

[Document Name] Specification

[Title of the Invention] CUTTING APPARATUS AND METHOD OF
MANUFACTURING CUT PRODUCT

[Technical Field]

5 [0001]

The present invention relates to a cutting apparatus and a method of
manufacturing a cut product.

[Technical Background]

10 [0002]

Conventionally, as is shown in Patent Document 1, for example, a structure has
been developed in which a separating table has a dividing separating table portion, and
by tilting this dividing separating table portion in a Z direction, a wafer placed on top of
the separating table is bent into an inverted V shape thereby enabling this wafer to be
15 divided into two pieces.

[Documents of the Prior Art]

[Patent Documents]

[0003]

[Patent Document 1] Japanese Unexamined Patent Application (JP-A) No. 2015-191993

20 [Disclosure of the Invention]

[Problems to be Solved by the Invention]

[0004]

In recent years, in semiconductor packages such as an SOT (Small Outline
Transistor) or an SOIC (Small Outline Integrated Circuit), in order to manufacture a
25 greater number of packages using the same-sized lead frames, as is shown in FIG. 14,

resin-molded substrates that are resin-molded using lead frames in which the leads are mutually staggered relative to each other are manufactured.

[0005]

However, in a resin-molded substrate that utilizes lead frames whose leads are
5 formed so as to be mutually staggered, because the cutting lines of the package are not all positioned on the same straight lines, it is difficult to cut them using a cutting apparatus that employs a conventional blade.

[0006]

The present invention was therefore conceived in order to solve the above-
10 described problem, and it is a principal object thereof to make it possible, using a blade, to easily cut an object to be cut whose cutting lines within mutually adjacent separating elements are set on mutually different straight lines.

[Means for Solving the Problem]

[0007]

15 Namely, a cutting apparatus according to the present invention is a cutting apparatus that cuts, along cutting lines, an object to be cut in which a plurality of separating elements are connected together by means of connecting portions, and in which the cutting lines within the separating elements that are mutually adjacent to each other are set on mutually different straight lines, and is characterized in being provided
20 with a cutting table on which the object to be cut is held by means of suction, and a cutting mechanism that, using a blade, cuts the object to be cut that is being held on the cutting table, and is also characterized in that the cutting table is separated into a first table portion that, regarding the mutually adjacent separating elements, holds one of the separating elements by means of suction, and a second table portion that holds the other
25 of the separating elements by means of suction, and in that the first table portion and the

second table portion are formed so as to be able to move relatively to each other.

[Effects of the Invention]

[0008]

According to the present invention that is formed in the manner described above,
5 it is possible to enable an object to be cut whose cutting lines within mutually adjacent
separating elements are set on mutually different straight lines to be cut easily using a
blade.

10 [Brief Description of the Drawings]

[0009]

[FIG. 1] FIG. 1 is a plan view schematically showing an object to be cut.

[FIG. 2] FIG. 2 is a partially enlarged plan view showing cutting lines of an
object to be cut.

15 [FIG. 3] FIG. 3 is a plan view schematically showing a structure of a cutting
apparatus of a first embodiment of the present invention.

[FIG. 4] FIG. 4 is a plan view schematically showing a first state of a cutting
table of the same embodiment.

[FIG. 5] FIG. 5 is a plan view schematically showing a second state of the
20 cutting table of the same embodiment.

[FIG. 6] FIG. 6 is a plan view schematically showing a structure of each table
portion of the same embodiment.

[FIG. 7] FIG. 7 contains a cross-sectional view schematically showing a
structure of a variant example of a cutting table, and plan views schematically showing
25 the structures of each table portion.

[FIG. 8] FIG. 8 contains a plan view and a cross-sectional view schematically showing a structure of a transporting mechanism (i.e., a loader) of the same embodiment.

[FIG. 9] FIG. 9 contains a plan view and a cross-sectional view schematically showing a structure of a discharging mechanism (i.e., an unloader) of the same
5 embodiment.

[FIG. 10] FIG. 10 contains plan views showing each state of a cutting operation of the same embodiment.

[FIG. 11] FIG. 11 contains cross-sectional views showing each state of a cutting operation of a cutting table of a second embodiment.

10 [FIG. 12] FIG. 12 contains a plan view and a cross-sectional view schematically showing a structure of a discharging mechanism (i.e., an unloader) of the second embodiment.

[FIG. 13] FIG. 13 contains plan views showing an object to be cut according to a variant embodiment and a cutting method for the same.

15 [FIG. 14] FIG. 14 is a plan view showing a resin-molded substrate that utilizes lead frames whose leads are formed staggered relative to each other.

[Description of the Reference Numerals]

[0010]

20 100 ... Cutting Apparatus

W ... Object to be Cut

W1 ... Odd-Numbered Row Separating Elements (Plurality of Separating Elements)

W2 ... Even-Numbered Row Separating Elements (Plurality of Separating Elements)

W3 ... Connecting Portions

25 CL1, CL2 ... Cutting Lines

P ... Cut Products

2 ... Cutting Table

2A ... First Table Portion

2B ... Second Table Portion

5 3 ... Cutting Mechanism

31 ... Blade

4 ... Loader (Transporting Mechanism)

411 ... Transporting Suction Portion

10

[Best Embodiments for Implementing the Invention]

[0011]

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

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[0012]

As is described above, the cutting apparatus according to the present invention is a cutting apparatus that cuts, along straight lines, an object to be cut in which a plurality of separating elements are connected together by means of connecting portions, and in which the cutting lines within the separating elements that are mutually adjacent to each other are set on mutually different straight lines, and is characterized in being provided with a cutting table on which the object to be cut is held by means of suction, and a cutting mechanism that, using a blade, cuts the object to be cut that is being held on the cutting table, and is also characterized in that the cutting table is separated into a first table portion that, regarding the mutually adjacent separating elements, holds one of the

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separating elements by means of suction, and a second table portion that holds the other of the separating elements by means of suction, and in that the first table portion and the second table portion are formed so as to be able to move relatively to each other.

If this type of cutting apparatus is employed, then by moving the first table
5 portion that suctions one of the mutually adjacent separating elements relatively to the second table portion that suctions the other of the mutually adjacent separating elements, it is possible to position the cutting lines of the mutually adjacent separating elements on the same straight line, or to stagger mutually adjacent separating elements relative to each other in an up-down direction. As a result, it is possible to enable an object to be
10 cut whose cutting lines within mutually adjacent separating elements are set on mutually different straight lines to be easily cut by means of a blade.

[0013]

A specific aspect of a cutting table that may be considered is a structure in which the first table portion and the second table portion are formed in such a way that, in a
15 state in which the connecting portions have been cut by the cutting mechanism so that the mutually adjacent separating elements have been separated from each other, the first table portion and the second table portion are able to move relatively to each other within the same plane so that the respective cutting lines of each of the mutually adjacent separating elements are positioned on the same straight line.

20 [0014]

In this structure, once the respective cutting lines of the mutually adjacent separating elements have been positioned on the same straight lines by the first table portion and the second table portion, if, in this state, the cutting mechanism cuts the mutually adjacent separating elements, then the mutually adjacent separating elements
25 can be cut collectively in a single cutting operation.

[0015]

Another specific aspect of a cutting table that may be considered is a structure in which the first table portion and the second table portion are formed in such a way that, in a state in which the connecting portions have been cut by the cutting mechanism so that the mutually adjacent separating elements have been separated from each other, the first table portion and the second table portion are able to move relatively to each other in an up-down direction so that one of the mutually adjacent separating elements is positioned above the other of the mutually adjacent separating elements.

[0016]

In this structure, once one of the mutually adjacent separating elements has been raised above the other of the mutually adjacent separating elements by the first table portion and the second table portion, if, in this state, the cutting mechanism cuts the one of the mutually adjacent separating elements, then the mutually adjacent separating elements can be cut individually.

[0017]

A specific aspect of an object to be cut that may be considered is an object in which the plurality of separating elements are arranged in rows in the direction in which they will be cut by the blade, and their placement modes are divided into at least two groups, and the cutting lines of the separating elements of one of these groups are positioned on the same straight lines, while the cutting lines of the separating elements of another of these groups are positioned on the same straight lines.

In an object to be cut having this structure, it is desirable that the first table portion suction the separating elements of the one group, and that the second table portion suction the separating elements of the other group.

[0018]

In a case in which it is hypothesized that only the one or only the other one of the mutually adjacent separating elements may be suctioned and then either repositioned on the cutting table or removed from the cutting table, then it may be considered that the cutting apparatus of the present invention may be further provided with a transporting
5 mechanism that transports the object to be cut to the cutting table, and that the transporting mechanism may have a transporting suction portion that suctions only the one or only the other one of the mutually adjacent separating elements.

[0019]

In this case, it is desirable that the transporting mechanism be formed so as to
10 conform with the suctioning mode of the cutting table, and providing the transporting mechanism with a first transporting suction portion that suctions the separating elements of the one group, and a second transporting suction portion that suctions the separating elements of the other group may be considered.

[0020]

15 Furthermore, a method of manufacturing a cut product using the above-described cutting apparatus is also an aspect of the present invention.

[0021]

(First Embodiment of the Present Invention)

Hereinafter, a first embodiment of a cutting apparatus according to the present
20 invention will be described with reference to the drawings. Note that, in order to make each of the following drawings easier to understand, they are shown in schematic form and portions thereof may be omitted or emphasized as is appropriate. Moreover, the same descriptive symbols are employed for component elements that are the same in different drawings and any duplicated description of these component elements may be
25 omitted as is appropriate.

[0022]

(Cutting Apparatus Overall Structure)

A cutting apparatus 100 of the present embodiment cuts an object to be cut W into a plurality of individual cut products P (i.e., products P) by cutting along cutting
5 lines CL0 to CL2 that are set on the object to be cut W.

[0023]

Here, as is shown in FIG. 1 and FIG. 2, in the object to be cut W a plurality of separating elements W1 and W2 are connected together by means of connecting portions W3, and cutting lines CL1 and CL2 within mutually adjacent separating elements W1
10 and W2 are set on mutually different straight lines. A plurality of chips are sealed by means of resin molding in the respective separating elements W1 and W2 and, here, a plurality of chips are arranged in a row. Moreover, leads are provided for each of the chips. In addition, the plurality of separating elements W1 and W2 are aligned in a direction in which they will be cut (i.e., in a left-right direction in FIG. 1) by a blade 31
15 (see FIG. 3), and both end portions of the separating elements W1 and W2 are connected together by means of the connecting portions W3. More specifically, a structure is employed in which the separating elements W1 in odd-numbered rows that form one group, and the separating elements W2 in even-numbered rows that form another group are each formed in such a way that the respective leads thereof are staggered relative to
20 each other. As a result, the cutting lines CL1 of the separating elements W1 in the odd-numbered rows forming one group are all positioned on the same straight lines, while the cutting lines CL2 of the separating elements W2 in the even-numbered rows forming the other group are also all positioned on the same straight lines. Moreover, the straight lines on which the cutting lines CL1 of the separating elements W1 in the odd-numbered
25 rows are positioned are different from the straight lines on which the cutting lines CL2 of

the separating elements W2 in the even-numbered rows are positioned (see FIG. 2).

Note that the symbols CL0 in FIG. 2 indicate cutting lines that are used to cut the connecting portions W3 and separate the plurality of separating elements W1 and W2.

Moreover, the cutting lines CL0 to CL2 shown in the respective drawings are virtual

5 lines where it is intended that the object to be cut W will be cut by the blade 31, and do not appear on the actual object to be cut W.

[0024]

More specifically, as is shown in FIG. 3, the cutting apparatus 100 is provided

with a cutting table 2 that holds the object to be cut W by means of suction, a cutting

10 mechanism 3 that cuts the object to be cut W that is being held on the cutting table 2

using the blade 31, a transporting mechanism 4 (this may be referred to below as a loader

4) that transports the object to be cut W to the cutting table 2, and a discharging

mechanism 5 (this may be referred to below as an unloader 5) that transports cut products

P that have been cut on the cutting table 2 away from the cutting table 2.

15 [0025]

The cutting table 2 holds the object to be cut W by means of suction and, as is

shown in FIG. 4 through FIG. 6, is separated into a first table portion 2A that holds by

means of suction the one of the mutually adjacent separating elements W1 and W2,

namely, the separating elements W1, and a second table portion 2B that holds by means

20 of suction the other of the mutually adjacent separating elements W1 and W2, namely,

the separating elements W2. Note that the cutting table 2 is formed so as to be able to

be moved in its entirety in at least a Y direction by a moving mechanism (not shown in

the drawings). Moreover, the cutting table 2 may also be formed so as to be able to be

rotated in its entirety in a θ direction by a rotating mechanism (not shown in the

25 drawings).

[0026]

The first table portion 2A collectively holds by means of suction the odd-numbered rows (i.e., row 1, row 3, row 5, ...) of the separating elements W1 of the object to be cut W, while the second table portion 2B collectively holds by means of suction the even-numbered rows (i.e., row 2, row 4, row 6, ...) of the separating elements W2 of the object to be cut W. As is shown in FIG. 6, in particular, the first table portion 2A of the present embodiment is formed in a comb teeth shape in which a plurality of first mounting portions 2A1 that correspond to the separating elements W1 of the odd-numbered rows are connected together by connecting components 2A2, while the second table portion 2B is also formed in a comb teeth shape in which a plurality of second mounting portions 2B1 that correspond to the separating elements W2 of the even-numbered rows are connected together by connecting components 2B2.

[0027]

In addition to this, as is shown, for example, in FIG. 7, it is also possible to employ a structure in which the first table portion 2A is formed in a ladder shape in which both end portions of the plurality of first mounting portions 2A1 that correspond to the separating elements W1 of the odd-numbered rows are connected together by the connecting components 2A2, and in which the second table portion 2B has the plurality of second mounting portions 2B1 that correspond to the separating elements W2 of the even-numbered rows, and these second mounting portions 2B1 are disposed between the first mounting portions 2A1 of the first table portion 2A. Note that the plurality of second mounting portions 2B1 are connected together via a base component 2B3 underneath the first table portion 2A.

[0028]

Moreover, as is shown in FIG. 4 through FIG. 6, the first table portion 2A also

has a first table suctioning portion 21 that suctions the separating elements W1 of the odd-numbered rows, while the second table portion 2B has a second table suctioning portion 22 that suctions the separating elements W2 of the even-numbered rows. The first table suctioning portion 21 and the second table suctioning portion 22 are independent of each other. In addition, the first table suctioning portion 21 and the second table suctioning portion 22 may be formed in such a way that they can be switched independently of each other between a suctioning state and a non-suctioning state, or in such a way that they can both be switched simultaneously between a suctioning state and a non-suctioning state.

10 [0029]

The first table suctioning portion 21 has first suction holes 21a that open in an upper surface of the first table portion 2A (i.e., an upper surface of the first mounting portion 2A1), a first internal flow path 21b that is formed inside the first table portion 2A and communicates with the first suction holes 21a, and a first suction pump 21c that is connected to the first internal flow path 21b. Moreover, the second table suctioning portion 22 has second suction holes 22a that open in an upper surface of the second table portion 2B (i.e., an upper surface of the second mounting portion 2B1), a second internal flow path 22b that is formed inside the second table portion 2B and communicates with the second suction holes 22a, and a second suction pump 22c that is connected to the second internal flow path 22b. Note that it is also possible to employ a structure in which a single suction pump is used in common for both the first suction pump 21c and the second suction pump 22c, and the internal flow path that is connected to this single suction pump is switched using, for example, a switching valve (not shown in the drawings). Note also that it is also possible to use an ejector instead of a suction pump.

25 [0030]

As is shown in FIG. 4 and FIG. 5, the first table portion 2A and the second table portion 2B are formed such that they are able to move relatively to each other in an X direction. More specifically, a structure is employed in which, in a state in which the connecting portions W3 have been cut by the cutting mechanism 3 so that the mutually adjacent separating elements W1 and W2 have been separated from each other, the first table portion 2A and the second table portion 2B are able to move relatively to each other in an X direction within the same plane so that the respective cutting lines CL1 and CL2 of the mutually adjacent separating elements W1 and W2 are positioned respectively on the same straight lines. As a result of this, the mutually adjacent separating elements W1 and W2 can all be cut in a single cutting operation.

[0031]

In the present embodiment, the first table portion 2A and the second table portion 2B are formed such that the respective mounting portions 2A1 and 2B1 thereof are able to move in parallel relative to each other in the X direction. The first table portion 2A and the second table portion 2B perform this parallel movement relative to each other between (i) a first state (see FIG. 4) in which the connecting portions W3 are cut, and (ii) a second state (see FIG. 5) in which, once the connecting portions W3 have been cut, the respective cutting lines CL1 and CL2 of the mutually adjacent separating elements W1 and W2 are aligned respectively on the same straight lines.

[0032]

A structure in which the cutting table 2 has a moving mechanism 8 that causes the second table portion 2B to move in parallel in the X direction relative to the first table portion 2A may be considered as a structure for causing the respective table portions 2A and 2B to move relatively to each other within the same plane. Note that the first table portion 2A is fixed in place.

[0033]

More specifically, the moving mechanism 8 has an elastic component 81 such as a spring or the like, for example, that urges the second table portion 2B towards the first table portion 2A side, and an adjusting component 82 that is sandwiched between the
5 connecting component 2A2 of the first table portion 2A and the connecting portion 2B2 of the second table portion 2B, and adjusts a distance between the first table portion 2A and the second table portion 2B. The thickness of the adjusting component 82 changes in the portion thereof that is inserted between the connecting component 2A2 of the first table portion 2A and the connecting portion 2B2 of the second table portion 2B. The
10 adjusting component 82 of the present embodiment has a narrow-width portion 821 on an insertion distal end side thereof, and a broad-width portion 822 on a base end side thereof. The positions of the first table portion 2A and the second table portion 2B relative to each other are adjusted by varying the amount that the adjusting component 82 is inserted. Here, the first state (see FIG. 4) is set when the broad-width portion 822 is
15 inserted between the connecting component 2A2 and the connecting component 2B2, and the second state (FIG. 5) is set when the narrow-width portion 821 is inserted between the connecting component 2A2 and the connecting component 2B2. Note that the amount that the adjusting component 82 is inserted is adjusted by an actuator (not shown in the drawings) such as, for example, an air cylinder, a hydraulic cylinder, or a motor or
20 the like.

[0034]

In addition to this, it is also possible for the moving mechanism 8 to move at least one of the first table portion 2A and the second table portion 2B using an actuator such as, for example, an air cylinder or a motor or the like. In this case, for example,
25 the positional adjustment amount of the separating elements W2 in the even-numbered

rows may be set in advance, and the actuator may then be controlled based on this positional adjustment amount. Alternatively, cameras may be used to perform image recognition of the placement of the separating elements W1 of the odd-numbered rows and the separating elements W2 of the even-numbered rows (for example, of characteristic portions thereof such as edge portions or lead portions), and the amount of movement required in order to position the separating elements W2 of the even-numbered rows may be calculated from this image recognition, and then the actuator may be controlled based on the calculated amount of movement.

[0035]

The cutting mechanism 3 cuts the object to be cut W in a straight line, and, as is shown in FIG. 3, is provided with a blade 31, a spindle portion 32 that causes the blade 31 to rotate, and a moving mechanism (not shown in the drawings) that causes the spindle portion 32 to move in at least the X direction and the Z direction. A direction of the axis of rotation of the blade 31 is parallel with the upper surface of the cutting table 2 and, here, is a direction that extends in a horizontal direction. The object to be cut W is cut by the blade 31 as a result of the cutting table 2 and the cutting mechanism 3 being moved relatively to each other.

[0036]

The loader 4 transports an object to be cut W from an object to be cut housing portion 6 (see FIG. 3) that houses the object to be cut W to the cutting table 2. More specifically, as is shown in FIG. 8, the loader 4 is provided with a suction block 41 in which a transporting suction portion 411 that is used to suction the object to be cut W is provided, and a moving mechanism (not shown in the drawings) that moves the suction block 41.

[0037]

The transporting suction portion 411 of the suction block 41 has suction holes 411a that open in a lower surface of the suction block 41, an internal flow path 411b that is formed inside the suction block 41 and communicates with the suction holes 411a, and a suction pump 411c that is connected to the internal flow path 411b. Suction pads 411d that are made, for example, from resin or the like are provided for the suction holes 411a. Note that it is also possible for two transporting suction portion 411 systems to be provided independently of each other, with one system suctioning the separating elements W1 of the odd-numbered rows and the other system suctioning the separating elements W2 of the even-numbered rows.

10 [0038]

The unloader 5 suction cuts products P that have already been cut, and transports these cut products P from the cutting table 2 to a cut product housing portion 7 (see FIG. 3). More specifically, as is shown in FIG. 9, the unloader 5 is provided with a suction block 51 in which a transporting suction portion 511 that is used to suction the cut products P is provided, and a moving mechanism (not shown in the drawings) that moves this suction block 51.

[0039]

The transporting suction portion 511 of the suction block 51 has suction holes 511a that open in a lower surface of the suction block 51, an internal flow path 511b that is formed inside the suction block 51 and communicates with the suction holes 511a, and a suction pump 511c that is connected to the internal flow path 511b. Suction pads 511d that are made, for example, from resin or the like are provided for the suction holes 511a. Note that, in FIG. 9, the suction holes 511a of the odd-numbered rows and the suction holes 511a of the even-numbered rows are aligned on straight lines in the Y direction, however, they may also be offset from each other.

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[0040]

(Cutting Operation of the Cutting Apparatus 100)

An operation of the cutting apparatus 100 will now be described with reference to FIG. 10. Note that the cutting operation described below is performed as a result of each portion being controlled by a control portion CTL (see FIG. 3).

[0041]

(1) Loading of an object to be cut W.

The loader 4 holds by means of suction an object to be cut W that is being housed in the object to be cut housing portion 6, and transports it to the cutting table 2.

10 The object to be cut W that has been transported to the cutting table 2 is held by means of suction by the first table portion 2A and the second table portion 2B of the cutting table 2 (shown in FIG. 10 as [Suction holding of object to be cut]). Here, the positioning of the object to be cut W on the cutting table 2 may be achieved, for example, by fitting positioning pins that are provided on the cutting table 2 into positioning holes that are

15 formed in the object to be cut W. In addition, this positioning may also be achieved by fitting positioning pins that are provided on the loader 4 into positioning holes that are formed in the object to be cut W. Note that, when the object to be cut W is being loaded, the broad-width portion 822 of the adjusting component 82 is inserted between the first table portion 2A and the second table portion 2B so that these are set in the first

20 state (see FIG. 4).

[0042]

(2) Cutting of the object to be cut W

The connecting portions W3 of the object to be cut W that is being held by means of suction on the cutting table 2 are cut by the cutting mechanism 3 (shown in

25 FIG. 10 as [Cutting of connecting portions]). In the present embodiment, the respective

connecting portions W3 that connect together the two end portions of the plurality of separating elements W1 and W2 are each cut. As a result, the plurality of separating elements W1 and W2 of the object to be cut W are placed in a state of separation from each other. In this state, the cutting lines CL1 and CL2 of the separating elements W1 of the odd-numbered rows and the separating elements W2 of the even-numbered rows are not positioned on the same straight lines, but are positioned alternately from each other (i.e., in a zig-zag pattern) on mutually different straight lines.

[0043]

(3) Alignment of the separating elements W2 of the even-numbered rows (i.e., moving of the second table portion 2B)

In a state in which the connecting portions W3 have been cut so that the mutually adjacent separating elements W1 and W2 have been separated from each other, the second table portion 2B of the cutting table 2 is moved by the moving mechanism 8 (shown in FIG. 10 as [Alignment of even-numbered rows]). More specifically, the narrow-width portion 821 of the adjusting component 82 is inserted between the first table portion 2A and the second table portion 2B so that these are set in the second state (see FIG. 5). When the adjusting component 82 that is inserted between the first table portion 2A and the second table portion 2B is changed from the broad-width portion 822 to the narrow-width portion 821, the second table portion 2B is moved towards the first table portion 2A side by the elastic force of the elastic component 81. When the narrow-width portion 821 of the adjusting component 82 is inserted between the first table portion 2A and the second table portion 2B, the cutting lines CL2 of the separating elements W2 of the even-numbered rows are aligned so as to be on the same straight line as the cutting lines CL1 of the separating elements W1 of the odd-numbered rows.

Note that the suctioning of the respective separating elements W1 and W2 is maintained

by the respective table portions 2A and 2B.

[0044]

(4) Cutting of the separating elements W1 and W2 of the odd-numbered rows and even-numbered rows

5 After the second table portion 2B that is holding the separating elements W2 of the even-numbered rows has been moved, the cutting mechanism 3 cuts the cutting lines CL1 of the separating elements W1 of the odd-numbered rows and the cutting lines CL2 of the separating elements W2 of the even-numbered rows that are both located on the same straight lines (shown in FIG. 10 as [Cutting of odd-numbered rows and even-

10 numbered rows]). Note that prior to cutting the plurality of separating elements W1 and W2, it is also possible to perform image recognition using cameras in order to confirm that the cutting lines CL1 of the separating elements W1 of the odd-numbered rows and the cutting lines CL2 of the separating elements W2 of the even-numbered rows are both actually located on the same straight lines.

15 [0045]

(5) Discharging of cut products P

The unloader 5 employs suction to hold the plurality of cut products P that are being held by means of suction on the cutting table 2 and transports them to the cut product housing portion 7. Here, before the suctioning by the cutting table 2 is

20 canceled, it is also possible to press the suction pads 511d of the unloader 5 against the plurality of cut products P so as to prevent any mispositioning of the plurality of cut products P or suction errors or the like. Note that, when the plurality of cut products P are being suctioned by the unloader 5, the first table portion 2A and the second table portion 2B may be left in the second state, or may be restored to the first state.

25 [0046]

(Effects Obtained from the First Embodiment)

According to the cutting apparatus 100 of the first embodiment, by causing the first table portion 2A that is suctioning one of the mutually adjacent separating elements W1 and W2 and the second table portion 2B that is suctioning the other of the mutually adjacent separating elements W1 and W2 to move relatively to each other within the same plane, it is possible to position the cutting lines CL1 and CL2 of the mutually adjacent separating elements W1 and W2 on the same straight lines. As a result, it is possible to enable an object to be cut W in which the cutting lines CL1 and CL2 of the mutually adjacent separating elements W1 and W2 are set on mutually different straight lines to be easily cut by means of the blade 31.

[0047]

(Second Embodiment of the Present Invention)

Next, a second embodiment of the cutting apparatus according to the present invention will be described with reference to the drawings. Note that in the cutting apparatus 100 of the second embodiment, the structure of the cutting table 2 and the unloader 5 differ from those of the first embodiment. Note also that the remaining structure is the same as in the first embodiment.

[0048]

In the cutting apparatus 100 of the second embodiment, as is shown in FIG. 11, the first table 2A and the second table 2B are formed in such a way that, in a state in which the connecting portions W3 have been cut by the cutting mechanism 3 so that the mutually adjacent separating elements W1 and W2 have been separated from each other, the first table 2A and the second table 2B can be moved relative to each other in an up-down direction so that one of the mutually adjacent separating elements W1 and W2 is positioned above the other one thereof. By employing this structure, it becomes

possible to cut the mutually adjacent separating elements W1 and W2 independently of each other.

[0049]

More specifically, the first table portion 2A and the second table portion 2B are formed such that the respective mounting portions 2A1 and 2B1 thereof move in parallel relative to each other in the Z direction. As is shown in FIG. 11, the first table portion 2A and the second table portion 2B perform a parallel movement relative to each other between (i) the first state in which the connecting portions W3 are cut, (ii) a second state in which the separating elements W2 of the even-numbered rows are positioned above the separating elements W1 of the odd-numbered rows, and (iii) a third state in which the separating elements W1 of the odd-numbered rows are positioned above the separating elements W2 of the even-numbered rows. Here, in a case in which there is a transition from the first state to the second state or to the third state, then either the first table portion 2A or the second table portion 2B may be raised or lowered by a moving mechanism (not shown in the drawings). Note that a structure in which the moving mechanism causes either the first table portion 2A or the second table portion 2B to move by inserting an adjustment component, as in the above-described embodiment, may be employed or, alternatively, employing an actuator such as, for example, a hydraulic cylinder or a motor or like may also be considered.

[0050]

As is shown in FIG. 12, the unloader 5 is provided with a suction block 51 in which transporting suction portions 512 and 513 that suction the cut products P are provided, and a moving mechanism (not shown in the drawings) that moves this suction block 51.

[0051]

More specifically, the first transporting suction portion 512 suctions the cut products P of the separating elements W1 of the odd-numbered rows (i.e., row 1, row 3, row 5, ...) of the object to be cut W, while the second transporting suction portion 513 suctions the cut products P of the separating elements W2 of the even-numbered rows (i.e., row 2, row 4, row 6, ...) of the object to be cut W. In other words, the unloader 5 is formed in such a way that it is possible to independently switch between suctioning and not suctioning the cut products P of the separating elements W1 of the odd-numbered rows, and between suctioning and not suctioning the cut products P of the separating elements W2 of the even-numbered rows.

10 [0052]

The first transporting suction portion 512 has first suction holes 512a that open in a lower surface of the suction block 51, a first internal flow path 512b that is formed inside the suction block 51 and communicates with the first suction holes 512a, and a first suction pump 512c that is connected to the first internal flow path 512b. Note that suction pads 512d that are made, for example, from resin or the like are provided for the suction holes 512a. Moreover, the second transporting suction portion 513 has second suction holes 513a that open in a lower surface of the suction block 51, a second internal flow path 513b that is formed inside the suction block 51 and communicates with the second suction holes 513a, and a second suction pump 513c that is connected to the second internal flow path 513b. Note that suction pads 513d are provided for the suction holes 513a. In addition, it is also possible to employ a structure in which a single suction pump is used in common for both the first suction pump 512c and the second suction pump 513c, and the internal flow path that is connected to this single suction pump is switched using, for example, a switching valve (not shown in the drawings). Note also that, in FIG. 12, the suction holes 512a of the odd-numbered rows

and the suction holes 513a of the even-numbered rows are each aligned on a single straight line in the Y direction, however, they may also be mutually offset from each other.

[0053]

5 In a cutting operation performed by the cutting apparatus 100 having this structure, (1) the loading of the object to be cut W, and (2) the cutting of the connecting portions W3 are the same as in the previously described embodiment. Hereinafter, an operation performed after the cutting of the connecting portions W3 will be described.

[0054]

10 (3) Moving and cutting of the separating elements W2 of the even-numbered rows

 In a state in which the connecting portions W3 have been cut so that the mutually adjacent separating elements W1 and W2 have been separated from each other, the second table portion 2B of the cutting table 2 is raised upwards. Next, the cutting mechanism 3 cuts the cutting lines CL2 of the separating elements W2 of the even-numbered rows that are located on the same straight line (shown in FIG. 11 as [Cutting of even-numbered rows (Second state)]). Once the cutting of the separating elements W2 of the even-numbered rows has ended, the second table portion 2B is lowered.

[0055]

(4) Moving and cutting of the separating elements W1 of the odd-numbered rows

20 Next, the first table portion 2A of the cutting table 2 is raised upwards. Next, the cutting mechanism 3 cuts the cutting lines CL1 of the separating elements W1 of the odd-numbered rows that are located on the same straight lines (shown in FIG. 11 as [Cutting of odd-numbered rows (Third state)]). Once the cutting of the separating elements W1 of the odd-numbered rows has ended, the first table portion 2A is lowered.

25 [0056]

(5) Discharging of cut products P

The unloader 5 employs suction to hold the plurality of cut products P that are being held by means of suction on the cutting table 2 and transports them to the cut product housing portion 7. Here, before the suctioning by the cutting table 2 is

5 canceled, it is also possible to press the suction pads 512d and 513d of the unloader 5 against the plurality of cut products P so as to prevent any mispositioning of the plurality of cut products P or suction errors or the like. Note that the discharging of the cut products P does not need to be performed after both the separating elements W1 and the separating elements W2 of the odd-numbered rows and the even-numbered rows have
10 been cut, and it is also possible to unload the cut products P using the second transporting suction portion 513 after the cutting of the separating elements W2 of the even-numbered rows has ended, and to unload the cut products P using the first transporting suction portion 512 after the cutting of the separating elements W1 of the odd-numbered rows has ended.

15 [0057]

(Effects Obtained from the Second Embodiment)

According to the cutting apparatus 100 of the second embodiment, by causing the first table portion 2A that is suctioning one of the mutually adjacent separating elements W1 and W2 and the second table portion 2B that is suctioning the other of the
20 mutually adjacent separating elements W1 and W2 to move relatively to each other in an up-down direction, it is possible to position the cutting lines CL1 and CL2 of the mutually adjacent separating elements W1 and W2 on the same straight lines. As a result, it is possible to enable an object to be cut W in which the cutting lines CL1 and CL2 of the mutually adjacent separating elements W1 and W2 are set on mutually
25 different straight lines to be easily cut by means of the blade 31.

[0058]

(Other Variant Embodiments)

Note that the present invention is not limited to the above-described respective embodiments.

5 [0059]

For example, in the above-described first embodiment, a structure is employed in which the separating elements W2 of the even-numbered rows are moved (i.e., the second table portion 2B is moved), however, it is also possible for a structure to be employed in which the cutting lines CL1 of the separating elements W1 of the odd-numbered rows are aligned with the cutting lines CL2 of the separating elements W2 of the even-numbered rows by moving the separating elements W1 of the odd-numbered rows (i.e., by moving the first table portion 2A).

[0060]

Furthermore, in the above-described first embodiment, a structure is employed in which the cutting lines CL1 and CL2 are aligned with each other by moving either the separating elements W1 of the odd-numbered rows or the separating elements W2 of the even-numbered rows, however, depending on the placement mode of the cutting lines CL1 and CL2 set in the object to be cut W, for example, it is also possible for a structure to be employed in which both the separating elements W1 of the odd-numbered rows and the separating elements W2 of the even-numbered rows are moved so as to be aligned with each other.

[0061]

Moreover, in the above-described second embodiment, in a case in which the cut products P of the separating elements W1 of the odd-numbered rows and the cut products P of the separating elements W2 of the even-numbered rows are transported collectively

as one group, then it is possible to employ a common suction system in which the unloader 5 only has one suction transporting portion.

[0062]

The object to be cut W that is cut by the cutting apparatus 100 of the present invention is not limited to those described in the foregoing embodiments, and substrates such as, for example, printed circuit boards (i.e., PCB substrates) that have not been resin molded may also be cut using the cutting apparatus 100 of the present invention. In this case, as is shown in FIG. 13, the object to be cut W may be, for example, a substrate in which grooves K have been cut by means of router processing. In this substrate, the plurality of separating elements W1 and W2 are formed substantially in an L shape when looked at in plan view, and are connected together by connecting portions W3. In addition, the cutting lines CL1 and CL2 within the mutually adjacent separating elements W1 and W2 are set on mutually different straight lines. In this type of object to be cut W as well, in the same way as in the above-described embodiments, after cutting the connecting portions W3, by then moving the first table portion 2A and the second table portion 2B relatively to each other within the same plane so as to align the cutting lines CL1 of the separating elements W1 of the odd-numbered rows with the cutting lines CL2 of the separating elements W2 of the even-numbered rows, these cutting lines CL1 and CL2 can be cut collectively in a single cutting operation (shown in FIG. 13 as [Alignment and cutting of cutting lines of odd-numbered rows and even-numbered rows]). Moreover, after cutting the connecting portions W3, by then moving the first table portion 2A and the second table portion 2B relatively to each other in an up-down direction, the separating elements W1 of the odd-numbered rows and the separating elements W2 of the even-numbered rows can be cut separately from each other (shown in FIG. 13 as [Odd-numbered rows and even-numbered rows are cut separately]).

[0063]

In the object to be cut W of the above-described respective embodiments, the placement modes of the plurality of separating elements are divided into two groups (i.e., odd-numbered rows and even-numbered rows), and the cutting lines CL1 and CL2 are mutually different from each other in the separating elements W1 of the odd-numbered rows and the separating elements W2 of the even-numbered rows, however, the present invention is not limited to separating elements of odd-numbered rows and separating elements of even-numbered rows and can also be applied to objects having separating elements in which the cutting lines are not set on the same straight lines as each other in a plurality of separating elements. For example, the present invention may also be applied to objects that are grouped in such a way that, for example, the placement modes of the plurality of separating elements of the object to be cut W are divided, for example, into two left and two right identical rows. In addition, the object to be cut W may be an object in which the placement modes of the plurality of separating elements are divided into three or more groups.

[0064]

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

[Industrial Applicability]

[0065]

According to the present invention, it is possible to enable an object to be cut

whose cutting lines within mutually adjacent separating elements are set on mutually different straight lines to be easily cut using a blade.

What is claimed is:

1. A cutting apparatus that cuts, along cutting lines, an object to be cut in which a plurality of separating elements are connected together by means of connecting portions,
5 and in which cutting lines within the separating elements that are mutually adjacent to each other are set on mutually different straight lines, comprising:

a cutting table on which the object to be cut is held by means of suction; and

a cutting mechanism that, using a blade, cuts the object to be cut that is being held on the cutting table, wherein

10 the cutting table is separated into a first table portion that, regarding the mutually adjacent separating elements, holds one of the separating elements by means of suction, and a second table portion that holds the other of the separating elements by means of suction, and wherein

the first table portion and the second table portion are formed so as to be able to
15 move relatively to each other.

2. The cutting apparatus according to Claim 1, wherein the first table portion and the second table portion are formed in such a way that, in a state in which the connecting portions have been cut by the cutting mechanism so that the mutually adjacent separating elements have been separated from each other, the first table portion and the second table
20 portion are able to move relatively to each other within the same plane so that the respective cutting lines of the mutually adjacent separating elements are positioned on the same straight lines.

3. The cutting apparatus according to Claim 2, wherein the cutting mechanism cuts the mutually adjacent separating elements in a state in which the respective cutting lines
25 of the mutually adjacent separating elements have been positioned on the same straight

lines by the first table portion and the second table portion.

4. The cutting apparatus according to Claim 1, wherein the first table portion and the second table portion are formed in such a way that, in a state in which the connecting portions have been cut by the cutting mechanism so that the mutually adjacent separating elements have been separated from each other, the first table portion and the second table portion are able to move relatively to each other in an up-down direction so that one of the mutually adjacent separating elements is positioned above the other of the mutually adjacent separating elements.

5. The cutting apparatus according to Claim 4, wherein the cutting apparatus cuts the one of the mutually adjacent separating elements in a state in which one of the mutually adjacent separating elements has been raised above the other of the mutually adjacent separating elements by the first table portion and the second table portion.

6. The cutting apparatus according to any one of Claim 1 through Claim 5, wherein the plurality of separating elements are arranged in rows in the direction in which they will be cut by the blade, and their placement modes are divided into at least two groups, and the cutting lines of the separating elements of one group are positioned on the same straight lines, while the cutting lines of the separating elements of another group are positioned on the same straight lines, and wherein

the first table portion holds the separating elements of the one group by means of suction, and

the second table portion holds the separating elements of the other group by means of suction.

7. The cutting apparatus according to any one of Claim 1 through Claim 6, further comprising a transporting mechanism that transports the object to be cut to the cutting table, wherein

the transporting mechanism has a transport suctioning portion that suctions only the one or only the other one of the mutually adjacent separating elements.

8. The cutting apparatus according to any one of Claim 1 through Claim 6, further comprising a transporting mechanism that transports the object to be cut to the cutting
5 table, wherein

the transporting mechanism has a first transport suctioning portion that suctions the separating elements of the one group, and a second transport suctioning portion that suctions the separating elements of the other group.

9. A method of manufacturing a cut product using the cutting apparatus according
10 to any one of Claim 1 through Claim 8.