

[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, in a cutting
apparatus that cuts a workpiece such as a chip scale package (CSP) substrate, there is
provided a cutting table that includes a plurality of first suction ports that are used to
suction a package, and a plurality of second suction ports that are used to suction edge
15 fragments (i.e., scrap material) that are adjacent to the package. In this cutting
apparatus, the plurality of first suction ports are arranged in rows so as to correspond to
the layout configuration of the package being cut, while the plurality of second suction
ports are arranged in the vicinity of a periphery of the plurality of first suction ports that
coincide with the positions of the edge fragments.

20 [Documents of the Prior Art]

[Patent Documents]

[0003]

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

[Disclosure of the Invention]

25 [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 greater number of packages using the same-sized lead frames, as is shown in FIG. 10, 5 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 formed so as to be mutually staggered, because the cutting lines of the package are not all 10 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-described problem, and it is a principal object thereof to make it possible, using a blade, 15 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]

Namely, a cutting apparatus according to the present invention is a cutting 20 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, and a 25 cutting mechanism that, using a blade, cuts the object to be cut that is being held on the

cutting table, wherein the cutting table includes a first table suctioning portion that, regarding 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 of the separating elements.

5 [Effects of the Invention]

[0008]

According to the present invention that is formed in the manner described above, 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
10 blade.

[Brief Description of the Drawings]

[0009]

15 [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.

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

20 [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 schematically show a structure of a transporting mechanism (i.e., a loader) of the same embodiment.

25 [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.

[FIG. 7] FIG. 7 contains cross-sectional views showing each state of a cutting operation of the same embodiment.

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

10 [FIG. 10] FIG. 10 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]

100 ... Cutting Apparatus

15 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

20 P ... Cut Products

2 ... Cutting Table

21 ... First Table Suctioning Portion

22 ... Second Table Suctioning Portion

3 ... Cutting Mechanism

25 31 ... Blade

4 ... Loader (Transporting Mechanism)

411 ... First Transporting Suction Portion

412 ... Second Transporting Suction Portion

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[Best Embodiments for Implementing the Invention]

[0011]

Next, the present invention will be described in greater detail using drawings.

It should be noted, however, that the present invention is not limited by the following

10 description.

[0012]

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
15 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, wherein the cutting table includes a first table suctioning portion that,
20 regarding 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 of the separating elements.

If this type of cutting apparatus is employed, then because the cutting table includes the first table suctioning portion that suctions one of the separating elements,
25 and the second table suctioning portion that suctions the other of the mutually adjacent

separating elements, it is possible to cancel the suctioning of only the one or of only the other one of the mutually adjacent separating elements, and to then redispense that separating element on the cutting table, or remove that separating element from the cutting table. As a result, it is possible to enable an object to be cut whose cutting lines
5 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 that may be considered in order to suction only the one or only the other one of the mutually adjacent separating elements, and to then redispense that
10 separating element on the cutting table, or remove that separating element from the cutting table is an aspect in which the cutting apparatus of the present invention is further provided with a transporting mechanism that transports the object to be cut to the cutting table, and in which the transporting mechanism has a transporting suction portion that
suctions only the one or only the other one of the mutually adjacent separating elements.

15 [0014]

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, it is desirable that the cutting table cancel the suctioning of the separating elements by either the first table suctioning portion or the second table suctioning
20 portion, and that the transporting mechanism firstly suction the separating element whose suctioning by the cutting table has been canceled, and then align the cutting lines of the mutually adjacent separating elements so that these are on the same straight lines.

If this type of structure is employed, then because the cutting lines of the mutually adjacent separating elements are aligned on the same straight lines, the cutting
25 lines of the mutually adjacent separating elements can all be cut in a single cutting

operation.

[0015]

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 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 first table suctioning portion suction the separating elements of the one group, and that the second table suctioning portion suction the separating elements of the other group.

[0016]

In this case, it is desirable that the transporting mechanism be formed so as to conform with the suction mode of the cutting table, and a structure in which the transporting mechanism is provided with 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 may be considered.

[0017]

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

[0018]

(Embodiment of the Present Invention)

Hereinafter, an embodiment of a cutting apparatus according to the present 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 omitted as is appropriate.

5 [0019]

(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.

10 [0020]

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 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 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-numbered rows forming one group are all positioned on the same straight lines, while the

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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 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 the actual object to be cut W.

[0021]

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 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.

[0022]

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 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).

[0023]

5 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.

[0024]

10 More specifically, the first table suctioning portion 21 collectively suctions 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 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 W1 of the odd-numbered rows, and between suctioning and not suctioning the separating elements W2 of the even-numbered rows.

[0025]

20 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
25 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
5 of a suction pump.

[0026]

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
10 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.

15 [0027]

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
20 CL2 of the mutually adjacent separating elements W1 and W2 coincide with each other on the cutting table 2.

[0028]

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
25 object to be cut W are provided, and a moving mechanism (not shown in the drawings)

that moves the suction block 41.

[0029]

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.

10 [0030]

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.

[0031]

20 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 suction holes 411a. In addition, the second transporting suction portion 412 has second

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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
5 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).

[0032]

10 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 that are used to suction the cut products P are provided, and a moving mechanism (not shown in the drawings) that
15 moves this suction block 51.

[0033]

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
20 a suction pump 511c that is connected to the internal flow path 511b. Note that suction pads 511d that are made, for example, from resin or the like are provided for the suction holes 511a. In this way, unlike the loader 4, the unloader 5 does not have two independent transporting suction portions, and is instead formed having the transporting suction portion 511 that indiscriminately suctions a plurality of cut products P. Note
25 also that, in FIG. 6, the suction holes 511a of the odd-numbered rows and 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.

[0034]

(Cutting Operation of the Cutting Apparatus 100)

5 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).

[0035]

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

10 The loader 4 holds by means of suction an object to be cut W that was 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 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
15 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 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.

20 [0036]

(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 FIG. 7 and FIG. 8 as [Cutting of connecting portions]). In the present embodiment, the
25 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 cut lines CL1 and CL2 of the separating elements W1 of the even-numbered rows and the separating elements W2 of the odd-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.

[0037]

(3) Stopping the suctioning of the separating elements W2 of the odd-numbered

10 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 cutting table 2 stops the suctioning of the separating elements W2 of the even-numbered rows by the second table suctioning portion 22 (shown in FIG. 7 and FIG. 8 as [Stopping suction and then lifting of even-numbered rows]). 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 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.

[0038]

25 (4) Redisposing the separating elements W2 of the even-numbered rows

After the loader 4 has suctioned the separating elements W2 of the even-numbered rows whose suctioning by the cutting table 2 has been stopped, the loader 4 then lifts up these separating elements W2 of the even-numbered rows from the cutting table 2 (shown in FIG. 7 and FIG. 8 as [Stopping suction and then lifting of even-numbered rows]). Next, the loader 4 redispersed these separating elements W2 of the even-numbered rows such that the cutting lines CL2 thereof are arranged on the same straight lines as the cutting lines CL1 of the separating elements W1 of the odd-numbered rows (shown in FIG. 7 and FIG. 8 as [Redisposing of even-numbered rows]). These redispersed separating elements W2 of the even-numbered rows are held by suction on the cutting table 2 by the second table suctioning portion 22.

[0039]

Here, a method of performing the positioning in this redispersing of the separating elements W2 of the even-numbered rows that might be considered is, (i) prior to moving the separating elements W2 of the even-numbered rows, to employ cameras 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 to then calculate, using this image recognition, the amount of movement needed to position the separating elements W2 of the even-numbered rows, and to then control the loader 4 based on this calculated amount of movement. In addition to this, it is also possible to perform the positioning in this redispersing of the separating elements W2 of the even-numbered rows by (ii) fitting positioning pins that are provided on the cutting table 2 into positioning holes that are provided in the separating elements W2 of the even-numbered rows, or by (iii) setting a positional adjustment amount for the separating elements W2 of the even-numbered rows in advance, and then controlling the moving mechanism of the

loader 4 based on this positional adjustment amount.

[0040]

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

5 After the separating elements W2 of the even-numbered rows have been redispersed, 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 located on the same straight lines (shown in FIG. 8 as [Cutting of odd-numbered rows and even-numbered rows]). Note that, prior to cutting
10 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 [0041]

(6) Discharging of cut products P

 The unloader 5 employs suction in order 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.

[0042]

(Effects Obtained from the Present Embodiment)

25 According to the cutting apparatus 100 of the present embodiment, because the

cutting table 2 is provided with the first table suctioning portion 21 that suctions the one of the mutually adjacent separating elements W1 and W2, and the second table suctioning portion 22 that is independent from the first table suctioning portion 21 and suctions the other one of the mutually adjacent separating elements W1 and W2, it is possible to cancel the suctioning of only the one or of only the other one of the mutually adjacent separating elements W1 or W2, and to then redispense that separating element on the cutting table 2, or remove that separating element from the cutting table 2. As a result, it is possible to enable an object to be cut W whose cutting lines CL1 and CL2 within mutually adjacent separating elements W1 and W2 are set on mutually different straight lines to be easily cut by means of the blade 31.

[0043]

(Other Variant Embodiments)

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

[0044]

For example, in the above-described embodiment, a structure is employed in which the separating elements W2 of the even-numbered rows are redispensed, however, it is also possible to create a structure in which, by redispensing the separating elements W1 of the odd-numbered rows, 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.

[0045]

In the above-described embodiment 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 loader 4 redispenses the separating elements W1 of the odd-numbered rows that are no longer being suctioned.

[0046]

In the above-described embodiment a structure is employed in which the separating elements W1 or W2 of the odd-numbered rows or the even-numbered rows are redispensed by the loader 4, however, it is also possible to employ a structure in which the separating elements W1 or W2 of the odd-numbered rows or the even-numbered rows are redispensed using the unloader 5. In this case, in the same way as the loader 4 of the above-described embodiment, the unloader 5 is formed having a first transporting suction portion that suctions the separating elements W1 of the odd-numbered rows and a second transporting suction portion that suctions the separating elements W2 of the even-numbered rows.

[0047]

Furthermore, in the above-described embodiment a structure is employed in which only one of the separating elements W1 or W2 of the odd-numbered rows or the even-numbered rows are redispensed, 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 and W2 of the odd-numbered rows and the even-numbered rows are redispensed.

[0048]

In the above-described embodiment a structure is employed in which the cutting lines CL1 of the separating elements W1 of the odd-numbered rows and the cutting elements CL2 of the separating elements W2 of the even-numbered rows are mutually aligned and are cut together in a single operation, however, the following method may also be employed. For example, after the connecting portions W3 have been cut, the separating elements W2 of the even-numbered rows may be removed from the cutting table 2, and the separating elements W1 of the odd-numbered rows may then be cut into pieces by cutting along the cutting lines CL1 thereof. Next, after the cut products P resulting from this cutting operation have been discharged from the cutting table 2, the separating elements W2 of the even-numbered rows are once again held by suction on the cutting table 2, and the separating elements W2 of the even-numbered rows may then be cut into pieces by cutting along the cutting lines CL2 thereof. The cut products P resulting from this cutting operation are then discharged from the cutting table 2.

[0049]

The object to be cut W that is cut by the cutting apparatus 100 of the present invention is not limited to that described in the foregoing embodiment, 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. 9, 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 align the cutting lines CL1 of the separating elements W1 of the odd-numbered rows with the cutting elements CL2 of the separating elements W2 of the even-numbered rows and to then cut these together in a single cutting operation (shown in FIG. 9 as [Alignment and cutting of cutting lines of odd-numbered rows and even-numbered rows]). Moreover, after the connecting portions W3 have been cut, the separating elements W1 of the odd-numbered rows and the separating elements W2 of the even-numbered rows can then be cut separately from each other (shown in FIG. 9 as [Odd-numbered rows and even-numbered rows are cut separately]).

[0050]

In the object to be cut W of the above-described embodiment, 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.

[0051]

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]

[0052]

According to the present invention, it is 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.

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; 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 includes a first table suctioning portion that, regarding 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 of the separating elements.

2. The cutting apparatus according to Claim 1, further comprising a transporting
15 mechanism that transports the object to be cut to the cutting table, wherein

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

3. The cutting apparatus according to Claim 2, wherein, in a state in which the connecting portions have been cut by the cutting mechanism so that the mutually
20 adjacent 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 transporting mechanism firstly suctions the separating element whose suctioning by the cutting table has been stopped, and then aligns the cutting lines of the
25 mutually adjacent separating elements so that these are on the same straight lines.

4. The cutting apparatus according to any one of Claim 1 through Claim 3, 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
5 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 suctioning portion suctions the separating elements of the one group, and

- the second table suctioning portion suctions the separating elements of the other
10 group.

5. The cutting apparatus according to Claim 2 or Claim 3, or to Claim 4 which cites Claim 2, wherein the transporting mechanism comprises:

a first transport suctioning portion that suctions the separating elements of the one group; and

- 15 a second transport suctioning portion that suctions the separating elements of the other group.

6. A method of manufacturing a cut product using the cutting apparatus according to any one of Claim 1 through Claim 5.