

HOLDING TABLE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a holding table for holding a workpiece.

Description of the Related Art

A cutting apparatus that cuts a workpiece such as a package substrate by a cutting blade, for example, may hold the workpiece by a holding table including a holding plate that has relief grooves corresponding to streets of the package substrate and suction holes corresponding to chips and a base that supports the holding plate in an attachable and detachable manner.

The positions of the relief grooves and the suction holes and the like differ on the basis of the type of the package substrate, and therefore, when the type of the package substrate to be cut is changed, the holding plate in the holding table may be changed. Conventionally, as the method of fixing the holding plate to the base, vacuum (see, for example, Japanese Patent Laid-open No. 2011-114145), screwing, or an A latch (also called catch clip or draw latch) is the mainstream.

SUMMARY OF THE INVENTION

However, as described in Japanese Patent Laid-open No. 2011-114145, the method of fixing the holding plate by vacuum has a problem in that a suction source is specially needed to fix the holding plate and the structure of the base, or the holding table as a whole, becomes complicated for transmitting a negative pressure to the holding plate. In addition, in the method of fixing the holding plate by vacuum, it is difficult to cause the sectional area of the flow path for transmitting the negative pressure to be a sectional area necessary for sufficiently fixing the holding plate. On the other hand, the method of fixing the holding plate by screwing or an A latch has a problem in that it is difficult to enable automatic replacement of the holding plate.

Accordingly, it is an object of the present invention to provide a holding table that enables automatic replacement of a holding plate by an apparatus with a simple structure.

In accordance with an aspect of the present invention, there is provided a holding table for holding a workpiece. The holding table includes a holding plate that has a holding surface for holding the workpiece and

a base to which the holding plate is detachably mounted, in which the base has a hook erected from an upper surface thereof, the holding plate has in a lower surface thereof a recess for engagement with the hook, and the holding plate and the base, with the hook accommodated in the recess, are relatively rotated from a state of being obliquely deviated in plane directions into an overlapping positional relation, to thereby fit the hook to the recess and fix the holding plate to the base.

Preferably, the hook has an erected part erected from the upper surface of the base and a locking part extending in a direction intersecting the erected part, and the recess has, at one end in a plane direction parallel to an extending direction of the holding surface, a fitting part for fitting to the locking part.

Preferably, the recess is formed in a part corresponding to a track with which the hook makes contact when the holding plate and the base are relatively rotated.

The present invention produces an effect that the holding plate can be sufficiently fixed to the cutting apparatus and automatic replacement of the holding plate by an apparatus can be enabled.

The above and other objects, features and

advantages of the present invention and the manner of realizing them will become more apparent, and the invention itself will best be understood from a study of the following description and appended claims with reference to the attached drawings showing some preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view depicting a configuration example of a cutting apparatus provided with a holding table according to an embodiment of the present invention;

FIG. 2 is a sectional view depicting the configuration of the holding table according to the embodiment;

FIG. 3 is a perspective view depicting, in a disassembled state, the holding table illustrated in FIG. 2;

FIG. 4 is a plan view of the holding table illustrated in FIG. 2;

FIG. 5 is a plan view schematically depicting a holding plate of the holding table illustrated in FIG. 2;

FIG. 6 is a sectional view taken along line VI-VI of FIG. 5;

FIG. 7 is a side view depicting the configuration of a carrying unit of a holding plate replacing mechanism of the cutting apparatus illustrated in FIG. 1;

FIG. 8 is a side view depicting a state in which one end portion of a recess of a workpiece held by the carrying unit of the cutting apparatus illustrated in FIG. 1 is positioned on a vertical-directionally upper side of a hook of a base;

FIG. 9 is a plan view depicting the holding plate and the base illustrated in FIG. 8;

FIG. 10 is a side view depicting a state in which a lower surface of the holding plate illustrated in FIG. 8 is placed on an upper surface of the base;

FIG. 11 is a plan view depicting a state in which the holding plate illustrated in FIG. 10 and the base are positioned in an overlapping positional relation;

FIG. 12 is a sectional view taken along line XII-XII of FIG. 11;

FIG. 13 is a sectional view of a major part of a holding table according to a first modification of the embodiment;

FIG. 14 is a sectional view of a major part of a holding table according to a second modification of the embodiment;

FIG. 15 is a perspective view of a holding plate of a holding table according to a third modification of the embodiment; and

FIG. 16 is a sectional view of a major part of the holding plate illustrated in FIG. 15.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

An embodiment of the present invention will be described in detail below referring to the drawings. The present invention is not limited by the contents of the following description of the embodiment. In addition, the components described below include those which can be easily conceived by a person skilled in the art and those which are substantially the same. Further, the configurations described below can be combined as required. Besides, various types of omission, replacement, or modification are possible within such ranges as not to depart from the gist of the present invention.

[Embodiment]

A holding table according to an embodiment of the present invention will be described based on the drawings. FIG. 1 is a perspective view depicting a configuration example of a cutting apparatus including

the holding table according to the embodiment. FIG. 2 is a sectional view depicting the configuration of the holding table according to the embodiment. FIG. 3 is a perspective view depicting, in a disassembled state, of the holding table illustrated in FIG. 2. FIG. 4 is a plan view of the holding table illustrated in FIG. 2. FIG. 5 is a plan view schematically depicting a holding plate of the holding table illustrated in FIG. 2. FIG. 6 is a sectional view taken along line VI-VI of FIG. 5. FIG. 7 is a side view depicting the configuration of a carrying unit of a holding plate replacing mechanism of the cutting apparatus illustrated in FIG. 1.

The holding table 10 according to the embodiment constitutes the cutting apparatus 1 depicted in FIG. 1. The cutting apparatus 1 is an apparatus for cutting a workpiece 200. In the embodiment, the workpiece 200 is a package substrate including a substrate, a plurality of device chips mounted on the substrate, and a molding resin covering the device chips. The workpiece 200 is formed in a flat plate shape which is rectangular in plan view shape. The workpiece 200 includes a device region 201 in which the device chips are mounted on the substrate and a peripheral surplus region 202 which surrounds the device region 201 and in which the device

chips are not mounted on the substrate. The device region 201 has the device chips mounted in those regions of the substrate which are partitioned by intersecting streets. The device chip is, for example, an integrated circuit such as an integrated circuit (IC) or large scale integration (LSI).

In the embodiment, the workpiece 200 is what is called a quad flat non-leaded package (QFN) substrate in which device chips mounted on a substrate are covered with a molding resin and which is divided along the streets by cutting into individual package device chips. The workpiece 200 is a QFN substrate in the present invention, but the invention is not limited to the substrate. For example, the workpiece 200 may be a chip scale packaging (CSP) substrate or a ball grid array (BGA). In the embodiment, the workpieces 200 differing in product number (type) or the like are different in the number of streets, the number of device chips, the interval between the adjacent streets, or the like.

(Cutting Apparatus)

The cutting apparatus 1 illustrated in FIG. 1 is a cutting apparatus for holding the workpiece 200 by a holding table 10 and cutting (corresponding to processing) the workpiece 200 along the streets by a

cutting blade 21. As depicted in FIG. 1, the cutting apparatus 1 includes the holding table 10 that suction holds the workpiece 200 by a holding surface 11, a cutting unit 20 that cuts the workpiece 200 held on the holding table 10 by the cutting blade 21, an unillustrated imaging unit that images the workpiece 200 held on the holding table 10, and a control unit 100.

In addition, as illustrated in FIG. 1, the cutting apparatus 1 includes a moving unit 30 that relatively moves the holding table 10 and the cutting unit 20. The moving unit 30 includes at least an X-axis moving unit 31 as a processing feeding unit that puts the holding table 10 into processing feeding in an X-axis direction parallel to a horizontal direction, a Y-axis moving unit 32 as an indexing feeding unit that puts the cutting unit 20 into indexing feeding in a Y-axis direction parallel to a horizontal direction and orthogonal to the X-axis direction, a Z-axis moving unit 33 as a cutting-in feeding unit that puts the cutting unit 20 into cutting-in feeding in a Z-axis direction orthogonal to both the X-axis direction and the Y-axis direction and parallel to the vertical direction, and a rotational moving unit 34 that rotates the holding table 10 in an axis parallel to the Z-axis direction.

The X-axis moving unit 31 moves the holding table 10 in the X-axis direction which is the processing feeding direction, to thereby put the holding table 10 and the cutting unit 20 into relative processing feeding in the X-axis direction. The Y-axis moving unit 32 moves the cutting unit 20 in the Y-axis direction which is the indexing feeding direction, to thereby put the holding table 10 and the cutting unit 20 into relative indexing feeding in the Y-axis direction. The Z-axis moving unit 33 moves the cutting unit 20 in the Z-axis direction which is the cutting-in feeding direction, to thereby put the holding table 10 and the cutting unit 20 into relative cutting-in feeding in the Z-axis direction. The rotational moving unit 34 supports the holding table 10. Moreover, the rotational moving unit 34 is moved toward the X-axis direction with the holding table 10 by the X-axis moving unit 31. In addition, the rotational moving unit 34 rotates a base 13, depicted in FIG. 2, of the holding table 10 around an axis 136, to thereby relatively rotate the holding plate 12 and the base 13 of the holding table 10 around the axes 126 and 136.

The X-axis moving unit 31, the Y-axis moving unit 32, and the Z-axis moving unit 33 each include a known ball screw provided to be rotatable around an axis, a

known motor that rotates the ball screw around the axis, and known guide rails that support the holding table 10 or the cutting unit 20 movably in the X-axis direction, the Y-axis direction, or the Z-axis direction.

The holding table 10 is provided to be movable in the X-axis direction over a processing region 2 under the cutting unit 20 and a carrying-in/out region 3 which is spaced from a lower side of the cutting unit 20 and where the workpiece 200 is carried in or out, by the X-axis moving unit 31, and is provided to be rotatable around an axis parallel to the Z-axis direction by the rotational moving unit 34. The configuration of the holding table 10 will be described later.

The cutting unit 20 is cutting means in which the cutting blade 21 for cutting the workpiece 200 held on the holding table 10 is detachably mounted. The cutting unit 20 is provided to be movable in the Y-axis direction by the Y-axis moving unit 32 and to be movable in the Z-axis direction by the Z-axis moving unit 33, relative to the workpiece 200 held on the holding table 10.

As illustrated in FIG. 1, the cutting unit 20 is provided on a support frame 5 erected from an apparatus main body 4, through the Y-axis moving unit 32, the Z-axis moving unit 33, and the like. The cutting unit 20 is

configured such that the cutting blade 21 can be positioned at an optional position of the holding surface 11 of the holding table 10, by the Y-axis moving unit 32 and the Z-axis moving unit 33.

The cutting unit 20 includes the cutting blade 21, a spindle housing 22 provided to be movable in the Y-axis direction and the Z-axis direction by the Y-axis moving unit 32 and the Z-axis moving unit 33, and a spindle 23 which is provided on the spindle housing 22 such as to be rotatable around an axis, which is rotated by an unillustrated motor, and which has a tip end on which the cutting blade 21 is mounted.

The cutting blade 21 is an extremely thin grindstone having a substantially ring-like shape. In the embodiment, the cutting blade 21 is what is called a hub blade which includes an annular circular base and an annular cutting edge disposed at a peripheral edge of the circular base and configured to cut the workpiece 200. The cutting edge includes abrasive grains of diamond, cubic boron nitride (CBN) or the like and a bond material (binder) such as a metal or a resin and is formed in a predetermined thickness. Note that in the present invention, the cutting blade 21 may be what is called a washer blade including only a cutting edge 212. The

cutting blade 21 is rotated, with the spindle 23 rotated around an axis by the motor. Note that axes of the cutting blade 21 and the spindle 23 of the cutting unit 20 are parallel to the Y-axis direction.

The imaging unit is fixed to the cutting unit 20 such as to be moved as one body with the cutting unit 20. The imaging unit includes an imaging element that images a region to be divided of the uncut workpiece 200 held on the holding table 10. The imaging element is, for example, a charge-coupled device (CCD) imaging element or a complementary metal oxide semiconductor (CMOS) imaging element. The imaging unit images the workpiece 200 held on the holding table 10 to obtain an image, for example, for performing alignment between the workpiece 200 and the cutting blade 21, and outputs the thus obtained image to the control unit 100.

In addition, the cutting apparatus 1 includes an unillustrated X-axis direction position detection unit for detecting the position of the holding table 10 in the X-axis direction, an unillustrated Y-axis direction position detection unit for detecting the position of the cutting unit 20 in the Y-axis direction, and a Z-axis direction position detection unit for detecting the position of the cutting unit 20 in the Z-axis direction.

The X-axis direction position detection unit and the Y-axis direction position detection unit can each include a linear scale parallel to the X-axis direction or the Y-axis direction and a reading head. The Z-axis direction position detection unit detects the position of the cutting unit 20 in the Z-axis direction by pulses of a motor. The X-axis direction position detection unit, the Y-axis direction position detection unit, and the Z-axis direction position detection unit output the position of the holding table 10 in the X-axis direction or the position of the cutting unit 20 in the Y-axis direction or the Z-axis direction to the control unit 100. Note that in the embodiment, the positions of each component of the cutting apparatus 1 in the X-axis direction, the Y-axis direction, and the Z-axis direction are determined as positions with reference to an unillustrated reference positions which are predetermined.

The control unit 100 control each component of the cutting apparatus 1, to cause the cutting apparatus 1 to perform a processing operation on the workpiece 200. Note that the control unit 100 is a computer that has an arithmetic processing device having a microprocessor such as a central processing unit (CPU), a storage device having a memory such as a read only memory (ROM) or a

random access memory (RAM), and an input-output interface device. The arithmetic processing device of the control unit 100 performs arithmetic processing according to a computer program stored in the storage device, and outputs control signals for controlling the cutting apparatus 1 to each component of the cutting apparatus 1 through the input-output interface device.

The control unit 100 is connected to an unillustrated display unit including, for example, a liquid crystal display for displaying the state of a processing operation and images, and an input unit used when an operator registers processing contents information and the like. The input unit includes at least one of a touch panel provided in the display unit and an external input device such as a keyboard.

(Holding Table)

As illustrated in FIGS. 1 and 2, the holding table 10 has a rectangular plan-view shape larger than that of the workpiece 200. As depicted in FIGS. 1, 2, and 3, the holding table 10 includes a holding plate 12 having a holding surface 11 for holding the workpiece 200 and a base 13 to which the holding plate 12 is detachably mounted.

The base 13 is rectangular in plan-view shape, is

formed in a thick flat plate shape, and is supported by a rotational moving unit 34. As illustrated in FIG. 2, the base 13 has an upper surface 131 formed flat in parallel to horizontal directions, and is formed in a central portion of the upper surface 131 with a suction recess 135 which is connected to a suction source 134 through a suction passage 132 and an on-off valve 133. In addition, as depicted in FIG. 3, the base 13 has hooks 14 erected from a peripheral side of the suction recess 135 of the upper surface 131. The hooks 14 are provided at both end portions in the longitudinal direction of the base 13, and the base 13 is provided with two hooks 14. In the present invention, however, the positions and the number of the hooks 14 are not limited to those described in the embodiment. As depicted in FIG. 3, each of the hooks 14 has an erected part 141 and a locking part 142.

The erected part 141 is erected from the upper surface 131 of the base 13 in a direction orthogonal to the upper surface 131. The erected part 141 is formed in a columnar shape erected from the upper surface 131. Note that, while the erected part 141 is formed in the shape of a tetragonal prismatic column in the embodiment, the shape is not limited to a tetragonal prismatic column in the present invention. The locking part 142 extends from

an upper end of the erected part 141 in a direction intersecting the erected part 141. The locking parts 142 of the two hooks 14 extend from upper ends of the erected parts 141 in opposite directions along the short direction of the base 13, and extend from the upper ends of the erected parts in the same direction of a circumference of a circle centered on an axis 136 which passes through the center of the upper surface 131 of the base 13 and is orthogonal to the upper surface 131. In addition, a lower end surface 143 of the locking part 142 is parallel to the upper surface 131, and in the embodiment, the locking part 142 has a thickness which is constant over the whole length in the extending direction from the upper end of the erected part 141.

The holding plate 12 is formed in a rectangular plan-view shape of the same size as the plan-view shape of the base 13 and is formed in a flat plate shape having a constant thickness. The holding surface 11 is fixed on the upper surface 131 of the base 13. As depicted in FIGS. 3, 4, and 5, the holding plate 12 includes a central chip holding part 121 and a frame-like part 122 that surrounds the chip holding part 121 and constitutes the holding surface 11 for holding the workpiece 200. The holding plate 12 has the workpiece 200 placed on the

holding surface 11 and holds the workpiece 200 on the holding surface 11.

The holding plate 12 is provided with relief grooves 15 at positions corresponding to streets of the workpiece 200 on the holding surface 11. Note that the corresponding positions herein are positions overlapping with each other in the thickness direction. The relief grooves 15 are formed ranging over the chip holding part 121 and the frame-like part 122. The relief grooves 15 are recessed from the holding surface 11 and are formed along the streets of the workpiece 200 held on the holding surface 11. The relief grooves 15 are formed in a width wider than the thickness of the cutting blade 21. The cutting blade 21 for cutting the workpiece 200 held on the holding surface 11 along the streets enters into the relief grooves 15.

The chip holding part 121 includes an elastically deformable synthetic resin such as rubber and is disposed at a position corresponding to the device region 201 of the workpiece 200 placed on the holding surface 11. The chip holding part 121 is provided with suction holes 16 at positions corresponding to the device chips of the workpiece 200 on the upper surface 123, namely, the holding surface 11. In the embodiment, the suction holes

16 are opened in the number of one in a region partitioned by the relieve grooves 15 in the upper surface 123, namely, the holding surface 11. The suction holes 16 penetrate the chip holding part 121 of the holding plate 12 in the thickness direction. Note that in FIGS. 3 and 5, the relief grooves 15 and the suction holes 16 are omitted.

As illustrated in FIGS. 5 and 6, a lower surface 125 of the holding plate 12 is provided with recesses 17 for engagement with the hooks 14. In the embodiment, the recesses 17 are provided in a lower surface of the frame-like part 122 of the lower surface 125 of the holding plate 12 and are formed to be recessed from the lower surface 125. In the embodiment, the recesses 17 are provided at both end portions in the longitudinal direction of the holding plate 12, and the holding plate 12 is provided with two recesses 17. In the present invention, however, the positions and the number of the recesses 17 are not limited to those described in the embodiment.

The plan-view shape of the recess 17 is an arcuate shape along the circumferential direction of a circle centered on the axis 126 which passes through the center of the lower surface 125 of the holding plate 12 and

which is orthogonal to the lower surface 125. With the plan-view shape of the recess 17 thus formed in an arcuate shape along the circumferential direction of a circle centered on the axis 126, the recess 17 is formed at a part corresponding to a track with which the hook 14 of the holding plate 12 makes contact when the holding plate 12 and the base 13 are relatively rotated around the axes 126 and 136.

In addition, in a state in which the lower surface 125 of the holding plate 12 is laid on the upper surface 131 of the base 13 and the holding plate 12 and the base 13 are deviated obliquely in plan directions, the hook 14 enters into the inside of one end part 171 of the recess 17. Note that the state in which the holding plate 12 and the base 13 are deviated obliquely in the plane directions means a state in which the longitudinal direction of the base 13 and the longitudinal direction of the holding plate 12 intersect each other.

Besides, when the base 13 and the holding plate 12 are relatively rotated around the axes 126 and 136 such as to make a change from a state in which the lower surface 125 of the holding plate 12 is laid on the upper surface 131 of the base 13 and the holding plate 12 and the base 13 are deviated obliquely in plane directions to

an overlapping positional relation, the hook 14 on the inside of the one end part 171 of the recess 17 is moved toward the other end part 172 of the recess 17. Note that the overlapping positional relation means a state in which the longitudinal direction of the base 13 and the longitudinal direction of the holding plate 12 are parallel to each other.

In addition, as depicted in FIG. 6, a fitting surface 173 which is a fitting part parallel to the holding surface 11 is provided at the other end part 172 of the recess 17 of the holding plate 12. When the lower surface 125 of the holding plate 12 is laid on the upper surface 131 of the base 13 and the holding plate 12 and the base 13 are positioned in the overlapping positional relation, the fitting surface 173 makes close contact with the lower end surface 143 of the locking part 142, and is fitted to the locking part 142. Note that the other end part 172 of the recess 17 of the holding plate 12 provided with the fitting surface 173 is one end in a plane direction parallel to the extending direction of the holding surface 11 of the recess 17.

With the abovementioned configuration, when the base 13 and the holding plate 12 are relatively rotated around the axes 126 and 136 by the rotational moving unit

34, while the hook 14 is accommodated in one end part 171 of the recess 17, so as to make a change from the state in which the lower surface 125 of the holding plate 12 is laid on the upper surface 131 of the base 13 into the overlapping positional relation, the fitting surface 173 of the recess 17 is thereby fitted to the lower end surface 143 of the hook 14, and the holding plate 12 is fixed to the base 13 in a state in which their longitudinal directions are parallel to each other. With the workpiece 200 placed on the holding surface 11 and with the suction holes 16 sucked by the suction source 134 through the suction passage 132 and the suction recess 135, the holding table 10 suction holds the workpiece 200 placed on the holding surface 11. In the embodiment, the holding table 10 suction holds the workpiece 200 which is divided by the cutting blade 21 entering into the relief grooves 15 into individual package device chips, on the holding surface 11 directly, without using an adhesive tape therebetween.

In addition, the holding plate 12 of the holding table 10 according to the embodiment is provided with fitting recesses 18 at both end portions in the longitudinal direction thereof. Beside, the holding plate 12 of the holding table 10 corresponds to the workpiece

200, with the relief grooves 15 corresponding to the streets of the workpiece 200 of a product number (type) held, and with the suction holes 16 corresponding to the device chips. The holding plates 12 of the holding table 10, with the product numbers (types) or the like of the corresponding workpieces 200 being different, are different in the number of the relief grooves 15, the number of the suction holes 16, the interval between the adjacent relief grooves 15, or the like. In addition, the holding table 10 according to the embodiment has the holding plate 12 fixed to the base 13 being changed correspondingly to the product number of the workpiece 200 to be cut.

Besides, the cutting apparatus 1 depicted in FIG. 1 includes a holding plate replacing mechanism 40 for changing the holding plate 12 to be fixed to the base 13. By replacing the holding plate 12 to be fixed to the base 13, the holding plate replacing mechanism 40 changes the holding plate 12 fixed to the base 13 correspondingly to the product number of the workpiece 200 to be cut by the cutting apparatus 1. As depicted in FIG. 1, the holding plate replacing mechanism 40 includes a holding plate holding section 41 and a carrying unit 42.

In the embodiment, the holding plate holding

section 41 is disposed on the apparatus main body 4 of the cutting apparatus 1. In the embodiment, a plurality of (two) holding plate holding sections 41 are provided and configured to hold the holding plates 12 corresponding respectively to the workpieces 200 of different product numbers.

The carrying unit 42 carries the holding plate 12 between the holding plate holding section 41 and the base 13 in the carrying-in/out region 3 and attaches and detaches the holding plate 12 to and from the base 13. The carrying unit 42 includes a carrying section main body 44 provided with a plurality of engaging claws 43 at a lower end thereof, a lift cylinder 45 for lifting the carrying section main body 44 upward and downward in the Z-axis direction, and a Y-axis moving unit 46 which is supported by a second support frame 6 erected from the apparatus main body 4 and which moves the lift cylinder 45 along the Y-axis direction.

The carrying section main body 44 is provided with the engaging claws 43 in the same number as the fitting recesses 18 provided in the holding plate 12, namely, in plurality (in the embodiment, two). In the embodiment, the engaging claws 43 are provided at both end portions in the X-axis direction of the carrying section main body

44. As depicted in FIG. 7, the engaging claw 43 is provided at a lower end thereof with a claw section 431 which can be fitted into the fitting recess 18. In addition, the carrying section main body 44 includes an unillustrated moving mechanism that moves the plurality of engaging claws 43 in such directions that the claw sections 431 of the engaging claws 43 are moved toward and away from each other.

The carrying section main body 44 causes the moving mechanism to move the claw sections 431 of the plurality of engaging claws 43 closer to each other, to fit the claw sections 431 of the engaging claws 43 into the fitting recesses 18, and to thereby hold the holding plate 12. The carrying section main body 44 causes the moving mechanism to move the claw sections 431 of the plurality of engaging claws 43 away from each other, to release the fitting of the claw sections 431 of the engaging claws 43 in the fitting recesses 18, and to thereby release the holding of the holding plate 12.

The carrying unit 42 holds the holding plate 12 on the holding plate holding section 41 by the carrying section main body 44, and carries the carrying section main body 44 holding the holding plate 12 to the base 13 in the carrying-in/out region 3 by the lift cylinder 45

and the Y-axis moving unit 46. Besides, after the holding plate 12 held by the carrying section main body 44 is fixed to the base 13, the carrying unit 42 releases the holding of the holding plate 12 by the carrying section main body 44, and carries the holding plate 12 on the holding plate holding section 41 to the base 13 in the carrying-in/out region 3.

In addition, the carrying unit 42 holds the holding plate 12 on the base 13 in the carrying-in/out region 3 by the carrying section main body 44, and carries the carrying section main body 44 holding the holding plate 12 to the holding plate holding section 41 by the lift cylinder 45 and the Y-axis moving unit 46. Besides, after the holding plate 12 held by the carrying section main body 44 is held by the holding plate holding section 41, the carrying unit 42 releases the holding of the holding plate 12 by the carrying section main body 44, and carries the holding plate 12 on the base 13 to the holding plate holding section 41.

(Processing Operation of Cutting Apparatus)

Before the cutting apparatus 1 starts a processing operation, the operator places the holding plate 12 on each holding plate holding section 41 and registers processing contents information in the control unit 100.

Note that the processing contents information includes the product number of the workpiece 200 as an object of cutting and the product number of the workpiece 200 to which the holding plate 12 placed on each holding plate holding section 41 corresponds.

Thereafter, the cutting apparatus 1 starts the processing operation when an instruction to start the processing operation is given from the operator. Upon starting the processing operation, the cutting apparatus 1 attaches and fixes the holding plate 12 corresponding to the product number of the workpiece 200 as an object of cutting to the base 13, and places the uncut workpiece 200 on the holding surface 11 of the holding table 10 in the carrying-in/out region 3. The cutting apparatus 1 suction holds the workpiece 200 on the holding surface 11 of the holding table 10, the X-axis moving unit 31 moves the holding table 10 toward the processing region 2, the imaging unit images the workpiece 200, and alignment is performed based on an image obtained by imaging by the imaging unit.

While relatively moving the workpiece 200 and the cutting unit 20 along the street, the cutting apparatus 1 causes the cutting blade 21 to cut into each street until the cutting blade 21 reaches the relief groove 15, to

thereby divide the workpiece 200 into individual package device chips. The cutting apparatus 1 moves the workpiece 200 divided into the individual package device chips toward the carrying-in/out region 3, and releases the suction holding on the holding surface 11 in the carrying-in/out region 3, to thereby finish the processing operation.

(Holding Plate Attaching Operation)

Next, a holding plate attaching operation of fixing the holding plate 12 to the base 13 will be described. FIG. 8 is a side view of a state in which one-end portions of the recesses in the workpiece held by the carrying unit of the processing apparatus depicted in FIG. 1 are positioned on a vertical-directionally upper side of the hooks of the base. FIG. 9 is a plan view depicting the holding plate and the base illustrated in FIG. 8. FIG. 10 is a side view of a state in which the lower surface of the holding plate illustrated in FIG. 8 is placed on the upper surface of the base. FIG. 11 is a plan view of a state in which the holding plate and the base illustrated in FIG. 10 are positioned into an overlapping positional relation. FIG. 12 is a sectional view taken along line XII-XII of FIG. 11.

In the embodiment, at the time when the holding

plate 12 corresponding to the product number of the workpiece 200 to be cut is attached and fixed to the base 13, first, the control unit 100 of the cutting apparatus 1 controls the Y-axis moving unit 46 of the carrying unit 42 of the holding plate replacing mechanism 40, and causes the carrying section main body 44 to position the holding plate 12 corresponding to the product number of the workpiece 200 as an object of cutting at a position on an upper side of the holding plate holding section 41. The control unit 100 of the cutting apparatus 1 controls the lift cylinder 45 of the carrying unit 42 of the holding plate replacing mechanism 40 and the like to lower the carrying section main body 44, thereafter holds the holding plate 12 corresponding to the product number of the workpiece 200 as an object of cutting by engaging it with the engaging claws 43, and raises the carrying section main body 44.

As illustrated in FIG. 8, the control unit 100 of the cutting apparatus 1 controls the Y-axis moving unit 46 of the carrying unit 42 of the holding plate replacing mechanism 40 to position the carrying section main body 44 at a position on an upper side of the base 13 in the carrying-in/out region 3. Note that in this instance, in the embodiment, the control unit 100 of the cutting

apparatus 1 controls the rotational moving unit 34 to put the holding plate 12 held by the carrying section main body 44 and the base 13 in the carrying-in/out region 3 into a state of being obliquely deviated in plane directions, such that the one end parts 171 of the recesses 17 of the holding plate 12 held by the carrying section main body 44 are positioned on an upper side of the hooks 14. Note that in FIG. 9, the suction recess 135, the relief grooves 15, and the suction holes 16 are omitted.

The control unit 100 of the cutting apparatus 1 controls the lift cylinder 45 of the carrying unit 42 of the holding plate replacing mechanism 40 to lower the carrying section main body 44, to thereby insert the hooks 14 into the one end parts 171 of the recesses 17 of the holding plate 12 held by the carrying section main body 44, and to lay the lower surface 125 of the holding plate 12 on the upper surface 131 of the base 13, as illustrated in FIG. 10. In the embodiment, the control unit 100 of the cutting apparatus 1 controls the rotational moving unit 34 to rotate the base 13 around the axis 136 in such a direction that the hooks 14 are moved toward the other end parts 172 of the recesses 17. In the embodiment, the control unit 100 of the cutting

apparatus 1 controls the rotational moving unit 34 to position the holding plate 12 and the base 13 from an obliquely deviated state into an overlapping positional relation, as depicted in FIG. 11, whereon the rotation of the rotational moving unit 34 is stopped. Note that in FIG. 11, the relief grooves 15 and the suction holes 16 are omitted.

Then, as depicted in FIG. 12, the lower end surface 143 makes close contact with the fitting surface 173, the lower surface 143 is fitted to the fitting surface 173, and the recesses 17 are fitted to the hooks 14, thereby fixing the holding plate 12 to the base 13. Note that when the holding plate 12 of the holding table 10 is fixed to the base 13, the upper surface 131 of the base 13, the lower surface 125 of the holding plate 12, and the holding surface 11 become parallel to one another.

The control unit 100 of the cutting apparatus 1 controls the moving mechanism of the carrying unit 42 of the holding plate replacing mechanism 40 to release the engagement of the engaging claws 43, thereafter controls the lift cylinder 45 to raise the carrying section main body 44, and finishes the operation of attaching the holding plate 12 to the base 13. Note that at the time of detaching the holding plate 12 from the base 13 and

carrying the thus detached holding plate 12 to the holding plate holding section 41, the cutting apparatus 1 performs an operation reverse to that at the time of fitting and fixing the holding plate 12 to the base 13.

As has been described above, in the holding table 10 according to the embodiment, the base 13 is provided with the hooks 14 whereas the holding plate 12 is provided with the recesses 17, and therefore, the structure is simple, and an unnecessary space is not taken. In addition, in the holding table 10 according to the embodiment, since the recesses 17 are fitted to the hooks 14 by relatively rotating the holding plate 12 and the base 13 from a state of being obliquely deviated in plane directions into the overlapping positional relation while the hooks 14 are accommodated in the recesses 17, fixation of the holding plate 12 to the base 13 and the detachment of the holding plate 12 from the base 13 can be performed by the relative rotating operation of the holding plate 12 and the base 13, and therefore, automatic replacement of the holding plate 12 by the holding plate replacing mechanism 40 which is a device is easy to carry out.

As a result, the holding table 10 according to the embodiment produces an effect that the holding plate 12

can be sufficiently fixed to the cutting apparatus 1 and that automatic replacement of the holding plate 12 by the holding plate replacing mechanism 40 can be enabled.

In addition, since, in the holding table 10 according to the embodiment, the hook 14 includes the erected part 141 and the locking part 142 and the recess 17 has at the other end part the fitting surface 173 for fitting to the lower end surface 143 of the locking part 142, the holding plate 12 can be fixed to the base 13.

Besides, since, in the holding table 10 according to the embodiment, the recess 17 is formed in an arcuate shape along the circumferential direction of a circle centered on the axis 126, it is possible, by relatively rotating the base 13 and the holding plate 12 around the axes 126 and 136, to attach and detach the holding plate 12 to and from the base 13.

[Modification]

Holding tables according to modifications of the embodiment of the present invention will be described based on the drawings. FIG. 13 is a sectional view of a major part of a holding table according to a first modification of the embodiment. FIG. 14 is a sectional view of a major part of a holding table according to a second modification of the embodiment. FIG. 15 is a

perspective view of a holding plate of a holding table according to a third modification of the embodiment. FIG. 16 is a sectional view of a major part of the holding plate depicted in FIG. 15. Note that in FIGS. 13, 14, 15, and 16, the same parts as those in the embodiment above are denoted by the same reference symbols as used above, and descriptions thereof are omitted.

As illustrated in FIGS. 13 and 14, the holding table 10 of the present invention may have a configuration in which the lower end surface 143 of the locking part 142 of the hook 14 and the fitting surface 173 of the recess 17 which are fitted to each other are inclined relative to the upper surface 131 of the base 13, the lower surface 125 of the holding plate 12, and the holding surface 11. Note that, in the examples depicted in FIGS. 13 and 14, the lower end surface 143 of the locking part 142 of the hook 14 is inclined in such a direction as to be gradually spaced away from the upper surface 131 of the base 13 in going away from the erected part 141, and the fitting surface 173 is inclined in such a direction as to gradually approach the lower surface 125 of the holding plate 12 in going toward the one end part 171. In addition, in the first modification illustrated in FIG. 13, a perpendicular surface 144

orthogonal to the upper surface 131 of the base 13, the lower surface 125 of the holding plate 12, and the holding surface 11 is formed at a tip end of the hook 14, whereas in the second modification depicted in FIG. 14, the perpendicular surface 144 is not formed but a corner is formed at the tip end of the hook 14.

Besides, as depicted in FIGS. 15 and 16, the holding table 10 of the present invention may have a configuration in which the recess 17 penetrates the frame-like part 122 of the holding plate 12. In addition, in the third modification as illustrated in FIGS. 15 and 16, like in the first modification and the second modification, the lower end surface 143 of the locking part 142 of the hook 14 and the fitting surface 173 of the recess 17 which are fitted to each other may be inclined relative to the upper surface 131 of the base 13, the lower surface 125 of the holding plate 12, and the holding surface 11. Note that in FIG. 15, the relief grooves 15 and the suction holes 16 are omitted.

In the holding tables 10 according to the first modification, the second modification, and the third modification, the base 13 is provided with the hooks 14, the holding plate 12 is provided with the recesses 17, and the recesses 17 are fitted to the hooks 14 by

relatively rotating the holding plate 12 and the base 13 from a state of being obliquely deviated in plane directions into an overlapping positional relation while the hooks 14 are accommodated in the recesses 17. Therefore, like in the embodiment, there is produced an effect that the holding plate 12 can be sufficiently fixed to the cutting apparatus 1, and automatic replacement of the holding plate 12 by the holding plate replacing mechanism 40 can be enabled.

Note that the present invention is not limited to the above-described embodiment and modifications. In other words, the present invention can be carried out with various modifications within such ranges as not to depart from the gist of the invention. Note that, while only the base 13 has been rotated around the axis 136 to relatively rotate the holding plate 12 and the base 13 in the abovementioned embodiment, in the present invention, only the holding plate 12 may be rotated around the axis 126, or both the base 13 and the holding plate 12 may be rotated around the axes 126 and 136.

The present invention is not limited to the details of the above described preferred embodiments. The scope of the invention is defined by the appended claims and all changes and modifications as fall within the

equivalence of the scope of the claims are therefore to be embraced by the invention.

WHAT IS CLAIMED IS:

1. A holding table for holding a workpiece, the holding table comprising:

a holding plate that has a holding surface for holding the workpiece; and

a base to which the holding plate is detachably mounted,

wherein the base has a hook erected from an upper surface thereof,

the holding plate has in a lower surface thereof a recess for engagement with the hook, and

the holding plate and the base, with the hook accommodated in the recess, are relatively rotated from a state of being obliquely deviated in plane directions into an overlapping positional relation, to thereby fit the hook to the recess and fix the holding plate to the base.

2. The holding table according to claim 1,

wherein the hook has

an erected part erected from the upper surface of the base, and

a locking part extending in a direction intersecting the erected part, and

the recess has, at one end in a plane direction

parallel to an extending direction of the holding surface, a fitting part for fitting to the locking part.

3. The holding table according to claim 1,
wherein the recess is formed in a part corresponding to a track with which the hook makes contact when the holding plate and the base are relatively rotated.