

BLADE REPLACEMENT DEVICE, CUTTING APPARATUS, AND METHOD OF MANUFACTURING CUT PRODUCTS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2022-083496, filed on May 23, 2022, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to a blade replacement device, a cutting apparatus, and a method of manufacturing cut products.

BACKGROUND

[0003] Patent Document 1 discloses a technique for suppressing water, water droplets, mist, or the like from adhering to a blade replacement mechanism. Specifically, Patent Document 1 discloses a waterproof cover that covers a suction unit of the blade replacement mechanism when cutting an object to be cut. The waterproof cover has an opening/closing door, and a blade suction surface of the suction unit is accommodated in the waterproof cover in a state of facing a direction opposite to the opening/closing door. With this configuration, it is possible to suppress a cutting water, water droplets, mist, or the like from adhering to the blade suction surface, and consequently to reduce occurrence of malfunction of the blade replacement mechanism or the like.

[Prior Art Documents]

[Patent Documents]

[0004] Patent Document 1: Japanese Patent Laid-Open Publication No. 2021-65981

SUMMARY

[0005] In the blade replacement mechanism disclosed in Patent Document 1, it is desired to maintain the blade suction surface to be in a clean state from the viewpoint of preventing malfunction of the blade replacement mechanism or the like.

[0006] The present disclosure has been made in view of the circumstances described above, and provides a blade replacement device, a cutting apparatus, and a method of manufacturing cut products, which are capable of maintaining a blade suction surface to be in a clean state.

[0007] A blade replacement device according to the present disclosure includes: a blade replacement mechanism comprising at least a first suctioner configured to suction a blade; a cover main body configured to accommodate the blade replacement mechanism in the cover main body; a closer configured to be movable integrally with the blade replacement mechanism, and further configured to close an opening of the cover main body in a state in which the blade replacement mechanism is accommodated in the cover main body; and a gas spray configured to spray a gas to a blade suction surface of the first suctioner when the blade replacement mechanism is accommodated in the cover main body.

[0008] A cutting apparatus according to the present disclosure includes: the above-described blade replacement device; and a cutting mechanism configured to cut an object to be cut with a blade replaced by the blade replacement device.

[0009] A method of manufacturing cut products according to the present disclosure is a method of manufacturing cut products by using the above-described cutting apparatus, and includes: replacing a blade of the cutting apparatus by the blade replacement device; and cutting the object to be cut by the cutting apparatus to which the blade replaced in the replacing the blade is installed.

BRIEF DESCRIPTION OF DRAWINGS

[0010] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the present disclosure.

[0011] FIG. 1 is a schematic plan view illustrating an overall configuration of a cutting apparatus according to an embodiment.

[0012] FIG. 2 is a perspective view illustrating a blade replacement device.

[0013] FIG. 3 is a perspective view illustrating an operation of a mover.

[0014] FIG. 4 is an enlarged cross-sectional perspective view illustrating a configuration of a spindle.

[0015] FIG. 5 is an enlarged cross-sectional perspective view illustrating a configuration of a holder.

[0016] FIG. 6 is a perspective view illustrating a state in which a moving plate closes an opening of a cover main body.

[0017] FIG. 7A is a perspective view illustrating a shape of a first cleaning sponge, and FIG. 7B is a perspective view illustrating a modification of the first cleaning sponge.

[0018] FIG. 8A is a partial cross-sectional plan view illustrating the cutting apparatus, and FIG. 8B is a perspective view illustrating a state inside the cover main body.

[0019] FIG. 9 is a flow chart illustrating a method of manufacturing cut products.

[0020] FIG. 10A is a schematic view showing a state in which a blade is cleaned with air from an air nozzle, FIG. 10B is a schematic view illustrating a state in which a second flange and a blade are removed from the spindle, and FIG. 10C is a schematic view illustrating a state in which used blades are accommodated.

[0021] FIG. 11A is a schematic view illustrating a state in which the second flange is cleaned with a second cleaning sponge, FIG. 11B is a schematic view illustrating a state in which the holder holds an unused blade, and FIG. 11C is a schematic view illustrating a state in which a first flange is cleaned with air from the air nozzle.

[0022] FIG. 12A is a schematic view illustrating a state in which the first flange is cleaned with the first cleaning sponge, FIG. 12B is a schematic view illustrating a state in which the second flange and the blade are installed to the spindle, and FIG. 12C is a schematic view illustrating in which air is sprayed to a blade suction surface when being accommodated in the cover main body

DETAILED DESCRIPTION

[0023] Reference will now be made in detail to various embodiments, examples of which are illustrated in the accompanying drawings. In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the present disclosure. However, it will be apparent to one of ordinary skill in the art that the present disclosure may be practiced without these specific details. In other instances, well-known methods, procedures, systems, and components have not been described in detail so as not to unnecessarily obscure aspects of the various embodiments.

<Configuration of Cutting Apparatus 1>

[0024] First, a configuration of a cutting apparatus 1 according to the present embodiment will be described. In the present embodiment, a configuration of the cutting apparatus 1 in a case of using, for example, a substrate W, which obtained by resin-molding a substrate on which semiconductor chips are mounted, as an object to be cut by the cutting apparatus 1 will be described.

[0025] As the molded substrate W, for example, a ball grid array (BGA) package substrate, a chip size package (CSP) package substrate, a light emitting diode (LED) package substrate, or the like is used. In addition, as the object to be cut, not only the molded substrate W, but also a molded lead frame obtained by resin-molding a lead frame having semiconductor chips mounted thereon may be used.

[0026] The cutting apparatus 1 illustrated in FIG. 1 is a machining device that cuts and dices the molded substrate W as the object to be cut into a plurality of cut products (products P). The cutting apparatus 1 includes a substrate supply module A, a cutting module B, and a storage module C as components. Each component is detachably attached with respect to other components and can be replaced.

<Substrate Supply Module A>

[0027] The substrate supply module A is mainly provided with a substrate supply mechanism 11 and a controller CTL.

[0028] The molded substrate W, which is the object to be cut, is unloaded from the substrate supply mechanism 11 and transferred to the cutting module B by a transfer mechanism (not illustrated). The controller CTL controls operations of respective components of the cutting apparatus 1. By controlling the respective components of the cutting apparatus 1 by the controller CTL, loading the molded substrate W, cutting the molded substrate W, inspecting the products P, unloading the products P, and the like can be performed. The controller CTL may be provided in a module other than the substrate supply module A. In addition, it is also possible to divide the controller CTL into a plurality of controllers and provide the controllers. For example, it is also possible to provide a controller CTL for each module and control the respective components by linking the controllers CTL.

<Cutting Module B>

[0029] The cutting module B illustrated in FIG. 1 is mainly provided with cutting tables 21, cutting jigs 22, moving mechanisms 23, rotary mechanisms 24, spindles 25, and a blade replacement device 26.

[0030] In the present embodiment, the twin-cut table type cutting apparatus 1 having two cutting tables 21 is exemplified. The cutting jig 22 is provided on each cutting table 21. Each cutting table 21 is movable in a Y direction by the moving mechanism 23 and rotatable in a θ direction by the rotary mechanism 24.

[0031] In the present embodiment, the twin-spindle cutting apparatus 1 having two spindles 25 is exemplified. The two spindles 25 are independently movable in X and Z directions. The spindle 25 is an example of a cutting mechanism according to the present disclosure.

[0032] The blade replacement device 26 is for replacing blades 25a used in the spindles 25. The blade replacement device 26 is disposed behind the spindles 25 (on an upper side in the drawing). The blade replacement device 26 mainly includes a blade replacement mechanism 100, a cover 200, a cleaning mechanism 300, a blade replacement stage 400, an air nozzle 500, and cameras 600. A detailed configuration of the blade replacement device 26 will be described later.

[0033] In the cutting module B, in a state in which the molded substrate W is held on the cutting table 21, the cutting table 21 and the two spindles 25 move relatively, thereby cutting and dicing the molded substrate W. The blades 25a of the spindles 25 rotate in a plane including the Y direction and the Z direction to cut the molded substrate W held on the cutting table 21. At this time, the molded substrate W may also be cut while spraying a cutting water toward the blades 25a. In addition, the blades 25a used in the spindles 25 may be replaced by the blade replacement device 26 at an appropriate timing.

<Storage Module C>

[0034] The storage module C is mainly provided with an inspection table 31 and a tray 32.

[0035] On the inspection table 31, an assembly including a plurality of products P obtained by cutting and dicing the molded substrate W is placed. The plurality of products P is inspected by an inspection camera (not illustrated) and sorted into non-defective products and defective products. The sorted non-defective products are stored on the tray 32. The sorted defective products are stored in a separately prepared tray (not illustrated) and excluded from the products P. In addition, it is not essential to inspect the products P in the storage module C.

<Detailed Configuration of Blade Replacement Device 26>

[0036] Next, a configuration of the blade replacement device 26 (the blade replacement mechanism 100, the cover 200, the cleaning mechanism 300, the blade replacement stage 400, the air nozzle 500, and the camera 600) will be described. Since the detailed structures, shapes, or the like of respective components of the blade replacement device 26 are not particularly limited, the shapes or the like of the respective components are appropriately simplified and illustrated in the present embodiment.

<Blade Replacement Mechanism 100>

[0037] As illustrated in FIGS. 2 and 3, the blade replacement mechanism 100 mainly includes a support 110, a holder 120, and a mover 130.

[0038] The support 110 supports the holder 120 and a first cleaning mechanism 310, which will be described later. The support 110 may be formed by combining appropriate members (bar-shaped members, plate-shaped members, and the like). In the present embodiment, the support 110 is formed in a rectangular shape elongated in one direction (the X direction in FIGS. 2 and 3).

[0039] The holder 120 is configured to hold the blade 25a provided in the spindle 25 and a second flange 25d configured to fix the blade 25a to the spindle 25. The holder 120 is provided at one end portion of the support 110 in a longitudinal direction thereof.

[0040] Here, a configuration of the spindle 25 (particularly, a portion related to fixing the blade 25a) will be described with reference to FIG. 4. FIG. 4 illustrates a partial cross-section of one of the two spindles 25 (the spindle 25 at the left-hand side of the drawing in FIG. 2).

[0041] A substantially annular first flange 25c is fixed to a rotary shaft 25b of the spindle 25. In addition, a substantially annular second flange 25d is provided to face the first flange 25c. The second flange 25d is an example of a flange according to the present disclosure.

[0042] The second flange 25d is pressed against the first flange 25c by fastening a detachable member 25e such as a nut to a boss portion of the first flange 25c. A first contact surface 25f and a second contact surface 25g protruding in directions facing each other are formed on outer peripheral portions of the first flange 25c and the second flange 25d, respectively. The substantially annular blade 25a is sandwiched and fixed between the first contact surface 25f and the second contact surface 25g. A plurality of through-holes 25h is formed in the detachable member 25e.

[0043] The holder 120 illustrated in FIG. 5 mainly includes a blade suctioner 121, a flange suctioner 122, and a detachable member rotator 123.

[0044] The blade suctioner 121 is for suctioning the blade 25a. The blade suctioner 121 is formed in a substantially cylindrical shape. A suction port and a suction groove (not illustrated) configured to suction the blade 25a are formed appropriately in an end surface (hereinafter referred to as a blade suction surface 121a) of the blade suctioner 121. The blade 25a may be suctioned and held on the blade suction surface 121a by suctioning air from the suction port or

the like of the blade suctioner 121 by an external suction device. The blade suctioner 121 is an example of a first suctioner according to the present disclosure.

[0045] The flange suctioner 122 is for suctioning the second flange 25d. The flange suctioner 122 is formed in a substantially cylindrical shape. The flange suctioner 122 is disposed inside the blade suctioner 121. A suction port and a suction groove (not illustrated) configured to suction the second flange 25d is formed appropriately in an end surface (hereinafter referred to as a flange suction surface 122a) of the flange suctioner 122. The second flange 25d may be suctioned and held on the flange suction surface 122a by suctioning air from the suction port or the like of the flange suctioner 122 by an external suction device. The flange suctioner 122 is an example of a second suctioner according to the present disclosure.

[0046] The detachable member rotator 123 for attaching and detaching the detachable member 25e to and from the boss portion of the first flange 25c by rotating the detachable member 25e. The detachable member rotator 123 is formed in an annular shape. The detachable member rotator 123 is disposed inside the flange suctioner 122. A plurality of protrusions 123a protruding in the X direction is provided on an end surface of the detachable member rotator 123. The protrusions 123a are disposed at positions corresponding to the through-holes 25h (see FIG. 4) in the detachable member 25e. The detachable member rotator 123 can be rotated by power of a rotary mechanism (not illustrated).

[0047] The holder 120 may attach and detach the detachable member 25e by rotating the detachable member rotator 123 in a state in which the protrusions 123a are inserted into the through-holes 25h in the detachable member 25e. In addition, the holder 120 may independently hold the blade 25a and the second flange 25d by the blade suctioner 121 and the flange suctioner 122, respectively.

[0048] As described above, the holder 120 may remove the blade 25a and the second flange 25d attached to the spindle 25 from the spindle 25 by operating the blade suctioner 121, the flange suctioner 122, and the detachable member rotator 123 appropriately. In addition, the holder 120 may install the blade 25a and the second flange 25d, which are being held by the holder 120, to the spindle 25.

[0049] A method of holding the blade 25a and the second flange 25d by the holder 120 is not limited to the method of suctioning and holding the blade 25a or the like. For example, a method of mechanically holding the blade 25a by hooking a claw-like member on the blade 25a may also be used.

[0050] The mover 130 illustrated in FIGS. 2 and 3 moves the support 110 in an arbitrary direction. The mover 130 mainly includes a rotator 131, a first linear mover 132, a second linear mover 133, and a third linear mover 134.

[0051] The rotator 131 rotates the support 110. The rotator 131 may rotate the support 110 by using a driving force of a driving source such as a motor, while supporting the support 110. The rotator 131 may rotate the support 110 around an axis parallel to the Y direction.

[0052] The first linear mover 132 moves the rotator 131 linearly. The first linear mover 132 may move the rotator 131 by using a driving force of a driving source such as a motor, while supporting the rotator 131. The first linear mover 132 may move the rotator 131 linearly along the Y direction.

[0053] The second linear mover 133 moves the first linear mover 132 linearly. The second linear mover 133 may move the first linear mover 132 by using a driving force of a driving source such as a motor, while supporting the first linear mover 132. The second linear mover 133 may move the first linear mover 132 linearly along the Z direction.

[0054] The third linear mover 134 illustrated in FIG. 2 moves the second linear mover 133 linearly. The third linear mover 134 may move the second linear mover 133 by using a driving force of a driving source such as a motor, while supporting the second linear mover 133. The third linear mover 134 may move the second linear mover 133 linearly along the X direction.

[0055] By combining movements of the respective components of the mover 130 configured as described above, it is possible to rotate the support 110 arbitrarily around the axis along the Y direction while moving the support 110 to an arbitrary position.

<Cover 200>

[0056] The cover 200 illustrated in FIGS. 1, 2, and 6 is for preventing water droplets, cutting chips, or the like from adhering to the blade replacement mechanism 100. The cover 200 mainly includes a cover main body 210, a moving plate 220, and a seal 230.

[0057] The cover main body 210 is configured to be capable of accommodating the blade replacement mechanism 100 therein. The cover main body 210 is formed in a hollow and substantially rectangular parallelepiped shape to surround the blade replacement stage 400, which will be described later, from lateral and top sides. Thus, the cover main body 210 may partition a space in which the spindles 25 are disposed and a space in which the blade replacement stage 400 is disposed. FIG. 2 illustrates only one side surface of the cover main body 210 (a surface on the right-hand side in FIG. 1) for convenience of explanation. An opening 211 and a leak 212 are formed in the cover main body 210.

[0058] The opening 211 is formed to penetrate one side surface of the cover main body 210 (in the present embodiment, the surface on the right-hand side in FIG. 1). The opening 211 is formed in a shape through which the blade replacement mechanism 100 can pass. In the present embodiment, an example in which the opening 211 is formed in a rectangular shape is illustrated.

[0059] The leak 212 illustrated in FIGS. 2 and 6 is a portion that connects an internal space and an external space of the cover main body 210 when the moving plate 220, which will be described later, closes the opening 211. The leak 212 is formed by cutting the cover main body 210 out along the X direction from one side surface (the side surface where the opening 211 is formed) to a top surface of the cover main body 210. An end portion of leak 212 is connected to an upper end of the opening 211. In the present embodiment, by forming the leak 212, interference between the cover main body 210 and the mover 130 is avoided when the blade replacement mechanism 100 moves between the internal space and the external space of the cover main body 210.

[0060] The moving plate 220 illustrated in FIGS. 1, 2 and 6 is configured to be capable of closing the opening 211 of the cover main body 210. The moving plate 220 is formed in a shape corresponding to the opening 211. Specifically, the moving plate 220 is formed in a

substantially rectangular plate shape that is much larger than the opening 211. The moving plate 220 is disposed on one side of the support 110 in the X direction (on the right-hand side in FIG. 2). The moving plate 220 is provided on the mover 130 in a state in which a plate surface thereof is oriented in the X direction. Specifically, the moving plate 220 is provided on the second linear mover 133 and is movable in the X direction integrally with the blade replacement mechanism 100 (particularly, the support 110) by the third linear mover 134. The moving plate 220 is an example of a closer according to the present disclosure.

[0061] The seal 230 seals a contact portion between the cover main body 210 and the moving plate 220. The seal 230 is made of a flexible material (e.g., rubber or the like). The seal 230 is provided on a side surface of the moving plate 220 facing the cover main body 210. The seal 230 is provided along an outer periphery of the moving plate 220.

<Cleaning Mechanism 300>

[0062] The cleaning mechanism 300 illustrated in FIG. 1 is for cleaning the flanges (the first flange 25c and the second flange 25d) configured to fix the blade 25a to the spindle 25. The cleaning mechanism 300 mainly includes a first cleaning mechanism 310 and a second cleaning mechanism 320.

[0063] The first cleaning mechanism 310 illustrated in FIG. 3 cleans the first flange 25c in a state of being installed to the spindle 25. The first cleaning mechanism 310 mainly includes a first cleaning sponge 311 and an air nozzle 312.

[0064] The first cleaning sponge 311 illustrated in FIGS. 3 and 7A is a cleaning member for cleaning the first flange 25c. The first cleaning sponge 311 is formed in a cylindrical shape having a planar shape larger than a contour of the first flange 25c. The first cleaning sponge 311 is installed to one longitudinal end portion of the support 110 via a disk-shaped installation member 311a. The first cleaning sponge 311 is provided on a side opposite to the holder 120 in the longitudinal direction of the support 110. In other words, the first cleaning sponge 311 is provided at a position inverted 180 degrees from the holder 120 with a rotary shaft of the rotator 131 as a center.

[0065] The first cleaning sponge 311 is not limited to the cylindrical shape illustrated in FIG. 7A and may have any shape. For example, like a modification illustrated in FIG. 7B, the first cleaning sponge 311 may have a shape obtained by dividing a cylinder into a plurality of pieces. In this case, it is possible to clean the first flange 25c by corner portions of the sponge and thus to improve cleaning performance of the first cleaning sponge 311.

[0066] The air nozzle 312 illustrated in FIG. 3 may discharge compressed air supplied from a compressor (not illustrated). The air nozzle 312 is provided at one end portion (on the same side as the first cleaning sponge 311) of the support 110 in the longitudinal direction. The air nozzle 312 is disposed with a discharge direction of the air facing a side of the first cleaning sponge 311.

[0067] The second cleaning mechanism 320 illustrated in FIG. 2 and FIGS. 8A and 8B cleans the second flange 25d in a state of being removed from the spindle 25 (a state of being held by the holder 120). The second cleaning mechanism 320 is an example of a flange cleaning mechanism according to the present disclosure. The second cleaning mechanism 320 mainly includes a second cleaning sponge 321 and a driver 322.

[0068] The second cleaning sponge 321 is a cleaning member for cleaning the second flange 25d. The second cleaning sponge 321 is formed in a cylindrical shape having the same diameter as that of the second flange 25d. The second cleaning sponge 321 is formed in the same shape as the first cleaning sponge 311 illustrated in FIGS. 7A and 7B. The second cleaning sponge 321 is provided on a top surface of the blade replacement stage 400, which will be described later, with an axis of the cylinder oriented in the Z direction. The second cleaning sponge 321 is an example of a flange cleaner according to the present disclosure.

[0069] The driver 322 rotates the second cleaning sponge 321. The driver 322 includes, for example, a driving source such as a motor. An output shaft of the driver 322 is connected to the second cleaning sponge 321. The second cleaning sponge 321 can be rotated around an axis parallel to the Z direction by a driving force of the driver 322.

<Blade Replacement Stage 400>

[0070] The blade replacement stage 400 is for storing unused blades 25a and used blades 25a.

The blade replacement stage 400 mainly includes a used blade storage 410 and an unused blade storage 420.

[0071] The used blade storage 410 is a part where the used blades 25a used in the spindles 25 are stored. The used blade storage 410 is formed in a box shape with an open top. The used blade storage 410 may store one blade 25a therein. In addition, the used blade storage 410 may store a plurality of blades 25a therein.

[0072] The unused blade storage 420 is a part where the unused blades 25a for replacement are stored. The unused blade storage 420 is formed in a prismatic shape extending in a vertical direction (up-down direction). The unused blade storage 420 may hold the blades 25a by being inserted into centers of the blades 25a. The unused blade storage 420 may store a plurality of blades 25a stacked vertically. In addition, by configuring the prismatic unused blade storage 420 to discharge air outward (toward the blades 25a) from a lateral surface thereof, the plurality of blades 25a may be easily separated from one another. The unused blade storage 420 is an example of a replacement blade storage according to the present disclosure.

[0073] On the top surface of the blade replacement stage 400, the used blade storage 410, the unused blade storage 420, and the second cleaning mechanism 320 are arranged side by side along the X direction. Specifically, the unused blade storage 420, the used blade storage 410, and the second cleaning mechanism 320 are arranged in this order from a side near the opening 211 of the cover main body 210.

[0074] The configurations of the used blade storage 410 and the unused blade storage 420 are not limited to the present embodiment and may be arbitrarily changed. As an example, it is also possible to form the used blade storage 410 in a prismatic shape extending in the vertical direction (up-down direction), like the unused blade storage 420.

<Air Nozzle 500>

[0075] The air nozzle 500 is for spraying a gas (in the present embodiment, air) to the blade suctioner 121 of the blade replacement mechanism 100. The air nozzle 500 may discharge

compressed air supplied from a compressor (not illustrated). The air nozzle 500 is disposed in a vicinity of the blade replacement stage 400. The air nozzle 500 is disposed so as to discharge air horizontally. The air nozzle 500 is disposed such that a tip end thereof (in a discharge direction of the air) faces an upper end surface of the second cleaning sponge 321. In addition, as will be described later, the air nozzle 500 may increase an internal pressure of the cover main body 210 (a pressure of the internal space) to prevent cutting chips and water droplets from entering the cover main body 210. The air nozzle 500 is an example of a gas spray according to the present disclosure.

<Cameras 600>

[0076] The cameras 600 are for imaging an inside of the cover main body 210. The cameras 600 are disposed inside the cover main body 210. The cameras 600 are disposed such that lenses thereof face the blade replacement stage 400. In the present embodiment, by disposing two cameras 600 inside the cover main body 210, the entire blade replacement stage 400 (the second cleaning mechanism 320, the used blade storage 410, and the unused blade storage 420 which are provided in the blade replacement stage 400) is imaged. The arrangement and number of the cameras 600 in the present embodiment are examples and may be arbitrarily changed. Images captured by the cameras 600 are displayed on, for example, a display device such as a monitor provided outside the cutting apparatus 1. A user of the cutting apparatus 1 may confirm a state inside the cover main body 210 by confirming the images displayed on the display device.

<Method of Manufacturing Cut Products>

[0077] Next, with reference to FIGS. 1 and 9, an outline of a method of manufacturing cut products (cut products manufacturing method) by using the cutting apparatus 1 configured as described above will be described.

[0078] The cut product manufacturing method according to the present embodiment mainly includes a blade replacement process S10 and a cutting process S20. These processes will be described in order below.

[0079] The blade replacement process S10 is a process of replacing the blade 25a of the cutting apparatus 1 by the blade replacement device 26.

[0080] Specifically, in the blade replacement process S10, a used blade 25a installed to the spindle 25 is removed by the blade replacement mechanism 100, and an unused blade 25a is installed to the spindle 25 instead. In the blade replacement process S10, the blade replacement device 26 may also clean the flanges (the first flange 25c and the second flange 25d) for fixing the blade 25a.

[0081] After the replacement of the blade 25a is completed, the blade replacement process S10 is transitioned to the cutting process S20.

[0082] The cutting process S20 is a process of cutting the molded substrate W by the spindle 25 to which the blade 25a replaced in the blade replacement process S10 is installed.

[0083] Specifically, the molded substrate W is transferred from the substrate supply module A to the cutting module B in the cutting process S20. The molded substrate W held on the cutting table 21 of the cutting module B is cut and diced into a plurality of products P by the spindle 25. The diced products P are sorted into non-defective products and defective products in the storage module C. As described above, it is possible to manufacture the products P by cutting the molded substrate W.

[0084] In addition, although FIG. 9 illustrates the cut products manufacturing method in a simplified manner, timings or number of times of executing the respective processes, an order of executing the processes, and the like may be arbitrarily changed. For example, while the cutting process S20 is being repeatedly performed, a wear amount of the blade 25a may be detected by an appropriate sensor to execute the blade replacement process S10 when the wear amount exceeds a predetermined amount. In addition, the blade replacement process S10 may be executed at a timing when an operation time of the cutting apparatus 1, a production number of the products P, or the like exceeds a predetermined value.

<Operations of Blade Replacement Device 26>

[0085] Next, operations of the blade replacement device 26 in the cut product manufacturing processes (the blade replacement process S10 and the cutting process S20) will be specifically described.

[0086] When replacing the blade 25a in the blade replacement process S10, first, as illustrated in FIG. 10A, the support 110 is moved by the mover 130 so that the tip end of the air nozzle 312 is directed toward the blade 25a installed to the spindle 25. In this state, air is discharged from the air nozzle 312 to remove cutting chips and water droplets adhering to the blade 25a. At this time, by slightly reciprocating the support 110 while spraying air to the blade 25a, an orientation and range of spraying the air to the blade 25a may be changed to more effectively remove the cutting chips and the like.

[0087] Subsequently, as illustrated in FIG. 10B, the support 110 is turned over by the mover 130, and the holder 120 is moved to a position facing the blade 25a of the spindle 25. Then, the second flange 25d and the blade 25a are separated from the spindle 25 by the holder 120.

[0088] Subsequently, as illustrated in FIG. 10C, the holder 120 is moved by the mover 130 to a position facing the used blade storage 410 provided in the blade replacement stage 400 from above. Then, holding of the blade 25a by the holder 120 is released, and the used blade 25a is stored in the used blade storage 410.

[0089] Subsequently, as illustrated in FIG. 11A, in a state in which an axis of the holder 120 (the second flange 25d) is aligned with an axis of the second cleaning sponge 321 of the second cleaning mechanism 320, the second flange 25d is moved by the mover 130 to a position where the second flange 25d is brought into contact with a top surface of the second cleaning sponge 321. In this state, by rotating the second cleaning sponge 321 by the driver 322, a surface of the second flange 25d (particularly, the second contact surface 25g illustrated in FIG. 4) is cleaned. In addition, air is sprayed from the air nozzle 500 toward the second flange 25d and the second cleaning sponge 321. Thus, it is possible to remove cutting chips and the like which have adhered to the second flange 25d.

[0090] Subsequently, as illustrated in FIG. 11B, the holder 120 is moved by the mover 130 to a position facing the used blade storage 420 provided in the blade replacement stage 400 from above. Then, an unused blade 25a stored in the unused blade storage 420 is held by the holder 120.

[0091] By providing the used blade storage 410, the unused blade storage 420, and the second cleaning mechanism 320 in the same blade replacement stage 400 as in the present embodiment, it is possible to suppress a moving distance when the holder 120 moves among the used blade storage 410, the unused blade storage 420, and the second cleaning mechanism 320 to be short. In addition, by disposing the second cleaning mechanism 320 and the unused blade storage 420 with the used blade storage 410 interposed therebetween, it is possible to prevent water droplets and the like, which are scattered during cleaning the second flange 25d by the second cleaning mechanism 320, from adhering to the unused blades 25a stored in the unused blade storage 420. In order to prevent water droplets and the like, which are scattered during cleaning the second flange 25d by the second cleaning mechanism 320, from adhering to the unused blades 25a, a configuration in which the air nozzle 500 is disposed to discharge air to a side opposite to the unused blade storage 420 may be adopted.

[0092] Subsequently, as illustrated in FIG. 11C, the support 110 is moved by the mover 130, and the tip end of the air nozzle 312 is directed to the first flange 25c installed to the spindle 25. In this state, air is discharged from the air nozzle 312, and cutting chips and water droplets, which have adhered to the first flange 25c, are removed.

[0093] Subsequently, as illustrated in FIG. 12A, the first cleaning sponge 311 of the first cleaning mechanism 310 is moved by the mover 130 to a position where the first cleaning sponge 311 is brought into contact with the first flange 25c installed to the spindle 25. By rotating the spindle 25 in this state, a surface of the first flange 25c (in particular, the first contact surface 25f illustrated in FIG. 4) is cleaned. Thus, it is possible to remove cutting chips and the like which have adhered to the first flange 25c.

[0094] Subsequently, as illustrated in FIG. 12B, the support 110 is turned over by the mover 130, and the holder 120 is moved to a position facing the first flange 25c of the spindle 25.

Then, the second flange 25d and the blade 25a held by the holder 120 are installed to the spindle 25.

[0095] In the above-described example, the operations of performing replacement of the blade 25a of one spindle 25 or the like have been described. However, since operations of performing replacement of the blade 25a of the other spindle 25 or the like are substantially the same, descriptions will be omitted.

[0096] When cutting the molded substrate W in the cutting process S20, as indicated by the two-dot chain lines in FIG. 2, the blade replacement mechanism 100 (in particular, the support 110 provided with the holder 120) is accommodated inside the cover main body 210 via the opening 211.

[0097] Specifically, as illustrated in FIG. 12C, in a state in which the blade suction surface 121a of the holder 120 is directed downward by the mover 130, the blade suction surface 121a is moved to a position facing the second cleaning sponge 321 of the second cleaning mechanism 320 in the up-down direction. At this time, by closing the opening 211 with the moving plate 220, the internal space of the cover main body 210 in which the blade replacement stage 400 is disposed and the external space of the cover main body 210 in which the spindle 25 is disposed may be partitioned from each other. At this time, the mover 130 moves the holder 120 to a slightly more inward (leftward in FIG. 12C) position compared to that in the case of cleaning the second flange 25d (*see* FIG. 11A). Along with this, the moving plate 220 is pressed against the cover main body 210, and the seal 230 is elastically deformed to be compressed. As a result, it is possible to seal a gap between the cover main body 210 and the moving plate 220 regardless of some dimensional errors and assembly errors of respective components.

[0098] In addition, when the molded substrate W is cut in the cutting process S20, air is sprayed from the air nozzle 500 toward the blade suction surface 121a of the holder 120.

[0099] As described above, in the cutting process S20, since the internal space and the external space of the cover main body 210 are partitioned from each other, it is possible to prevent cutting chips or water droplets generated at the time of cutting the molded substrate W from adhering to the blade replacement stage 400 (in particular, the unused blade storage 420 in which the

replacement blades 25a are stored) or the holder 120. Furthermore, the air sprayed from the air nozzle 500 may maintain the blade suction surface 121a of the holder 120 to be in a clean state.

[0100] In addition, since the air from the air nozzle 500 is sprayed in the state in which the opening 211 of the cover main body 210 is closed by the moving plate 220, it is possible to increase the internal pressure (the pressure of the internal space) of the cover main body 210. Thus, it is possible to prevent cutting chips and water droplets from entering the inside of the cover main body 210.

[0101] In addition, as illustrated in the right-hand side drawing of FIG. 6, the air inside the cover main body 210 may be discharged to the outside via the leak 212. Thus, it is possible to prevent an excessive increase in the internal pressure of the cover main body 210. Furthermore, since the leak 212 is formed in an upper portion of the cover main body 210, the air discharged to the outside of the cover main body 210 via the leak 212 does not wind up cutting chips and water droplets falling on a floor surface. Therefore, it is possible to more effectively prevent the cutting chips and water droplets from entering the inside of the cover main body 210.

[0102] From the viewpoint of preventing the air discharged from the leak 212 from winding up cutting chips and the like, the leak 212 may be formed at least above the lowermost end of the moving plate 220. From the same point of view, the leak 212 may be formed at a relatively high position. For example, the leak 212 may be formed at a position higher than a vertical center of the moving plate 220, a position higher than a vertical center of the opening 211, a position higher than the air nozzle 500, or the like. From the same point of view, the leak 212 may be formed at least not to open downward. In other words, the leak 212 may be formed to open upward or toward a lateral side as in the present embodiment.

[0103] In the present embodiment, the leak 212 is formed in the cover main body 210, but it is possible to form the leak 212, for example, in the moving plate 220 or in both the cover main body 210 and the moving plate 220.

[0104] Although the embodiment of the present disclosure has been described above, the present disclosure is not limited to the above-described embodiment and may be appropriately modified within the scope of the technical ideas of the disclosure described in the claims.

[0105] For example, the configurations (the shapes, numbers, and the like) of the respective members exemplified in each of the above embodiment are not particularly limited and may be arbitrarily modified. As an example, the shapes of the cover main body 210 and the moving plate 220 may be arbitrarily modified according to the shape, size, and the like of the blade replacement mechanism 100.

[0106] In addition, the configuration of the mover 130 of the present embodiment (*see* FIG. 3 and the like) is an example, a specific configuration is not limited as long as the holder 120 and the first cleaning mechanism 310 can be moved to required positions. Although the moving plate 220 is provided on the second linear mover 133, the present disclosure is not limited thereto. That is, the moving plate 220 only needs to be configured to be movable integrally with the blade replacement mechanism 100 to close the opening 211. For example, a configuration in which the moving plate 220 is provided on the third linear mover 134 independently of the second linear mover 133 may be adopted.

[0107] In the present embodiment, an example in which when cleaning the first flange 25c, the spindle 25 is rotated (*see* FIG. 12A) has been illustrated, but a configuration in which, for example, the first cleaning sponge 311 is rotated may be adopted.

[0108] The cleaning mechanism 300 according to the present embodiment performs cleaning by using sponges (the first cleaning sponge 311 and the second cleaning sponge 321) as cleaning members, but the present disclosure is not limited thereto and may use any cleaning member (e.g., a rag or the like).

[0109] In addition, the cleaning mechanism 300 according to the present embodiment cleans the flange with the sponges and the air nozzle 312, but the method of cleaning the flange is not limited thereto. The flange may be cleaned with any cleaning method. For example, the flange may be cleaned by spraying a cleansing water to the flange or may be cleaned by suctioning cutting chips and the like adhered to the flange. The cleaning mechanism 300 may clean the flange by combining a plurality of cleaning methods.

[0110] In the present embodiment, an example in which the first flange 25c is cleaned in the state in which the first flange 25c is installed to the spindle 25 (*see* FIGS. 11C and 12A) has been

illustrated, but the present disclosure is not limited thereto. For example, a configuration in which cleaning the first flange 25c is performed in a state in which the first flange 25c is separated from the spindle 25 may be adopted. In this case, a separation mechanism for attaching and detaching the first flange 25c may be provided to automatically attach and detach the first flange 25c.

[0111] In the present embodiment, an example in which both the holder 120 and the first cleaning mechanism 310 are provided on the support 110 and moved integrally has been illustrated, but the present disclosure is not limited thereto. For example, the holder 120 and the first cleaning mechanism 310 may be provided on separate members, respectively, and may be moved independently of each other.

[0112] In the present embodiment, an example in which the blade 25a installed to the spindle 25 is removed and another blade 25a is installed in the blade replacement process S10 has been illustrated, but the present disclosure is not limited thereto. For example, in the blade replacement process S10, a blade 25a may also be installed to the spindle 25 to which the blade 25a has not yet been attached. In addition, in the blade replacement process S10, which is executed after the cutting process S20 is completed, the work of only removing the blade 25a installed to the spindle 25 may be performed (without installing another blade 25a).

[0113] In the present embodiment, the blade replacement device 26 including the cleaning mechanism 300 is illustrated, but the present disclosure is not limited thereto. It is not essential for the blade replacement device 26 to include the cleaning mechanism 300.

[0114] The operations of the cutting apparatus 1 exemplified in the present embodiment is an example, and the present disclosure is not limited thereto. That is, it is possible to arbitrarily change the order of the operations and operation modes of the respective components of the cutting apparatus 1.

<Supplementary Notes>

[0115] A blade replacement device 26 according to a first aspect of the present disclosure includes:

a blade replacement mechanism 100 including at least a blade suctioner 121 (a first suctioner) configured to suction a blade 25a;

a cover main body 210 configured to accommodate the blade replacement mechanism 100 in the cover main body 210;

a moving plate 220 (a closer) configured to be movable integrally with the blade replacement mechanism 100, and further configured to close an opening 211 of the cover main body 210 in a state in which the blade replacement mechanism 100 is accommodated in the cover main body 210; and

an air nozzle 500 (a gas spray) configured to spray a gas to a blade suction surface 121a of the blade suctioner 121 when the blade replacement mechanism 100 is accommodated in the cover main body 210.

[0116] With the blade replacement device 26 of the first aspect of the present disclosure, it is possible to remove cutting chips and water droplets adhered to the blade suction surface 121a. Thus, the blade suction surface 121a can be maintained to be in a clean state. As a result, it is possible to reduce occurrence of malfunction of the blade replacement mechanism 100 or the like. In addition, since the blade suction surface 121a can be maintained to be in the clean state, it is possible to reduce a maintenance frequency or workload, improving maintainability.

[0117] According to a second aspect of the present disclosure, the blade replacement device 26 of the first aspect further includes an unused blade storage 420 (a replacement blade storage) disposed inside the cover main body 210 and configured to store a plurality of blades 25a for replacement by stacking the blades 25a in a vertical direction.

[0118] With the blade replacement device 26 of the second aspect of the present disclosure, since it is possible to stack and store the plurality of blades 25a, a holding mechanism for preventing the blades 25a from falling is unnecessary. Thus, it is possible to avoid occurrence of malfunction due to cutting chips and water droplets entering a mover and a driver of the holding mechanism.

[0119] According to a third aspect of the present disclosure, in the blade replacement device 26 of the first or second aspect, the air nozzle 500 is further configured to spray the gas to the blade suctioner 121 in a state in which the blade suction surface 121a is directed downward.

[0120] With the blade replacement device 26 of the third aspect of the present disclosure, it is possible to effectively remove cutting chips and water droplets adhered to the blade suction surface 121a.

[0121] According to a fourth aspect of the present disclosure, the blade replacement device 26 of any one of the first to third aspects further includes a seal 230 configured to seal a contact portion between the cover main body 210 and the moving plate 220 in a state in which the moving plate 220 closes the opening 211,

wherein at least one selected from the group of the cover main body 210 and the moving plate 220 is provided with a leak 212 disposed above a lowermost end of the moving plate 220 and configured to discharge air inside the cover main body 210 to an outside of the cover main body 210.

[0122] With the blade replacement device 26 of the fourth aspect of the present disclosure, it is possible to increase the internal pressure of the cover main body 210 and suppress cutting chips and the like from entering the cover main body 210. In addition, by discharging the air inside the cover main body 210 via the leak 212, it is possible to prevent the internal pressure of the cover main body 210 from increasing excessively. In addition, by forming the leak 212 above the lowermost end of the moving plate 220, it is possible to prevent cutting chips and the like from being wound up by the air discharged from the cover main body 210.

[0123] According to a fifth aspect of the present disclosure, the blade replacement device 26 of any one of the first to fourth aspects further includes a used blade storage 410 disposed inside the cover main body 210 and configured to store a used blade 25a.

[0124] With the blade replacement device 26 of the fifth aspect of the present disclosure, work of storing the used blade 25a may be performed inside the cover main body 210.

[0125] According to a sixth aspect of the present disclosure, in the blade replacement device 26 of any one of the first to fifth aspects, the blade replacement mechanism 100 further includes:

a flange suctioner 122 (a second suctioner) configured to suction a second flange 25d (a flange) independently of the blade suctioner 121; and

a detachable member rotator 123 configured to rotate a detachable member 25e that allows the blade 25a to be attached and detached with respect to a spindle 25.

[0126] With the blade replacement device 26 of the sixth aspect of the present disclosure, work of attaching and detaching the blade 25a may be performed efficiently.

[0127] According to a seventh aspect of the present disclosure, the blade replacement device 26 of the sixth aspect further includes a second cleaning mechanism 320 (a flange cleaning mechanism) configured to clean at least the second flange 25d suctioned by the flange suctioner 122.

[0128] With the blade replacement device 26 of the seventh aspect of the present disclosure, since it is possible to remove cutting chips and water droplets adhered to the second flange 25d, the second flange 25d can be maintained to be in a clean state. Thus, it is possible to reduce occurrence of malfunction of the cutting apparatus 1 or the like.

[0129] According to an eighth aspect of the present disclosure, in the blade replacement device 26 of the seventh aspect, the second cleaning mechanism 320 is disposed inside the cover main body 210, the blade suctioner 121 is disposed to face a second cleaning sponge 321 (a flange cleaning member) of the second cleaning mechanism 320 when the blade replacement mechanism 100 is accommodated in the cover main body 210, and the air nozzle 500 is further configured to spray the gas to the blade suction surface 121a and the second cleaning sponge 321.

[0130] With the blade replacement device 26 of the eighth aspect of the present disclosure, it is possible to maintain the second cleaning sponge 321 to be in a clean state as well as the blade suction surface 121a.

[0131] According to a ninth aspect of the present disclosure, the blade replacement device 26 of any one of the first to eighth aspects further includes a camera 600 configured to capture an image inside of the cover main body 210.

[0132] With the blade replacement device 26 of the ninth aspect of the present disclosure, it is possible to confirm a state inside the cover main body 210, which is difficult to be seen from the outside.

[0133] According to a tenth aspect of the present disclosure, a cutting apparatus 1 includes: the blade replacement device 26 of any one of the first to ninth aspects; and a spindle 25 (a cutting mechanism) configured to cut a molded substrate W (an object to be cut) with the blade 25a replaced by the blade replacement device 26.

[0134] With the cutting apparatus 1 of the tenth aspect of the present disclosure, since it is possible to remove cutting chips or water droplets adhered to the blade suction surface 121a, the blade suction surface 121a can be maintained to be in a clean state. Thus, it is possible to reduce occurrence of malfunction of the blade replacement mechanism 100 and to further reduce occurrence of malfunction of the cutting apparatus 1.

[0135] According to an eleventh aspect of the present disclosure, a method of manufacturing cut products is a method of manufacturing the cut products by using the cutting apparatus 1 of the tenth aspect, and includes: a blade replacement process S10 of replacing a blade 25a of the cutting apparatus 1 by the blade replacement device 26; and a cutting process S20 of cutting the molded substrate W by the cutting apparatus 1 to which the blade 25a replaced in the blade replacement process S10 is installed.

[0136] With the cut products manufacturing method of the eleventh aspect of the present disclosure, since it is possible to remove cutting chips or water droplets adhered to the blade suction surface 121a, the blade suction surface 121a can be maintained to be in a clean state. Thus, it is possible to reduce occurrence of malfunction of the blade replacement mechanism 100 and to further reduce occurrence of malfunction of the cutting apparatus 1.

[0137] According to the present disclosure, it is possible to maintain a blade suction surface to be in a clean state.

[0138] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the disclosures. Indeed, the embodiments described herein may be embodied in a variety of other forms. Furthermore,

various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the disclosures. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the disclosures.

[Description of Reference Numerals]

[0139] 1: cutting apparatus, 25: spindle, 25a: blade, 26: blade replacement device, 25d: second flange, 25e: detachable member, 100: blade replacement mechanism, 121: blade suctioner, 121a: blade suction surface, 122: flange suctioner, 123: detachable member rotator, 210: cover main body, 211: opening, 212: leak, 220: moving plate, 230: seal, 320: second cleaning mechanism, 321: second cleaning sponge, 410: used blade storage, 420: unused blade storage, 500: air nozzle, 600: camera

WHAT IS CLAIMED IS:

1. A blade replacement device comprising:
 - a blade replacement mechanism comprising at least a first suctioner configured to suction a blade;
 - a cover main body configured to accommodate the blade replacement mechanism in the cover main body;
 - a closer configured to be movable integrally with the blade replacement mechanism, and further configured to close an opening of the cover main body in a state in which the blade replacement mechanism is accommodated in the cover main body; and
 - a gas spray configured to spray a gas to a blade suction surface of the first suctioner when the blade replacement mechanism is accommodated in the cover main body.
2. The blade replacement device of Claim 1, further comprising a replacement blade storage disposed inside the cover main body and configured to store a plurality of blades for replacement by stacking the blades in a vertical direction.
3. The blade replacement device of Claim 1 or 2, wherein the gas spray is further configured to spray the gas to the first suctioner in a state in which the blade suction surface is directed downward.
4. The blade replacement device of any one of Claims 1 to 3, further comprising a seal configured to seal a contact portion between the cover main body and the closer in a state in which the closer closes the opening,
 - wherein at least one selected from the group of the cover main body and the closer is provided with a leak disposed above a lowermost end of the closer and configured to discharge air inside the cover main body to an outside of the cover main body.

5. The blade replacement device of any one of Claims 1 to 4, further comprising a used blade storage disposed inside the cover main body and configured to store a used blade.
6. The blade replacement device of any one of Claims 1 to 5, wherein the blade replacement mechanism further comprises:
- a second suctioner configured to suction a flange independently of the first suctioner;
 - and
 - a detachable member rotator configured to rotate a detachable member that allows the blade to be attached and detached with respect to a spindle.
7. The blade replacement device of Claim 6, further comprising a flange cleaning mechanism configured to clean at least the flange suctioned by the second suctioner.
8. The blade replacement device of Claim 7, wherein the flange cleaning mechanism is disposed inside the cover main body,
- wherein the first suctioner is disposed to face a flange cleaning member of the flange cleaning mechanism when the blade replacement mechanism is accommodated in the cover main body, and
 - wherein the gas spray is further configured to spray the gas to the blade suction surface and the flange cleaning member.
9. The blade replacement device of any one of Claims 1 to 8, further comprising a camera configured to capture an image inside of the cover main body.
10. A cutting apparatus comprising:
- the blade replacement device of any one of Claims 1 to 9; and
 - a cutting mechanism configured to cut an object to be cut with a blade replaced by the blade replacement device.

11. A method of manufacturing cut products by using the cutting apparatus of Claim 10, the method comprising:

replacing a blade of the cutting apparatus by the blade replacement device; and

cutting the object to be cut by the cutting apparatus to which the blade replaced in the replacing the blade is installed.