

[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 milling
apparatus has been developed that is provided with a transporting pad that uses suction in
order to hold a portion of the chips from among all the chips of a package substrate. In
this milling apparatus, a structure is employed in which a plurality of areas are set on a
15 chuck table so as to correspond to the external dimensions of a holding tray, and the
transporting pad is divided into the number of set areas so as to be able to suction and
transport the chips all at once.

[Documents of the Prior Art]

[Patent Documents]

20 [0003]

[Patent Document 1] Japanese Unexamined Patent Application (JP-A) No. 2003-234310

[Disclosure of the Invention]

[Problems to be Solved by the Invention]

[0004]

25 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 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.

5 [0005]

However, in a resin-molded substrate that utilizes lead frames whose leads are 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.

10 [0006]

The present invention was therefore conceived in order to solve the above-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.

15 [Means for Solving the Problem]

[0007]

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 with a cutting table on which the object to be cut is held by means of suction, a cutting mechanism that, using a blade, cuts the object to be cut, and a separating element transporting portion that, in a state in which the connecting portions have been cut by the cutting mechanism so that the separating elements have been separated from each other,

20

25

transports one of the mutually adjacent separating elements away from the cutting table.

[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 contains a plan view and a cross-sectional view that schematically show a structure of a cutting table of the same embodiment.

[FIG. 5] FIG. 5 contains a plan view and a cross-sectional view that
20 schematically show a structure of a transporting mechanism (i.e., a loader) of the same embodiment.

[FIG. 6] FIG. 6 contains a plan view and a cross-sectional view that schematically show a structure of a discharging mechanism (i.e., an unloader) of the same embodiment.

25 [FIG. 7] FIG. 7 contains cross-sectional views showing each state of a cutting

operation of the same embodiment.

[FIG. 8] FIG. 8 contains plan views showing each state of an object to be cut in a cutting operation of the same embodiment.

[FIG. 9] FIG. 9 is a plan view schematically showing a structure of a cutting
5 apparatus of a second embodiment.

[FIG. 10] FIG. 10 contains cross-sectional views showing each state of a cutting operation of the second embodiment.

[FIG. 11] FIG. 11 is a plan view schematically showing a structure of a cutting apparatus of a third embodiment.

10 [FIG. 12] FIG. 12 contains cross-sectional views showing each state of a cutting operation of the third 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.

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

[Description of the Reference Numerals]

[0010]

100 ... Cutting Apparatus

20 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

CL1, CL2 ... Cutting Lines

25 P ... Cut Products

2 ...	Cutting Table
21 ...	First Table Suctioning Portion
22 ...	Second Table Suctioning Portion
3 ...	Cutting Mechanism
5 31 ...	Blade
4 ...	Loader (Transporting Mechanism)
411 ...	First Transporting Suction Portion
412 ...	Second Transporting Suction Portion
10 ...	Separating Element Transporting Portion
10 11 ...	Cutting Table
12 ...	Temporary Placement Table

[Best Embodiments for Implementing the Invention]

15 [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.

[0012]

20 As is described above, the 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
25 with a cutting table on which the object to be cut is held by means of suction, a cutting

mechanism that, using a blade, cuts the object to be cut, and a separating element transporting portion that, in a state in which the connecting portions have been cut by the cutting mechanism so that the separating elements have been separated from each other, transports one of the mutually adjacent separating elements away from the cutting table.

5 If this type of cutting apparatus is employed, then because there is provided a separating element transporting portion that, in a state in which the separating elements have been separated from each other, transports one of the mutually adjacent separating elements away from the cutting table, it is possible to extract one of the mutually adjacent separating elements from the cutting table. As a result, it is possible to enable
10 an object to be 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 separating element transporting portion that may be considered is a structure in which the separating element transporting portion transports
15 one of the mutually adjacent separating elements from the cutting table to another cutting table.

In the case of this structure, each one of mutually adjacent separating elements can be cut independently at mutually separate cutting tables. Note that, when performing cutting at mutually independent cutting tables, the cutting may be performed
20 using a single common cutting blade, or may be performed using mutually different cutting blades.

[0014]

Another specific aspect of a separating element transporting portion that may be considered is a structure in which the separating element transporting portion transports
25 one of the mutually adjacent separating elements from the cutting table to a temporary

placement table.

In the case of this structure, the cutting mechanism cuts mutually adjacent separating elements in sequence. More specifically, after the separating element transporting portion has transported one of the mutually adjacent separating elements to the temporary placement table, the cutting mechanism cuts the other one of the mutually adjacent separating elements on the cutting table. Next, after the resulting cut products have been unloaded from the cutting table, the separating element transporting portion transports the one of the mutually adjacent separating elements from the temporary placement table to the cutting table and the cutting mechanism cuts the one of the mutually adjacent separating elements on the cutting table.

[0015]

Furthermore, another specific aspect of the separating element transporting portion that may be considered is a structure in which the separating element transporting portion holds the one of the mutually adjacent separating elements after having transported it from the cutting table.

In the case of this structure, in the same way as a case in which the one of the mutually adjacent separating elements is transported to the above-described temporary placement table, the cutting mechanism cuts mutually adjacent separating elements in sequence. More specifically, in a state in which the separating element transporting portion has transported the one of the mutually adjacent separating elements from the cutting table and is holding this separating element, the cutting mechanism cuts the other one of the mutually adjacent separating elements on the cutting table. Next, after the resulting cut products have been unloaded from the cutting table, the separating element transporting portion transports the one of the mutually adjacent separating elements to the cutting table, and the cutting mechanism cuts the one of the mutually adjacent

separating elements on the cutting table.

[0016]

In order for the transporting of the separating elements to be performed by the separating element transporting portion, it is desirable that the cutting table be provided
5 with a first table suctioning portion that, of the mutually adjacent separating elements, suctions one of the separating elements, and a second table suctioning portion that is independent of the first table suctioning portion and suctions the other one of the separating elements.

If this type of structure is employed, then it is possible to stop the suctioning of
10 just the separating element being transported by the separating element transporting portion, and the transporting of the separating element being transported by the separating element transporting portion can be reliably performed.

[0017]

A specific aspect that may be considered in order to enable the transporting of a
15 separating element to be performed by the separating element transporting portion is a structure in which, in a state in which the connecting portions have been cut by the cutting mechanism so that the separating elements have been separated from each other, the cutting table stops the suctioning of the separating elements by either the first table suctioning portion or the second table suctioning portion, and the separating element
20 transporting portion transports the separating element whose suctioning by the cutting table has been stopped away from the cutting table.

[0018]

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
25 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.

In an object to be cut having this structure, it is desirable that the separating
5 element transporting portion transport either the one group of separating elements or the other group of separating elements.

[0019]

Moreover, it is desirable that the cutting apparatus of the present invention be provided with a transporting mechanism that transports the object to be cut to the cutting
10 table, and a discharging mechanism that discharges cut products that have been cut at the cutting table, and that the transporting mechanism or the discharging mechanism function as the separating elements transporting portion.

If this type of structure is employed, then because it is possible to form the separating element transporting portion from the transporting mechanism or the
15 discharging mechanism, the apparatus structure can be simplified compared to a case in which the transporting mechanism and the discharging mechanism are provided separately from the separating element transporting portion.

[0020]

A specific aspect that may be considered in order for the transporting
20 mechanism or the discharging mechanism to function as a separating element transporting portion is a structure in which the transporting mechanism or the discharging mechanism includes a first transporting suction portion that suctions the separating elements of the one group, and a second transporting suction portion that is independent of the first transporting suction portion and suctions the separating elements of the other
25 group, and the transporting mechanism or the discharging mechanism functions as the

separating elements transporting portion using the first transporting suction portion or the second transporting suction portion.

[0021]

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

[0022]

(First Embodiment of the Present Invention)

Hereinafter, a first embodiment of a cutting apparatus according to the present invention will be described with reference to the drawings. Note that, in order to make
10 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 omitted as is appropriate.

15 [0023]

(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 lines CL0 to CL2 that are set on the object to be cut W.

20 [0024]

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 and W2 are set on mutually different straight lines. A plurality of chips are sealed by
25 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 (see FIG. 3), and both end portions of the separating elements W1 and W2 are connected
5 together by means of the connecting portions W3. More specifically, a structure is employed in which the separating elements W1 in odd-numbered rows form one group, and the separating elements W2 in even-numbered rows form another group, and the leads of the separating elements W1 are staggered relative to the leads of the separating elements W2. As a result, the cut lines CL1 of the separating elements W1 in the odd-
10 numbered rows forming one group are all positioned on the same straight lines, while the cut 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 cut lines CL1 of the separating elements W1 in the odd-numbered rows are positioned are different from the straight lines on which the cut lines CL2 of the
15 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 lines where it is intended that the object to be cut W will be cut by the blade 31, and do not appear on
20 the actual object to be cut W.

[0025]

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 mechanism 3 that cuts the object to be cut W that is being held on the cutting table 2
25 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.

[0026]

5 The cutting table 2 holds the object to be cut W by means of suction and, as is shown in FIG. 4, includes a first table suctioning portion 21 that suctions the one of the mutually adjacent separating elements W1 and W2, namely, the separating elements W1, and a second table suctioning portion 22 that suctions the other of the mutually adjacent separating elements W1 and W2, namely, the separating elements W2. Note that the
10 cutting table 2 is formed so as to be able to be moved 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 a θ direction by a rotating mechanism (not shown in the drawings).

[0027]

15 The first table suctioning portion 21 and the second table suctioning portion 22 are independent of each other, and are formed in such a way that they can be switched independently of each other between a suctioning state and a non-suctioning state.

[0028]

 More specifically, the first table suctioning portion 21 collectively suctions the
20 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 suctioning portion 22 collectively suctions the even-numbered rows (i.e., row 2, row 4, row 6, ...) of the separating elements W2 of the object to be cut W. In other words, the cutting table 2 is formed in such a way that it can independently switch between suctioning and not suctioning the separating elements
25 W1 of the odd-numbered rows, and between suctioning and not suctioning the separating

elements W2 of the even-numbered rows.

[0029]

The first table suctioning portion 21 has first suction holes 21a that open in an upper surface of the cutting table 2, a first internal flow path 21b that is formed inside the cutting table 2 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 cutting table 2, a second internal flow path 22b that is formed inside the cutting table 2 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 as 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.

[0030]

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.

[0031]

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.

Moreover, as is described below, the loader 4 causes one of the mutually adjacent separating elements W1 and W2 to move in such a way that the cutting lines CL1 and CL2 of the mutually adjacent separating elements W1 and W2 coincide with each other on the cutting table 2.

[0032]

More specifically, as is shown in FIG. 5, the loader 4 is provided with a suction block 41 in which transporting suction portions 411 and 412 that are used to suction the object to be cut W are provided, and a moving mechanism (not shown in the drawings) that moves the suction block 41.

[0033]

The first transporting suction portion 411 that suctions the one separating elements W1 of the mutually adjacent separating elements W1 and W2, and the second transporting suction portion 412 that suctions the other separating elements W2 of the mutually adjacent separating elements W1 and W2 are provided in the suction block 41. In other words, the suction block 41 of the loader 4 has the transporting suction portions 411 and 412 that correspond to the respective table suctioning portions 21 and 22 of the cutting table 2.

[0034]

More specifically, the first transporting suction portion 411 suctions 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 412 suctions 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 loader 4 is formed in such a way that it is

possible to independently switch between suctioning and not suctioning the separating elements W1 of the odd-numbered rows, and between suctioning and not suctioning the separating elements W2 of the even-numbered rows.

[0035]

5 The first transporting suction portion 411 has first suction holes 411a that open in a lower surface of the suction block 41, a first internal flow path 411b that is formed inside the suction block 41 and communicates with the first suction holes 411a, and a first suction pump 411c that is connected to the first internal flow path 411b. Suction pads 411d that are made, for example, from resin or the like are provided for the first
10 suction holes 411a. In addition, the second transporting suction portion 412 has second suction holes 412a that open in a lower surface of the suction block 41, a second internal flow path 412b that is formed inside the suction block 41 and communicates with the second suction holes 412a, and a second suction pump 412c that is connected to the second internal flow path 412b. Suction pads 412d are provided for the second suction
15 holes 412a. 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 411c and the second suction pump 412c, 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).

[0036]

20 In a state in which the connecting portions W3 have been cut by the cutting mechanism 3 so that the separating elements W1 and W2 have been separated from each other, the loader 4 that has the structure described above functions as a separating element transporting portion 10 that transports one of the mutually adjacent separating elements W1 or W2 away from the cutting table 2 to another cutting table 11 (see FIG.
25 3). The separating element transporting portion 10 of the present embodiment is formed

using the second transporting suction portion 412 of the loader 4. In other words, the separating element transporting portion 10 transports the separating elements W2 of the even-numbered rows from the cutting table 2 to the other cutting table 11.

[0037]

5 The unloader 5 suctions cut 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. 6, the unloader 5 is provided with a suction block 51 in which transporting suction portions 511 and 512 that are used to suction the cut products P are provided, and a moving mechanism (not shown in the drawings) that
10 moves this suction block 51.

[0038]

More specifically, the first transporting suction portion 511 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 512
15 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
20 elements W2 of the even-numbered rows.

[0039]

The first transporting suction portion 511 has first suction holes 511a that open in a lower surface of the suction block 51, a first internal flow path 511b that is formed inside the suction block 51 and communicates with the first suction holes 511a, and a
25 first suction pump 511c that is connected to the first internal flow path 511b. Note that

suction pads 511d that are made, for example, from resin or the like are provided for the first suction holes 511a. Moreover, the second transporting suction portion 512 has second suction holes 512a that open in a lower surface of the suction block 51, a second internal flow path 512b that is formed inside the suction block 51 and communicates with the second suction holes 512a, and a second suction pump 512c that is connected to the second internal flow path 512b. Note that suction pads 512d that are made, for example, from resin or the like are provided for the second suction holes 512a. 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 511c and the second suction pump 512c, 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. 6, the suction holes 511a of the odd-numbered rows and suction holes 512a of the even-numbered rows are aligned on straight lines in the Y direction, however, they may also be offset from each other.

[0040]

(Cutting Operation of the Cutting Apparatus 100)

An operation of the cutting apparatus 100 will now be described with reference to FIG. 7 and FIG. 8. 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) Transporting 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.

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 suctioning portion 21 and the second table suctioning portion 22

of the cutting table 2 (shown in FIG. 7 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 formed in the object to be cut W. In addition, this positioning
5 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.

[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
10 means of suction on the cutting table 2 are cut by the cutting mechanism 3 (shown in FIG. 8 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
15 each other. In this state, the cut 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]

20 (3) Transporting of the separating elements W2 of the even-numbered rows to the other cutting table 11

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 cutting table 2 stops the suctioning of the separating elements W2 of the even-
25 numbered rows by the second table suctioning portion 22. Note that, on the cutting

table 2, the suctioning of the separating elements W1 of the odd-numbered rows by the first table suctioning portion 21 is maintained. Here, prior to the stopping of the suctioning by the second table suctioning portion 22, the suction pads (more specifically, the suction pads 412d of the second transporting suction portion 412) of the loader 4 that is serving as the separating element transporting portion 10 are pressed against the separating elements W2 of the even-numbered rows. As a result of this, any mispositioning of the separating elements W2 of the even-numbered rows due to the suctioning of the second table suctioning portion 22 of the cutting table 2 being stopped is prevented. Next, the second transporting suction portion 412 of the loader 4 that is serving as the separating element transporting portion 10 transports the separating elements W2 of the even-numbered rows to the other cutting table 11 (shown in FIG. 7 and FIG. 8 as [Transporting of the even-numbered rows to the other cutting table]). Note that the separating elements W2 of the even-numbered rows that have been transported to the other cutting table 11 are held there by means of suction by a suctioning portion 111 of the other cutting table 11. Here, consideration may be given to positioning the separating elements W2 of the even-numbered rows on the other cutting table 11 by, for example, employing cameras to perform image recognition of the placement of the separating elements W2 in the even-numbered rows (for example, of characteristic portions thereof such as edge portions or lead portions).

20 [0044]

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

After the separating elements W2 of the even-numbered rows have been transported to the other cutting table 11, 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 on the cutting table 2. In addition, the cutting lines CL2 of the separating elements W2 of the even-numbered rows that are located on the same straight lines are cut on the other cutting table 11 either using another cutting mechanism or using the cutting mechanism 3 (shown in FIG. 7 and FIG. 8 as [Cutting of odd-numbered rows and even-numbered rows]). Note that, in the present embodiment, a double spindle mode (see FIG. 3) is employed in which a cutting mechanism 3 is provided respectively for each of the cutting tables 2 and 11, however, it is also possible to employ a single spindle mode in which a common cutting mechanism 3 is provided for both the cutting table 2 and the cutting table 11.

10 [0045]

(5) Discharging of cut products P

The unloader 5 holds, by means of suction provided by the first transporting suction portion 511, 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.

15 In addition, the unloader 5 holds, by means of suction provided by the second transporting suction portion 512, the plurality of cut products P that are being held by means of suction on the other cutting table 11 and transports them to the cut product housing portion 7. Here, prior to the suctioning by the cutting table 2 and the other cutting table 11 being canceled, it is also possible to press the suction pads 511d and 20 512d 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.

[0046]

(Effects Obtained from the First Embodiment)

According to the cutting apparatus 100 of the first embodiment, because there is 25 provided the separating element transporting portion 10 that, in a state in which the

separating elements W1 and W2 have been separated from each other, transports one of the mutually adjacent separating elements W1 or W2 away from the cutting table 2 to the other cutting table 11, it is possible to remove the one of the mutually adjacent separating elements W1 or W2 from the cutting table 2 so that the separating elements W1 and W2 are held on the separate cutting tables 2 and 11. 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]

10 (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 the structure of the cutting apparatus 100 of the second embodiment differs from that of the first embodiment in that the other cutting table 11 is not provided. Note also that the remaining structure is the same as in the first embodiment.

[0048]

More specifically, as is shown in FIG. 9, the cutting apparatus 100 of the second embodiment has a structure in which, instead of a cutting table, one of the mutually adjacent separating elements W1 and W2 is simply transported to a temporary placement table 12 where it is placed temporarily. Here, employing a structure in which the temporary placement table 12 has a suctioning portion that holds the transported separating element by means of suction may be considered. Using this temporary placement table 12, the cutting mechanism 3 cuts the separating elements W1 of the odd-numbered rows and the separating elements W2 of the even-numbered rows in sequence on the cutting table 2.

[0049]

In a cutting operation performed using the cutting apparatus 100 having this structure, (1) the transporting of the object to be cut W, and (2) the cutting of the connecting portions W3 are the same as in the above-described first embodiment.

5 Hereinafter, an operation performed after the connecting portions W3 have been cut will be described.

[0050]

(3) Transporting of the separating elements W2 of the even-numbered rows to the temporary placement table 12

10 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 cutting table 2 stops the suctioning of the separating elements W2 of the even-numbered rows by the second table suctioning portion 22. Note that, on the cutting table 2, the suctioning of the separating elements W1 of the odd-numbered rows by the
15 first table suctioning portion 21 is maintained. Here, prior to the stopping of the suctioning by the second table suctioning portion 22, the suction pads (more specifically, the suction pads 412d of the second transporting suction portion 412) of the loader 4 that is serving as the separating element transporting portion 10 are pressed against the separating elements W2 of the even-numbered rows. As a result of this, any
20 mispositioning of the separating elements W2 of the even-numbered rows due to the suctioning of the second table suctioning portion 22 of the cutting table 2 being stopped is prevented. Next, the second transporting suction portion 412 of the loader 4 that is serving as the separating element transporting portion 10 transports the separating elements W2 of the even-numbered rows to the temporary placement table 12 (shown in
25 FIG. 10 as [Transporting of the even-numbered rows to the temporary placement table]).

Here, consideration may be given to positioning the separating elements W2 of the even-numbered rows on the temporary placement table 12 by, for example, employing cameras to perform image recognition of the placement of the separating elements W2 in the even-numbered rows (for example, of characteristic portions thereof such as edge portions or lead portions).

[0051]

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

After the separating elements W2 of the even-numbered rows have been transported to the temporary placement table 12, 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 on the cutting table 2 (shown in FIG. 10 as [Cutting of odd-numbered rows]).

[0052]

(5) Discharging of cut products P obtained by cutting the separating elements W1 of the odd-numbered rows

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 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.

[0053]

(6) Transporting of the separating elements W2 of the even-numbered rows

The second transporting suction portion 412 (i.e., the separating element transporting portion 10) of the loader 4 that is serving as the separating element

transporting portion 10 employs suction in order to hold the separating elements W2 of the even-numbered rows that are on the temporary placement table 12, and transports them to the cutting table 2 (shown in FIG. 10 as [Transporting of even-numbered rows to the cutting table]). The separating elements W2 of the even-numbered rows that have been transported to the cutting table 2 are held by means of suction by the second table suctioning portion 22 of the cutting table 2. Here, consideration may be given to positioning the separating elements W2 of the even-numbered rows by, for example, employing cameras to perform image recognition of the placement of the separating elements W2 of the even-numbered rows (for example, of characteristic portions thereof such as edge portions or lead portions).

[0054]

(7) Cutting of the separating elements W2 of the even-numbered rows

After the separating elements W2 of the even-numbered rows have been transported to the cutting table 2, 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 lines on the cutting table 2 (shown in FIG. 10 as [Cutting of even-numbered rows]).

[0055]

(8) Discharging of cut products P obtained by cutting the separating elements W2 of the even-numbered rows

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 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.

[0056]

Note that, in the above description a structure is employed in which the separating elements W2 of the even-numbered rows are transported to the temporary placement table 12 by the separating element transporting portion 10, however, it is also possible to employ a structure in which the separating elements W1 of the odd-numbered rows are transported to the temporary placement table 12 by the separating element transporting portion 10.

[0057]

10 (Effects Obtained from the Second Embodiment)

According to the cutting apparatus 100 of the second embodiment, because there is provided the separating element transporting portion 10 that, in a state in which the separating elements W1 and W2 have been separated from each other, transports one of the mutually adjacent separating elements W1 or W2 away from the cutting table 2 to the temporary placement table 12, it is possible to remove the one of the mutually adjacent separating elements W1 or W2 from the cutting table 2. 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.

20 [0058]

(Third Embodiment of the Present Invention)

Next, a third embodiment of the cutting apparatus according to the present invention will be described with reference to the drawings. Note that the structure of the cutting apparatus 100 of the third embodiment differs from those of the preceding embodiments in that the other cutting table 11 and the temporary placement table 12 are

not provided. Note also that the remaining structure is the same as in the first embodiment.

[0059]

More specifically, the cutting apparatus 100 of the third embodiment is formed
5 in such a way that, instead of one of the mutually adjacent separating elements W1 or W2 being transported to the other cutting table 11 or the temporary placement table 12, as is shown in FIG. 11, one of the mutually adjacent separating elements W1 or W2 is transported away from the cutting table 2 and is held by the separating elements transporting portion 10.

10 [0060]

In a cutting operation performed by the cutting apparatus 100 having the above-described structure, (1) the transporting of the object to be cut W, and (2) the cutting of the connecting portions W3 are the same as in the above-described embodiments.

Hereinafter, an operation performed after the connecting portions W3 have been cut will
15 be described.

[0061]

(3) Transporting and holding 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
20 mutually adjacent separating elements W1 and W2 have been separated from each other, the cutting table 2 stops the suctioning of the separating elements W2 of the even-numbered rows by the second table suctioning portion 22. Note that, on the cutting table 2, the suctioning of the separating elements W1 of the odd-numbered rows by the first table suctioning portion 21 is maintained. Here, prior to the stopping of the
25 suctioning by the second table suctioning portion 22, the suction pads (more specifically,

the suction pads 412d of the second transporting suction portion 412) of the loader 4 that is serving as the separating element transporting portion 10 are pressed against the separating elements W2 of the even-numbered rows. As a result of this, any mispositioning of the separating elements W2 of the even-numbered rows due to the suctioning of the second table suctioning portion 22 of the cutting table 2 being stopped is prevented. Next, the second transporting suction portion 412 of the loader 4 that is serving as the separating element transporting portion 10 transports the separating elements W2 of the even-numbered rows and holds them on the outside of the cutting table 2 (shown in FIG. 12 as [Removal of the even-numbered rows and cutting of the odd-numbered rows]).

[0062]

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

After the separating elements W2 of the even-numbered rows have been transported away from the cutting table 2, 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 on the cutting table 2 (shown in FIG. 12 as [Removal of the even-numbered rows and cutting of the odd-numbered rows]).

[0063]

(5) Discharging of cut products P obtained by cutting the separating elements W1 of the odd-numbered rows

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 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.

[0064]

(6) Transporting of the separating elements W2 of the even-numbered rows

The second transporting suction portion 412 of the loader 4 that is serving as the
5 separating element transporting portion 10 transports the separating elements W2 of the
even-numbered rows that it is holding to the cutting table 2 (shown in FIG. 12 as
[Transporting of the even-numbered rows to the cutting table]). The separating
elements W2 of the even-numbered rows that have been transported to the cutting table 2
are held by means of suction by the second table suctioning portion 22 of the cutting
10 table 2. Here, consideration may be given to positioning the separating elements W2 of
the even-numbered rows on the cutting table 2 by, for example, employing cameras to
perform image recognition of the placement of the separating elements W2 of the even-
numbered rows (for example, of characteristic portions thereof such as edge portions or
lead portions).

15 [0065]

(7) Cutting of the separating elements W2 of the even-numbered rows

After the separating elements W2 of the even-numbered rows have been
transported to the cutting table 2, 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
20 straight lines on the cutting table 2 (shown in FIG. 12 as [Cutting of even-numbered
rows]).

[0066]

(8) Discharging of cut products P obtained by cutting the separating elements W2 of
the even-numbered rows

25 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 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.

[0067]

(Effects Obtained from the Third Embodiment)

According to the cutting apparatus 100 of the third embodiment, because there is provided the separating element transporting portion 10 that, in a state in which the separating elements W1 and W2 have been separated from each other, transports one of the mutually adjacent separating elements W1 or W2 away from the cutting table 2 and then holds this one of the mutually adjacent separating elements W1 or W2, it is possible to remove the one of the mutually adjacent separating elements W1 or W2 from the cutting table 2. 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.

[0068]

(Other Variant Embodiments)

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

[0069]

For example, in the above-described first embodiment, a structure is employed in which the separating elements W2 of the even-numbered rows are transported to the other cutting table 11, however, it is also possible to employ a structure in which the separating elements W1 of the odd-numbered rows are transported by the separating

element transporting portion 10 to the other cutting table 11. Moreover, it is also possible to employ a structure in which, after the connecting portions W3 have been cut on the cutting table 2, both the separating elements W1 of the odd-numbered rows and the separating elements W2 of the even-numbered rows are moved respectively to mutually separate cutting tables by the separating element transporting portion 10.

Moreover, in the above-described second embodiment, it is also possible to employ a structure in which the separating elements W1 of the odd-numbered rows are transported to the temporary placement table 12 by the separating element transporting portion 10, and in the above-described third embodiment, it is also possible to employ a structure in which the separating elements W1 of the odd-numbered rows are transported and then held by the separating element transporting portion 10.

[0070]

In each of the above-described embodiments, a structure is employed in which the loader 4 is provided with both the first transporting suction portion 411 and the second transporting suction portion 412, however, it is also possible for the loader 4 to be provided with only one of these. For example, in the case of a structure in which the loader 4 is only provided with the first transporting suction portion 411, then when the object to be cut W is being transported to the cutting table 2, the loader 4 transports the separating elements W1 of the odd-numbered rows while holding them by means of suction. Moreover, after the connecting portions W3 have been cut, the first table suctioning portion 21 of the cutting table 2 stops the suctioning of the separating elements W1 of the odd-numbered rows, and the first transporting suction portion 411 of the loader 4 transports the separating elements W1 of the odd-numbered rows that are no longer being suctioned to the other cutting table 11.

[0071]

Moreover, in each of the above-described embodiments, a structure is employed in which the loader 4 functions as the separating element transporting portion 10, however, it is also possible to employ a structure in which the unloader 5 functions as the separating element transporting portion 10. In this case, a structure is employed in which the unloader 5 is provided with a transporting suction portion that suctions only one of the separating elements W1 of the odd-numbered rows or the separating elements W2 of the even-numbered rows.

[0072]

In each of the above-described embodiments, a structure is employed in which the unloader 5 transports 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 individually to the cut product housing portion 7, however, it is also possible to employ a structure in which the unloader 5 firstly suctions both 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, and thereafter transports them to the cut product housing portion 7.

[0073]

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 the 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, it is possible to either transport one of the mutually adjacent separating elements to the other cutting table 11 and then perform the cutting, or to perform the cutting in sequence using the temporary placement table 12, or to perform the cutting in sequence by holding the one of the mutually adjacent separating elements on the separating element transporting portion 10.

[0074]

10 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.

[0075]

25 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
5 foregoing description and is only limited by the scope of the appended claims.

[Industrial Applicability]

[0076]

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
10 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 the 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;

a cutting mechanism that, using a blade, cuts the object to be cut; and

- 10 a separating element transporting portion that, in a state in which the connecting portions have been cut by the cutting mechanism so that the separating elements have been separated from each other, transports one of the mutually adjacent separating elements away from the cutting table.

2. The cutting apparatus according to Claim 1, wherein the separating element transporting portion transports one of the mutually adjacent separating elements from the
15 cutting table to another cutting table.

3. The cutting apparatus according to Claim 1, wherein the separating element transporting portion transports one of the mutually adjacent separating elements from the cutting table to a temporary placement table.

4. The cutting apparatus according to Claim 1, wherein the separating element
20 transporting portion holds the one of the mutually adjacent separating elements after having transported it from the cutting table.

5. The cutting apparatus according to any one of Claim 1 through Claim 4, wherein the cutting table comprises a first table suctioning portion that, regarding the mutually adjacent separating elements, suctions one of the separating elements, and a second table
25 suctioning portion that is independent of the first table suctioning portion and suctions

the other one of the separating elements.

6. The cutting apparatus according to Claim 5, wherein, in a state in which the connecting portions have been cut by the cutting mechanism so that the separating elements have been separated from each other, the cutting table stops the suctioning of the separating elements by either the first table suctioning portion or the second table suctioning portion, and

the separating element transporting portion transports the separating element whose suctioning by the cutting table has been stopped away from the cutting table.

7. The cutting apparatus according to any one of Claim 1 through Claim 6, 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 separating element transporting portion transports either the one group of separating elements or the other group of separating elements.

8. The cutting apparatus according to any one of Claim 1 through Claim 7, further comprising:

a transporting mechanism that transports the object to be cut to the cutting table;

and

a discharging mechanism that discharges cut products that have been cut at the cutting table, wherein

the transporting mechanism or the discharging mechanism function as the separating elements transporting portion.

9. The cutting apparatus according to Claim 8 which cites Claim 7, wherein the

transporting mechanism or the discharging mechanism comprises:

a first transporting suction portion that suctions the separating elements of the one group; and

a second transporting suction portion that is independent of the first transporting
5 suction portion and suctions the separating elements of the other group, and wherein
the transporting mechanism or the discharging mechanism functions as the
separating elements transporting portion using the first transporting suction portion or the
second transporting suction portion.

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