting a pressure reducing valve to the air cylinder 411a, the dress boards D1 can be appropriately picked up regardless of the number of dress boards D1 remaining in the new dress holder 43a.

[0061] The collection loader 41b is configured to mechanically retrieve a used dress board D1 held on the dressing table 5f and transport the retrieved dress board D1 from the dressing table 5f to the used dress box 43b. The reason why a new dress board D1 is held by suctioning while a used dress board D1 is held mechanically instead of by suctioning will be described below.

[0062] Many grooves have been formed in the used dress board D1. Depending on the weight of the dress board D1 and/or the size of the grooves, the dress board D1 in which many grooves have been formed may not be held stably by suctioning. In other words, the used dress board D1 may be held unstably.

[0063] In the cutting apparatus 1, a new (unused) dress board D1 is suctioned and held by the attachment loader 41a, and a used dress board D1 is mechanically held by the collection loader 41b. Therefore, according to the cutting apparatus 1, the new dress board D1 is held by suction, thus making it possible to suppress a decrease in the positional accuracy of the new dress board D1. Furthermore, according to the cutting apparatus 1, the used dress board D1 is mechanically held, and thus the used dress board D1 can be held stably.

[0064] FIG. 7 is a schematic side view of a portion of the transport mechanism 4b. As shown in FIG. 7, the collection loader 41b includes an air cylinder 411b and claw portions 49a and 49b. The air cylinder 411b can extend and retract in the up-down direction, and is configured to move the claw portions 49a and 49b in the up-down direction.

[0065] The claw portions 49a and 49b face each other in the horizontal direction (X-axis direction). The claw portions 49a and 49b are configured to move in directions moving toward each other and in directions moving away from each other. In other words, a pair of claw portions constituted by the claw portions 49a and 49b (hereinafter also simply referred to as a “pair of claw portions”) are configured to open and close in the horizontal direction. The collection loader 41b mechanically holds the dress board D1 by clamping the dress board D1 with the pair of claw portions.

[0066] The claw portion 49a includes a claw 45a, a linear bushing 47a, an air chuck 46a, and a spring 48a. The claw 45a is a plate-shaped member that has a width in the Y-axis direction and extends in the Z-axis direction. The lower end of the claw 45a is bent toward the claw 45b. The claw 45a is attached to the linear bushing 47a. A shaft extending in the X-axis direction passes through the linear bushing 47a, and the linear bushing 47a is configured to move on the shaft. The spring 48a is provided on the shaft that passes through the linear bushing 47a, on the side of the linear bushing 47a opposite to the side where the claw 45a is provided. The air chuck 46a is configured to move in the X-axis direction. The linear bushing 47a is attached to the air chuck 46a.

[0067] The claw portion 49b includes a claw 45b, a linear bushing 47b, an air chuck 46b, and a spring 48b. The claw 45b is a plate-shaped member that has a width in the Y-axis direction and extends in the Z-axis direction. The lower end of the claw 45b is bent toward the claw 45a. The claw 45b is attached to the linear bushing 47b. A shaft extending in the X-axis direction passes through the linear bushing 47b, and the linear bushing 47b is configured to move on the shaft. The spring 48b is provided on the shaft that passes through the linear bushing 47b, on the side of the linear bushing 47b opposite to the side where the claw 45b is provided. The air chuck 46b is configured to move in the X-axis direction. The linear bushing 47b is attached to the air chuck 46b.

[0068] When the air chucks 46a and 46b move toward each other, the linear bushing 47a with the claw 45a attached thereto and the linear bushing 47b with the claw 45b

attached thereto move toward each other. Finally, while the springs 48a and 48b are in a compressed state, the used dress board D1 is held by the claws 45a and 45b. While the springs 48a, 48b are in the compressed state, force acts in the direction in which the springs 48a and 48b expand, and thus the dress board D1 is held with an appropriate force (i.e., is soft clamped).

[0069] (1-3-3. Configuration of dressing table)

FIG. 8 is a diagram schematically showing the cutting table 5a and the dressing table 5f as viewed obliquely from above. As shown in FIG. 8, the dressing table 5f is provided at a position adjacent to the cutting table 5a and is fixed to the cutting table 5a.

The dressing table 5f includes a base portion 63 and a dress board arrangement member 60 fixed onto the base portion 63. The dress board arrangement member 60 is made of an elastic material such as rubber, and is replaceable. The dress board D1 is placed on the dress board arrangement member 60. The dress board D1 is held on the dress board arrangement member 60 by suction.

[0070] FIG. 9 is a schematic plan view of the dress board arrangement member 60. FIG. 10 is a diagram schematically showing a cross section taken along line X-X in FIG. 9. As shown in FIGS. 9 and 10, the dress board arrangement member 60 has a bottom portion 61. A plurality of holes H2 are formed in the bottom portion 61. The dress board D1 is suctioned through the holes H2. A cutout portion C2 is formed in each of a pair of opposing sides of the bottom portion 61. The reason why the cutout portions C2 are formed will be described later.

[0071] A protrusion portion 62 extending upward is formed on the outer periphery of the bottom portion 61 except for the portions where the cutout portions C2 are formed. The dress board D1 is disposed within the region surrounded by the protrusion portion 62. Note that the shape and size of the dress board D1 in a plan view are substantially the same as the shape and size of the region surrounded by the protrusion portion 62 in a plan view.

[0072] [2. Operation]

FIG. 11 is a flowchart showing a procedure of processing for automatic replacement of the dress board D1. The processing shown in this flowchart is executed by the control unit 70 of the computer 50 (FIG. 2) when attachment or replacement of the dress board D1 is required.

[0073] As shown in FIG. 11, the control unit 70 determines whether or not a used dress board D1 is present on the dressing table 5f by, for example, referring to the output of a sensor (not shown) that detects the suction state on the dressing table 5f (step S100). If it is determined that a used dress board D1 is not present on the dressing table 5f (NO in step S100), the control unit 70 executes the processing of step S120.

[0074] On the other hand, if it is determined that a used dress board D1 is present on the dressing table 5f (YES in step S100), the control unit 70 executes collection processing for collecting the used dress board D1 (step S110). Collection processing for collecting the dress board D1 will be described in detail later. When collection processing for collecting the used dress board D1 is complete, the control unit 70 executes attachment processing for attaching a new dress board D1 (step S120). Attachment processing for attaching a dress board D1 will be described in detail later.

[0075] FIG. 12 is a flowchart showing processing executed in step S110 (collection processing for collecting a dress board D1) in FIG. 11. As shown in FIG. 12, the control unit 70 controls a drive unit (e.g., a motor) of the transport mechanism 4b such that the collection loader 41b is moved to a position above the dressing table 5f (step S200). Thereafter, the control unit 70 controls a drive unit of the pair of claw portions of the collection loader 41b such that the pair of claw portions descend and pick up the used dress board D1 held on the dressing table 5f (step S210).

[0076] Referring again to FIG. 9, the pair of claw portions of the collection loader 41b descend in an open state, and then the pair of claw portions close, thus allowing the pair of claw portions to enter the cutout portions C2 of the dress board arrangement

member 60 included in the dressing table 5f. After entering the cutout portions C2, the pair of claw portions ascend, thereby picking up the dress board D1.

[0077] FIG. 13 is a diagram showing the positional relationship between the transport mechanism 4b and the table 5 when a dress board D1 held on the dressing table 5f is to be collected. As shown in FIG. 13, when the dress board D1 held on the dressing table 5f is to be collected, the collection loader 41b is located above the dressing table 5f. On the other hand, the substrate transport unit 42 and the cutting table 5a do not overlap each other in a plan view. The reason why the dress board D1 is collected in this positional relationship will be described below.

[0078] In the cutting apparatus 1, the substrate transport unit 42 includes pins PI1 that extend downward, and the cutting table 5a includes holes H1 into which the pins PI1 enter. In the cutting apparatus 1, in order to ensure positional accuracy of the package substrate P1, the pins PI1 of the substrate transport unit 42 are inserted into the holes H1 of the cutting table 5a before the package substrate P1 is placed on the cutting table 5a by the substrate transport unit 42. If the dress board D1 were collected by the collection loader 41b while the substrate transport unit 42 and the cutting table 5a overlap each other in a plan view, the pins PI1 of the substrate transport unit 42 would get in the way. According to the cutting apparatus 1, the dress board D1 is collected by the collection loader 41b in a state in which the substrate transport unit 42 and the cutting table 5a do not overlap each other in a plan view, and thus collection of the dress board D1 can be performed appropriately.

[0079] Referring again to FIG. 12, when picking up of the dress board D1 in step S210 is complete, the control unit 70 controls a drive unit of the transport mechanism 4b such that the collection loader 41b is moved to a position above the used dress box 43b (step S220). Thereafter, the control unit 70 controls the drive unit of the pair of claw portions of the collection loader 41b such that the pair of claw portions descend, enter the cutout portions C1 (FIG. 3) formed in the used dress box 43b, and then open (step S230).

As a result, the used dress board D1 is stored in the used dress box 43b. The pair of claw portions open while the claw portions are inside the cutout portions C1 (FIG. 3) formed in the used dress box 43b, thereby reducing the possibility that the used dress board D1 will not fall into the used dress box 43b.

5 [0080] FIG. 14 is a flowchart showing processing executed in step S120 (attachment processing for attaching the dress board D1) in FIG. 11. As shown in FIG. 14, the control unit 70 controls the drive unit of the transport mechanism 4b such that the attachment loader 41a is moved to a position above the new dress holder 43a (step S300). The control unit 70 controls the drive unit of the attachment loader 41a such that the
10 vacuum pad 44 of the attachment loader 41a descends, suctions, and holds a new dress board D1 stored in the new dress holder 43a (step S310).

[0081] The control unit 70 controls the drive unit of the transport mechanism 4b such that the attachment loader 41a is moved to a position above the dressing table 5f (step S320). Thereafter, the control unit 70 controls the drive unit of the attachment loader
15 41a such that the vacuum pad 44 descends and places the dress board D1 on the dressing table 5f (step S330).

[0082] FIG. 15 is a diagram showing the positional relationship between the transport mechanism 4b and the table 5 when a new dress board D1 is to be placed on the dressing table 5f. As shown in FIG. 15, when a new dress board D1 is to be placed on the dressing
20 table 5f, the attachment loader 41a is located above the dressing table 5f. On the other hand, the substrate transport unit 42 and the cutting table 5a do not overlap each other in a plan view. According to the cutting apparatus 1, the dress board D1 is placed by the attachment loader 41a in a state in which the substrate transport unit 42 and the cutting table 5a do not overlap in a plan view, and thus the dress board D1 can be appropriately
25 placed on the dressing table 5f without being affected by the pins PI1.

[0083] [3. Features]

As described above, in the cutting apparatus 1 according to the present

embodiment, the dress board transport unit 41 is included in the transport mechanism 4b. The dress board transport unit 41 automatically transports a dress board D1 between the storage mechanism 43 and the dressing table 5f. Therefore, according to the cutting apparatus 1, a dress board D1 is automatically transported between the storage mechanism 43 and the dressing table 5f, and therefore a dress board D1 attached to the dressing table 5f can be automatically replaced. As a result, the cutting apparatus 1 can reduce the time required to replace the dress board D1.

[0084] Note that the cutting apparatus 1 is an example of a “cutting apparatus” of the present invention. The cutting table 5a is an example of a “cutting table” of the present invention. The spindle unit 6 is an example of a “cutting mechanism” of the present invention. The dressing table 5f is an example of a “dressing table” of the present invention. The storage mechanism 43 is an example of a “storage mechanism” of the present invention. The transport mechanism 4b is an example of a “transport mechanism” of the present invention. The substrate transport unit 42 is an example of a “substrate transport unit” of the present invention. The dress board transport unit 41 is an example of a “dress board transport unit” of the present invention.

[0085] The attachment loader 41a is an example of an “attachment loader” of the present invention. The collection loader 41b is an example of a “collection loader” according to the present invention. The suction source 65 is an example of a “suction source” of the present invention. Each of the claw portions 49a and 49b is an example of a “claw portion” according to the present invention. The new dress holder 43a is an example of a “first storage portion” of the present invention. The used dress box 43b is an example of a “second storage portion” of the present invention. The moving mechanism 5c is an example of a “moving mechanism” of the present invention. The first cleaner 5e is an example of a “cleaning unit” of the present invention.

[0086] [4. Other embodiments]

The idea of the above embodiment is not limited to the embodiment described above.

Examples of other embodiments to which the idea of the above embodiment can be applied will be described below.

[0087] <4-1>

In the above embodiment, in automatic replacement of the dress board D1, attachment processing for attaching a new dress board D1 is executed after collection processing for collecting a used dress board D1 is complete. However, these processing procedures are not limited to this. For example, these processing procedures may be executed in parallel.

[0088] FIG. 16 is a flowchart showing an example in which collection processing and attachment processing for collecting and attaching dress boards D1 are performed in parallel. The processing shown in this flowchart may be executed by the control unit 70, for example.

[0089] As shown in FIG. 16, the control unit 70 controls the drive unit of the transport mechanism 4b such that the attachment loader 41a is moved to a position above the new dress holder 43a (step S400). The control unit 70 controls the drive unit of the attachment loader 41a such that the vacuum pad 44 of the attachment loader 41a descends, suctions, and holds a new dress board D1 stored in the new dress holder 43a (step S405).

[0090] The control unit 70 determines whether or not a used dress board D1 is present on the dressing table 5f by, for example, referring to the output of a sensor (not shown) that detects the suction state on the dressing table 5f (step S410). If it is determined that a used dress board D1 is not present on the dressing table 5f (NO in step S410), the control unit 70 executes the processing of step S425.

[0091] On the other hand, if it is determined that a used dress board D1 is present on the dressing table 5f (YES in step S410), the control unit 70 controls the drive unit of the transport mechanism 4b such that the collection loader 41b is moved to a position above the dressing table 5f (step S415). Thereafter, the control unit 70 controls the drive unit of the pair of claw portions of the collection loader 41b such that the pair of claw portions

descend and pick up the used dress board D1 held on the dressing table 5f (step S420).

[0092] The control unit 70 controls the drive unit of the transport mechanism 4b such that the attachment loader 41a is moved to a position above the dressing table 5f (step S425). Thereafter, the control unit 70 controls the drive unit of the attachment loader 41a such that the vacuum pad 44 descends and places the dress board D1 on the dressing table 5f (step S430). Thereafter, the control unit 70 controls the drive unit of the transport mechanism 4b such that the collection loader 41b is moved to a position above the used dress box 43b (step S435).

[0093] The control unit 70 determines whether or not the collection loader 41b is holding a used dress board D1 by, for example, referring to the output of a sensor (not shown) provided in the collection loader 41b (step S440). If it is determined that the collection loader 41b is not holding a used dress board D1 (NO in step S440), the processing shown in this flowchart ends. On the other hand, if it is determined that the collection loader 41b is holding a used dress board D1 (YES in step S440), the control unit 70 controls the drive unit of the pair of claw portions of the collection loader 41b such that the pair of claw portions descend, enter the cutout portions C1 (FIG. 3) formed in the used dress box 43b, and then open (step S445). As a result, the used dress board D1 is stored in the used dress box 43b.

[0094] In this way, if the collection processing for collecting a used dress board D1 and the attachment processing for attaching a new dress board D1 are performed in parallel, the time required for replacing the dress board D1 can be further shortened.

[0095] <4-2>

In the above embodiment, the collection loader 41b mechanically holds the used dress board D1. However, the collection loader 41b is not necessarily required to mechanically hold the dress board D1. For example, if the grooves formed in the dress board D1 are shallow or if the dress board D1 is lightweight, the collection loader 41b may hold the dress board D1 by suction.

[0096] <4-3>

In the above embodiment, the substrate transport unit 42 and the attachment loader 41a are connected to the same suction source 65. However, the substrate transport unit 42 and the attachment loader 41a do not necessarily need to be connected to the same suction source 65. The suction source connected to the substrate transport unit 42 and the suction source connected to the attachment loader 41a may be different suction sources.

[0097] <4-4>

Furthermore, the structure of the new dress holder is not limited to the structure of the new dress holder 43a in the above embodiment. For example, the new dress holder may have a structure such as that described below.

[0098] FIG. 17 is a schematic perspective view of a new dress holder 43aA and the periphery thereof in another embodiment. As shown in FIG. 17, the new dress holder 43aA is configured to store a plurality of dress boards D1 in a stacked manner. Note that in the example shown in FIG. 17, two dress boards D1 less than the maximum capacity (one example) are stored in the new dress holder 43aA.

[0099] The new dress holder 43aA is attached to the base portion 436 and includes a movable block 432A and the fixed block 433. The movable block 432A has a range of motion in the X-axis direction on the base portion 436. The movable block 432A can be fixed at a desired position within the range of motion.

[0100] The movable block 432A has a through hole H4 that extends through the movable block 432A in the thickness direction (X-axis direction). When the maximum number of dress boards D1 are stored in the new dress holder 43aA, the center of the through hole H4 is located at the boundary between the uppermost dress board D1 and the second uppermost dress board D1. A pipe 438 is connected to the through hole H4, and compressed air is sent through the pipe 438 to the through hole H4.

[0101] For example, when the attachment loader 41a suctions and holds a dress board

D1 stored in the new dress holder 43a, the discharge of compressed air from the through hole H4 is started. Then, when the dress board D1 ascends to the position of the through hole H4 while being suctioned and held by the attachment loader 41a, the discharge of compressed air from the through hole H4 is stopped. Thereafter, the transport of the dress board D1 continues.

[0102] The reason why the above operation is performed will be described below. For example, a wet dress board D1 may be unintentionally stored in the new dress holder 43aA. In such a case, dress boards D1 may stick to each other, and a plurality of dress boards D1 may be lifted up when the attachment loader 41a suctions and holds a dress board D1. By ejecting compressed air from the through hole H4 toward the boundary between dress boards D1 as described above, any lifted dress boards D1 other than the dress board D1 suctioned and held by the vacuum pad 44 can be caused to fall back into the new dress holder 43aA. In other words, according to this configuration, it is possible to prevent a situation in which a plurality of new dress boards D1 are unintentionally transported.

[0103] The embodiments of the present invention described above are illustrative. In other words, the detailed description and accompanying drawings have been disclosed for the purpose of illustration. Therefore, some of the components described in the detailed description and the attached drawings may not be essential for solving the problem. Accordingly, simply because non-essential components are described in the detailed description and accompanying drawings, such non-essential components are not intended to be immediately identified as essential.

[0104] Furthermore, the above embodiments are merely illustrative of the present invention in all respects. Various improvements and changes can be made to the above embodiments within the scope of the present invention. In other words, when implementing the present invention, specific configurations can be adopted as appropriate depending on the embodiment.

[0105] [5. Supplementary notes]

Various technical ideas including at least the following technology are disclosed in the present specification.

[0106] <Technology 1>

5 (Configuration)

A cutting apparatus including:

a cutting table configured to hold an object to be cut;

a cutting mechanism configured to cut, using a blade, the object to be cut held by the cutting table;

10 a dressing table configured to hold a dress board for dressing the blade;

a storage mechanism configured to store a plurality of dress boards in a stacked manner; and

a transport mechanism including a substrate transport unit and a dress board transport unit configured to move together with the substrate transport unit,

15 the substrate transport unit being further configured to suction the object to be cut and transport the suctioned object to be cut to the cutting table, and

the dress board transport unit being configured to transport the dress board between the storage mechanism and the dressing table.

[0107] (Effects etc.)

20 In this cutting apparatus, the dress board transport unit is included in the transport mechanism. The dress board transport unit automatically transports the dress board between the storage mechanism and the dressing table. Therefore, according to this cutting apparatus, the dress board is automatically transported between the storage mechanism and the dressing table, and therefore the dress board attached to the dressing
25 table can be automatically replaced.

[0108] <Technology 2>

(Configuration)

The cutting apparatus according to technology 1,

wherein the dress board transport unit includes:

an attachment loader configured to suction an unused dress board stored in the storage mechanism and transport the suctioned dress board from the storage
5 mechanism to the dressing table; and

a collection loader configured to mechanically hold a used dress board and transport the mechanically held dress board from the dressing table to the storage mechanism.

[0109] (Effects etc.)

10 In this cutting apparatus, the unused dress board is suctioned and held by the attachment loader, and the used dress board is mechanically held by the collection loader. Therefore, according to this cutting apparatus, the unused dress board is held by suction, thus making it possible to suppress a decrease in the positional accuracy of the unused dress board. Furthermore, since a large number of grooves are formed in the surface of
15 the used dress board, the suctioning and holding of the used dress board may become unstable. According to this cutting apparatus, the used dress board is held mechanically, and therefore the used dress board can be held stably.

[0110] <Technology 3>

(Configuration)

20 The cutting apparatus according to technology 2, wherein a suction source used for suctioning of the object to be cut by the substrate transport unit and a suction source used for suctioning of the dress board by the attachment loader are the same suction source.

[0111] (Effects etc.)

25 According to this cutting apparatus, the suction source for suctioning the object to be cut and the suction source for suctioning the dress board are the same suction source, thus making it possible to suppress an increase in the number of suction sources. As a

result, according to this cutting apparatus, it is possible to prevent an increase in the apparatus size.

[0112] <Technology 4>

(Configuration)

5 The cutting apparatus according to technology 2 or 3,
wherein the collection loader includes a pair of claw portions that oppose each other in a horizontal direction,

the pair of claw portions are configured to open and close in the horizontal direction, and

10 the collection loader mechanically holds the dress board by clamping the dress board with the pair of claw portions.

[0113] (Effects etc.)

According to this cutting apparatus, the used dress board is mechanically held by being clamped between the pair of claw portions, and therefore the used dress board
15 can be held stably.

[0114] <Technology 5>

(Configuration)

The cutting apparatus according to technology 4,
wherein the storage mechanism includes:

20 a first storage portion configured to store the unused dress board; and
a second storage portion configured to store the used dress board,
a shape of the first storage portion is different from a shape of the second storage portion,

the second storage portion includes a plurality of side wall portions,

25 the used dress board is stored in a space surrounded by the plurality of side wall portions, and

a cutout is formed in an upper end of each of two opposing side wall portions

among the plurality of side wall portions.

[0115] (Effects etc.)

In this storage mechanism, the first storage portion and the second storage portion have different shapes, and cutouts are formed in the upper ends of two opposing side wall portions among the side wall portions of the second storage portion. With this cutting apparatus, the pair of claw portions of the collection loader can be opened while inserted into the cutouts to allow the used dress board to drop, thereby enabling the used dress board to be securely stored in the second storage portion.

[0116] <Technology 6>

10 (Configuration)

The cutting apparatus according to any one of technology 1 to 5, further including:

a moving mechanism configured to move both the cutting table and the dressing table; and

15 a cleaning unit configured to clean the object to be cut and the dress board, wherein the moving mechanism moves between a set position at which the object to be cut is held by the cutting table and a processing position at which the object to be cut is subjected to cutting, and

20 the cleaning unit is provided in a region between the set position and the processing position.

[0117] (Effects etc.)

In this cutting apparatus, the cleaning unit is provided in the region between the set position and the processing position. Therefore, according to this cutting apparatus, the dress board held by the dressing table can be cleaned by the cleaning unit. As a result, with this cutting apparatus, even if machining waste generated during cutting of the object to be cut adheres to the dress board, the dress board can be cleaned, and the cleaned dress board can be used to perform blade dressing.

[0118] <Technology 7>

(Configuration)

The cutting apparatus according to technology 6, wherein the cleaning unit cleans the object to be cut and the dress board with at least a liquid.

5 [0119] (Effects etc.)

According to this cutting apparatus, the dress board held by the dressing table can be cleaned with at least with a liquid.

[0120] <Technology 8>

(Configuration)

10 The cutting apparatus according to any one of technology 1 to 7,
wherein the substrate transport unit includes a pin extending downward,
a hole is formed in the cutting table,
the substrate transport unit places the object to be cut on the cutting table while
the pin is inside the hole, and
15 the dress board transport unit transports the dress board to and from the dressing
table in a state in which the substrate transport unit and the cutting table do not overlap
each other in a plan view.

[0121] (Effects etc.)

In this cutting apparatus, in order to ensure positional accuracy of the object to
20 be cut, the object to be cut is placed on the cutting table while the pin of the substrate
transport unit is inside the hole of the cutting table. If the dress board is transported
between the dress board transport unit and the dressing table while the substrate transport
unit and the cutting table overlap each other in a plan view, the pin of the substrate
transport unit may get in the way. According to the above cutting apparatus, the dress
25 board is transported between the dress board transport unit and the dressing table without
the substrate transport unit and the cutting table overlapping each other in a plan view,
and thus the dress board can be transported appropriately.

[0122] <Technology 9>

(Configuration)

A method for manufacturing a cut product using the cutting apparatus according to any one of technology 1 to 8, including:

- 5 suctioning the object to be cut and transporting the suctioned object to be cut to the cutting table;
- transporting the dress board between the storage mechanism and the dressing table;
- dressing the blade using the dress board held by the dressing table; and
- 10 cutting, using the dressed blade, the object to be cut held by the cutting table to manufacture the cut product.

[0123] (Effects etc.)

- In this method for manufacturing a cut product, the dress board is automatically transported between the storage mechanism and the dressing table. Therefore,
- 15 according to this method for manufacturing a cut product, the dress board is automatically transported between the storage mechanism and the dressing table, and therefore the dress board attached to the dressing table can be automatically replaced.

List of Reference Numerals

- 20 [0124] 1: cutting apparatus; 3: substrate supply unit; 4: positioning unit; 4a: rail portion; 4b: transport mechanism; 5: table; 5a: cutting table; 5b: rotating mechanism; 5c: moving mechanism; 5d: first position checking camera; 5e: first cleaner; 5f: dressing table; 6: spindle unit; 6a: blade; 6b: second position checking camera; 6c: rotation shaft; 7: transport unit; 7a: second cleaner; 11: inspection table; 12: first optical inspection
- 25 camera; 13: second optical inspection camera; 14: arrangement unit; 15: extraction unit; 15a: good component tray; 15b: defective component tray; 20: monitor; 41: dress board transport unit; 41a: attachment loader; 41b: collection loader; 42: substrate transport unit;

43: storage mechanism; 43a, 43aA: new dress holder; 43b: used dress box; 44: vacuum
 pad; 45a, 45b: claw; 46a, 46b: air chuck; 47a, 47b: linear bushing; 48a, 48b: spring; 49a,
 49b: claw portion; 50: computer; 60: dress board arrangement member; 61: bottom
 portion; 62: protrusion portion; 63, 436: base portion; 65: suction source; 66: connection
 5 member; 70: control unit; 72: CPU; 74: RAM; 76: ROM; 80: storage unit; 81: control
 program; 90: input/output I/F; 95: acceptance unit; 411a, 411b: air cylinder; 430: bottom
 portion; 431a, 431b, 431c, 431d: side wall portion; 432, 432A: movable block; 433: fixed
 block; 434, 435: sensor; 437: protrusion portion; 438: pipe; A1: cutting module; B1:
 inspection/storage module; C1, C2: cutout portion; D1: dress board; H1, H2, H3: hole;
 10 H4: through hole; P1: package substrate; PI1: pin; S1: electronic component; V1:
 switching valve.

CLAIMS

[Claim 1] A cutting apparatus comprising:

a cutting table configured to hold an object to be cut;

5 a cutting mechanism configured to cut, using a blade, the object to be cut held by the cutting table;

a dressing table configured to hold a dress board for dressing the blade;

a storage mechanism configured to store a plurality of dress boards in a stacked manner; and

10 a transport mechanism including a substrate transport unit and a dress board transport unit configured to move together with the substrate transport unit,

the substrate transport unit being further configured to suction the object to be cut and transport the suctioned object to be cut to the cutting table, and

the dress board transport unit being configured to transport the dress board
15 between the storage mechanism and the dressing table.

[Claim 2] The cutting apparatus according to claim 1,

wherein the dress board transport unit includes:

20 an attachment loader configured to suction an unused dress board stored in the storage mechanism and transport the suctioned dress board from the storage mechanism to the dressing table; and

a collection loader configured to mechanically hold a used dress board and transport the mechanically held dress board from the dressing table to the storage mechanism.

25

[Claim 3] The cutting apparatus according to claim 2,

wherein a suction source used for suctioning of the object to be cut by the

substrate transport unit and a suction source used for suctioning of the dress board by the attachment loader are the same suction source.

[Claim 4] The cutting apparatus according to claim 2 or 3,

5 wherein the collection loader includes a pair of claw portions that oppose each other in a horizontal direction,

 the pair of claw portions are configured to open and close in the horizontal direction, and

 the collection loader mechanically holds the dress board by clamping the dress
10 board with the pair of claw portions.

[Claim 5] The cutting apparatus according to claim 4,

 wherein the storage mechanism includes:

 a first storage portion configured to store the unused dress board; and

15 a second storage portion configured to store the used dress board,

 a shape of the first storage portion is different from a shape of the second storage portion,

 the second storage portion includes a plurality of side wall portions,

 the used dress board is stored in a space surrounded by the plurality of side wall
20 portions, and

 a cutout is formed in an upper end of each of two opposing side wall portions among the plurality of side wall portions.

[Claim 6] The cutting apparatus according to any one of claims 1 to 5, further
25 comprising:

 a moving mechanism configured to move both the cutting table and the dressing table; and

a cleaning unit configured to clean the object to be cut and the dress board,
wherein the moving mechanism moves between a set position at which the object
to be cut is held by the cutting table and a processing position at which the object to be
cut is subjected to cutting, and

5 the cleaning unit is provided in a region between the set position and the
processing position.

[Claim 7] The cutting apparatus according to claim 6,

 wherein the cleaning unit cleans the object to be cut and the dress board with at
10 least a liquid.

[Claim 8] The cutting apparatus according to any one of claims 1 to 7,

 wherein the substrate transport unit includes a pin extending downward,
 a hole is formed in the cutting table,
15 the substrate transport unit places the object to be cut on the cutting table while
the pin is inside the hole, and

 the dress board transport unit transports the dress board to and from the dressing
table in a state in which the substrate transport unit and the cutting table do not overlap
each other in a plan view.

20

[Claim 9] A method for manufacturing a cut product using the cutting apparatus
according to any one of claims 1 to 8, comprising:

 suctioning the object to be cut and transporting the suctioned object to be cut to
the cutting table;

25 transporting the dress board between the storage mechanism and the dressing
table;

 dressing the blade using the dress board held by the dressing table; and

cutting, using the dressed blade, the object to be cut held by the cutting table to manufacture the cut product.