

DESCRIPTION

APPARATUS AND METHOD FOR CONVEYING SINGULATED ELECTRONIC COMPONENT

5

TECHNICAL FIELD

[0001]

The present invention relates to an apparatus and method for conveying a singulated electronic component. In particular, the present invention relates to a conveying technique used for manufacturing a plurality of electronic components by resin-molding semiconductor chips or other elements, each mounted on one of a plurality of grid areas provided on a substrate, to form a resin-molded substrate, and then singulating the resin-molded substrate by each area.

15 BACKGROUND ART

[0002]

The method of singulating a resin-molded substrate, which is one of the conventional and established methods for effectively manufacturing a plurality of electronic components, is explained with reference to Fig. 5. Fig. 5(1) illustrates a state in which a resin-molded substrate is stabilized on the stage ST, and Fig. 5(2) illustrates a state in which singulated electronic components have been conveyed to and arranged on the two tables T1 and T2, each illustrated as a schematic plain view. Every figure contained in the present application is schematically illustrated with an appropriate omission or exaggeration in order to make it clearly understood.

25 [0003]

A resin-molded substrate M includes a substrate composed of a printed-circuit board, a lead frame, or other components, and a molding resin formed on one side of the substrate (both not shown). As illustrated in Fig. 5(1), the resin-molded substrate M has a plurality of areas provided on the substrate, and these areas correspond to a plurality of electronic components P (refer to the electronic components P illustrated in Fig. 5(2)). In Fig. 5(1), the areas corresponding to the plurality of electronic components are indicated by numerals 11 through 15, 21 through 25, ..., and 81 through 85 for convenience of explanation. In Fig. 5(2), the plurality of electronic components P are indicated by numerals 11 through 15, 21 through 25, ..., and 81 through 85. On each area of the resin-molded substrate M, a chip-like component (not shown) such as a semiconductor chip or other chip is mounted. Sectioned by virtual lines L, the areas are arranged in a grid pattern in accordance with a constant pitch (center-to-center interval) in the X-direction and Y-direction. In Fig. 5, the planer shape of each area is a square, and the constant pitch in the X-direction and Y-direction is indicated by "p."

15 [0004]

In the process of manufacturing electronic components, the resin-molded substrate M is stabilized on the stage ST by means of sucking, adhesion, or other method, and then cut (fully cut off) along the virtual lines L with a dicer or other machines using a rotary blade. Accordingly, a plurality of singulated electronic components (refer to the electronic components P in Fig. 5(2)) are manufactured. The singulated electronic components are placed in a grid pattern on the stage ST which is illustrated in Fig. 5(1). These electronic components are stabilized with a suction jig, and carried from the surface of the stage ST to a storage tray or a table (both not shown) used in the subsequent process (for example, refer to Patent Document 1).

25 [0005]

In recent years, demands for the price reduction and downsizing of electronic devices have been decreasing the size of electronic components. This trend has brought about the following problems. First, the intervals between suction heads provided on the tip of suction jig have been decreasing, making it difficult to manufacture a suction jig. Second, in a tray for storing electronic components and a table used in the subsequent process, forming an inclined portion around the inner bottom portion of a recess in which each electronic component is stored has been becoming difficult. Such an inclined portion is provided for guiding an electronic component around the inner bottom portion of a recess. These problems are significant when the plane size of an electronic component is not more than 3 mm on a side.

[0006]

A conventional method employed to cope with these problems is to convey a plurality of electronic components and arrange them in a zigzag pattern. This method is explained with reference to Figs. 5 and 6. Figs. 6(1) through (3) are a schematic front view for explaining a process in which a plurality of singulated electronic components are conveyed from the stage ST and arranged in a zigzag pattern on each of the two tables T1 and T2.

[0007]

“Arranging a plurality of electronic components in a zigzag pattern” means arranging a plurality of electronic components in such a way that in relation to a given electronic component, other electronic components are placed not on the left, right, top and bottom, but in diagonal positions. In other words, “arranging a plurality of electronic components in a zigzag pattern” means arranging a plurality of electronic components at the positions corresponding to one color of a checkered pattern. A “checkered pattern” means a pattern in which blue and white are alternately arranged in a checkerboard-like manner. In the figures

contained in the present application, lines along the horizontal direction (X-direction) are referred to as the “rows” and lines along the vertical direction (Y-direction) are referred to as the “columns.” On the stage ST of Fig. 5(1), a total of 40 electronic components are arranged in eight rows by five columns.

5 [0008]

In Fig. 6, five suction heads H1 through H5 are provided in a conveying mechanism PU. The suction heads H1 through H5 have suction tubes V1 through V5, respectively. Each of the suction tubes V1 through V5 is connected to a decompression tank via a valve (both not shown). The decompression tank, valves, and suction tubes V1 through V5 are included
10 in a stabilization/stabilization-release mechanism for stabilizing electronic components and releasing the stabilization.

[0009]

First, the conveying mechanism PU moves down from the state illustrated in Fig. 6(1), and the singulated electronic components 11 through 15 on the stage ST are
15 simultaneously sucked by the five suction heads H1 through H5, respectively. Then, the conveying mechanism PU moves up, and then moves to a position above the table T1 of the two tables used in the subsequent process. After that, the conveying mechanism PU moves down and the suction through the suction tubes V1, V3, and V5 is discontinued. Consequently, as illustrated in Fig. 6(2), the electronic components 11, 13, and 15 are
20 arranged on the table T1 in such a manner as to have a pitch of 2p.

[0010]

Subsequently, as illustrated in Fig. 6(2), the conveying mechanism PU moves up and then moves to the right in the figure so that it moves to a position above the table T2 of the two tables used in the subsequent process. Then, the conveying mechanism PU moves down
25 and the suction through the suction tubes V2 and V4 is discontinued. Consequently, the

electronic components 12 and 14 are arranged on the table T2 in such a manner as to have a pitch of $2p$. With the process thus far, in Fig. 5(2), the electronic components 11 through 15 are placed in the extreme positive row (upper in the figure) on each of the tables T1 and T2. Specifically, the electronic components 11, 13, and 15 are arranged on the table T1 and the
5 electronic components 12 and 14 on the table T2, in such a manner as to have a pitch of $2p$ on each of the tables T1 and T2.

[0011]

After that, another suction jig (not shown) with suction heads having a pitch of $2p$ sequentially and collectively sucks the electronic components 11, 13, and 15, and the
10 electronic components 12 and 14, and then conveys them to a tray or a table used in the subsequent process. That is, first, the electronic components 11, 13, and 15 are collectively sucked and conveyed, and then, the electronic components 12 and 14 are collectively sucked and conveyed. With this conventional technique, three electronic components 11, 13, and 15 arranged in one row on the table T1 and two electronic components 12 and 14
15 arranged in one row on the table T2, i.e. a total of five electronic components P are conveyed in two steps. In the case illustrated in Fig. 5(2), a total of 40 electronic components are conveyed in 16 steps. Therefore, it is difficult to enhance the efficiency of conveying singulated electronic components arranged in a zigzag pattern.

[0012]

20 [Patent Document 1] Japanese Unexamined Patent Application Publication No. 2000-100757 (page 6)

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

25 [0013]

The problem to be solved by the present invention is the inefficiency in conveying singulated electronic components placed in a grid pattern on a stage to a table to arrange them in a zigzag pattern, and further conveying them from the surface of the table.

5 MEANS FOR SOLVING THE PROBLEM

[0014]

The numbers and characters in parenthesis in the explanations in “MEANS FOR SOLVING THE PROBLEM,” “EFFECTS OF THE INVENTION,” and “BEST MODES FOR CARRYING OUT THE INVENTION” are used with the aim of establishing an easy
10 comparison between the words in the specification and the components illustrated in the figures. It should be noted that these numbers and characters do not indicate that “the words in the specification are to be limitedly interpreted as the components illustrated in the figures.”

[0015]

15 To solve the aforementioned problem, the present invention provides an apparatus for conveying singulated electronic components, for conveying a plurality of electronic components (P) manufactured by resin-molding chips, each mounted on one of a plurality of grid areas provided on a substrate, to form a resin-molded substrate (M), and then singulating the resin-molded substrate (M) by each area, including:

20 a stabilization member (HA) having a lower surface onto which the plurality of electronic components (P) arranged at all positions of cells in a checkered pattern are to be collectively sucked after the resin-molded substrate (M) is singulated;

a stabilization release mechanism (V1 through V5) for selectively releasing a suction of the plurality of electronic components (P) stabilized on the stabilization member
25 (HA) to unfix the plurality of electronic components (P);

a table (TA) capable of being located below the stabilization member (HA);
a first reception part (S1) provided on the table (TA); and
a second reception part (S2) provided adjacent to the first reception part (S1) on the table (TA),

5 wherein the stabilization release mechanism (V1 through V5) releases, when the stabilization member (HA) is located above the first reception part (S1), a suction of electronic components (P) at positions corresponding to one color of a checkered pattern among the plurality of electronic components (P) sucked onto the stabilization member (HA), and releases, after the stabilization member (HA) moves from a position above the
10 first reception part (S1) to a position above the second reception part (S2), a suction of other plurality of electronic components (P) sucked onto the stabilization member (HA), so that all the electronic components (P) are arranged in a zigzag pattern with a constant pitch in the first reception part (S1) and the second reception part (S2).

[0016]

15 The present invention also provides a variation of the aforementioned apparatus for conveying singulated electronic components, including a moving mechanism for relatively moving the stabilization member (HA) and/or the table (TA), wherein:

in a case where the number of electronic components (P) in a direction (X-direction) orthogonal to a border line between the first reception part (S1) and the second reception
20 part (S2) is odd, the moving mechanism moves the stabilization member (HA) and/or the table (TA) in a direction (X-direction) orthogonal to the border line after the electronic components (P) are received in the first reception part (S1), and in a case where the number of electronic components (P) in a direction (X-direction) orthogonal to the border line is even, the moving mechanism moves, after the electronic components (P) are
25 received in the first reception part (S1), the stabilization member (HA) and/or the table (TA)

in a direction (X-direction) orthogonal to the border line and along a direction (Y-direction) parallel to the border line by a center-to-center interval (p) at which the electronic components (P) were arranged in the direction (Y-direction) when they were arranged at all positions of the cells.

5 [0017]

The present invention also provides another variation of the aforementioned apparatus for conveying singulated electronic components according to the aforementioned apparatus, including:

a conveying mechanism (PU) for collectively sucking and conveying electronic
10 components (P) contained in one line along one direction (X-direction) in the checkered pattern, among the plurality of electronic components (P) received in a zigzag pattern on the table (TA); and

a plurality of sucking mechanisms (H1 through H5) provided at predetermined center-to-center intervals (2p) in the conveying mechanism (PU), each of the sucking
15 mechanisms (H1 through H5) being for sucking one of the electronic components (P),

wherein the center-to-center intervals (p, 2p) of the sucking mechanisms (H1 through H5) can be changed.

[0018]

The present invention provides a method for conveying singulated electronic
20 components, for conveying a plurality of electronic components (P) manufactured by resin-molded chips, each mounted on one of a plurality of grid areas provided on a substrate, to form a resin-molded substrate, and then singulating the resin-molded substrate by each area, including the steps of:

collectively sucking, after the resin-molded substrate is singulated, the plurality of
25 electronic components (P) arranged at all positions of the cells in a checkered pattern onto

a lower surface of a stabilization member (HA);

aligning the stabilization member (HA) and a first reception part (S1) provided in a table (TA) capable of receiving the plurality of electronic components (P);

selectively releasing a suction of the plurality of electronic components (P)
5 stabilized on the stabilization member (HA) in order that electronic components (P) at positions corresponding to one color of a checkered pattern among the plurality of electronic components (P) are received in the first reception part (S1);

aligning the stabilization member (HA) and a second reception part (S2) provided adjacent to the first reception part (S1) on the table (TA); and

10 selectively releasing a suction of the plurality of electronic components (P) stabilized on the stabilization member (HA) in order that electronic components (P) at positions corresponding to the other color of the checkered pattern are received in the second reception part (S2), so that all the electronic components (P) are arranged in a zigzag pattern with a constant pitch in the first reception part (S2) and the second reception
15 part (S2).

[0019]

The present invention also provides a variation of the aforementioned method for conveying singulated electronic components, including a step of relatively moving the stabilization member (HA) and/or the table (TA) according to cases, wherein: in the step of
20 moving, in a case where the number of electronic components (P) in a direction (X-direction) orthogonal to a border line between the first reception part (S1) and the second reception part (S2) is even, the stabilization member (HA) and/or the table (TA) is moved, after the electronic components (P) are received in the first reception part (S1), in a direction (X-direction) orthogonal to the border line and moved along a direction
25 (Y-direction) parallel to the border line by a center-to-center interval (p) at which the

electronic components (P) were arranged in the direction (Y-direction) when they were arranged at all positions of the cells.

[0020]

The present invention also provides another variation of the aforementioned
5 method for conveying singulated electronic components, including the steps of:

collectively sucking and conveying, by using a conveying mechanism (PU),
electronic components (P) contained in one line along one direction (X-direction) in the
checkered pattern, among the plurality of electronic components (P) received in a zigzag
pattern on the table (TA); and

10 changing predetermined center-to-center intervals (p, 2p) at which a plurality of
sucking mechanisms (H1 through H5) are provided in the conveying mechanism (PU),
each of the sucking mechanisms (H1 through H5) being for sucking one of the electronic
components (P).

15 EFFECTS OF THE INVENTION

[0021]

With the present invention, a plurality of singulated electronic components (P) are
collectively sucked and conveyed by the stabilization member (HA), and then arranged on a
table (TA) in such a manner that they are received in a zigzag pattern. This significantly
20 enhances the efficiency of conveying the singulated electronic components (P).

[0022]

With the present invention, a plurality of electronic components (P) can be
efficiently arranged in a zigzag pattern, whether the number of the electronic components
(P) contained in one line along a direction (X-direction) orthogonal to the border line
25 between the first reception part (S1) and the second reception part (S2) is even or odd.

[0023]

With the present invention, the center-to-center intervals (p, 2p) of the plurality of sucking mechanisms (H1 through H5) of the conveying mechanism (PU) can be changed. Therefore, even in the case where the center-to-center intervals (p) of a plurality of singulated electronic components (P) vary, these plural electronic components (P) can be conveyed by changing the center-to-center intervals (p) of the plurality of sucking mechanisms (H1 through H5).

BRIEF DESCRIPTION OF THE DRAWINGS

10 [0024]

Fig. 1(1) is a plain view illustrating an initial state of electronic components to be conveyed by the conveying apparatus according to the first embodiment transparently viewed from above, and Fig. 1(2) is a plain view illustrating a state while the electronic components are conveyed.

15 Figs. 2(1) through 2(3) are a schematic front view for explaining a procedure of conveying a plurality of electronic components arranged in a zigzag pattern from a table.

Fig. 3(1) is a plain view illustrating an initial state of electronic components to be conveyed by the conveying apparatus according to the second embodiment transparently viewed from above, and Figs. 3(2) and 3(3) are plain views each illustrating a problem which occurs while the electronic components are conveyed.

Fig. 4(1) is a plain view illustrating an initial state of electronic components to be conveyed by the conveying apparatus according to the second embodiment transparently viewed from above, and Figs. 4(2) and 4(3) are plain views illustrating a state while the electronic components are conveyed.

25 Fig. 5(1) is a schematic plain view illustrating a state in which a resin-molded

substrate is stabilized on a stage, and Fig. 5(2) is a schematic plain view illustrating a state in which singulated electronic components have been conveyed onto two tables and arranged on them, both in a conventional technique.

Figs. 6(1) through 6(3) are a schematic front view for explaining a procedure of conveying singulated electronic components from a stage and arranging them in a zigzag pattern on two tables, in a conventional technique.

EXPLANATION OF NUMERALS

[0025]

10 11 through 15, 21 through 25, ..., and 81 through 85 ... Electronic Component

H1 through H5 ... Suction Head (Sucking Mechanism)

HA ... Stabilization Member

L ... Virtual Line

M ... Resin-molded Substrate

15 P ... Electronic Component

PU ... Conveying Mechanism

R1 through R8 ... Row

S1 ... First Reception Part

S2 ... Second Reception Part

20 ST ... Stage

TA ... Table

V1 through V5 ... Stabilization/Stabilization-Release Mechanism (Stabilization Release Mechanism)

25 BEST MODES FOR CARRYING OUT THE INVENTION

[0026]

In an apparatus for conveying singulated electronic components, a first reception part (S1) and a second reception part (S2) are adjacently provided on a table (TA). The first reception part (S1) is for receiving electronic components (P) located at positions
5 corresponding to one color of a checkered pattern among the plurality of electronic components (P), and the second reception part (S2) is for receiving electronic components (P) located at positions corresponding to the other color of the checkered pattern. In addition, a conveying mechanism (PU) is provided for collectively sucking and conveying electronic components (P) contained in one line along one direction (X-direction) in the
10 checkered pattern, among the plurality of electronic components (P) received in a zigzag pattern at equal center-to-center intervals (2p) on the table (TA). The conveying mechanism (PU) has a plurality of sucking mechanisms (H1 through H5) provided at predetermined intervals (2p), and each of the sucking mechanisms (H1 through H5) sucks one of the electronic components (P) contained in one line. The electronic components (P)
15 contained in one line along one direction (X-direction) are arranged at equal center-to-center intervals (2p).

FIRST EMBODIMENT

[0027]

20 A first embodiment of the apparatus for conveying electronic components according to the present invention will be explained with reference to Figs. 1 and 2. Fig. 1(1) is a plain view illustrating an initial state of electronic components to be conveyed by the conveying apparatus according to the present embodiment transparently viewed from above, and Fig. 1(2) is a plain view illustrating a state while the electronic components are
25 conveyed. Figs. 2(1) through 2(3) are a schematic front view for explaining a procedure of

conveying a plurality of electronic components arranged in a zigzag pattern from a table. This embodiment is intended for the case where an odd number of electronic components P are placed in one row (one line) on the stage ST of Fig. 5(1).

[0028]

5 As illustrated in Fig. 1(1), the apparatus for conveying electronic components according to the present embodiment has a stabilization member HA for collectively sucking and stabilizing a plurality of electronic components placed on the stage ST which is illustrated in Fig. 5(1). On the stage ST in Fig. 5(1), the number of the plurality of electronic components cut (singulated) by a dicer which uses a rotary blade is five per row. Since there
10 are eight rows, a total of 40 electronic components are arranged.

[0029]

The stabilization member HA is provided in such a manner that it can move in each of the directions X, Y, and Z in the figure. The stabilization member HA has a stabilization/stabilization-release mechanism (not shown) for collectively sucking and
15 stabilizing a plurality of electronic components P (i.e. electronic components 11 through 15, 21 through 25, ..., and 81 through 85) on its lower surface, and selectively releasing their stabilization. This stabilization/stabilization-release mechanism has suction tubes provided corresponding to each of the electronic components P, and a decompression tank connected via valves, each of which is connected to one of the suction tubes.

20 [0030]

As illustrated in Fig. 1(2), the apparatus for conveying electronic components according to the present embodiment has one table TA which is capable of being located below the stabilization member HA, and which receives a plurality of electronic components from the stabilization member HA. On the table TA, two reception parts, the first reception
25 part S1 and the second reception part S2, are adjacently provided without a space in between

as indicated with dashed lines in Fig. 1(2). Each of the reception parts S1 and S2 has recesses (not shown) corresponding to the plurality of electronic components to be received. Fig. 1(2) illustrates a state in which electronic components P are received in all the recesses.

[0031]

5 These recesses are provided in such a manner as to have a constant pitch of $2p$ in both the first reception part S1 and the second reception part S2, and to form a zigzag pattern (i.e. arranged at positions corresponding to one color of a checkered pattern) all over the first reception part S1 and the second reception part S2. Since the first reception part S1 and the second reception part S2 are adjacently provided without a space in between, the pitch
10 between any two electronic components P that are adjacent in one row across the border line between the first reception part S1 and the second reception part S2 is also $2p$. Accordingly, the recesses for receiving each of the plurality of electronic components P are arranged in a zigzag pattern with a pitch of $2p$, all over the first reception part S1 and the second reception part S2.

15 [0032]

Hereinafter, an operation of the apparatus for conveying electronic components according to the present embodiment will be described with reference to Figs. 1 and 2. First, the stabilization member HA collectively suks a plurality of electronic components P placed on the stage ST which is illustrated in Fig. 5(1) and stabilize them on the lower surface of the
20 stabilization member HA. At this point, as illustrated in Fig. 1(1), the electronic components 11 through 15, 21 through 25, $\dots$, and 81 through 85 are sucked and stabilized with a pitch of p in both the X-direction and Y-direction on the lower surface of the stabilization member HA. In detail, five electronic components 11 through 15 are aligned in one row, and in the same manner, five electronic components 21 through 25, $\dots$, and five electronic
25 components 81 through 85 are each aligned and sucked to be stabilized in one row.

[0033]

Next, the stabilization member HA moves to a position above the first reception part S1 on the table TA. After the electronic components P and the recesses provided corresponding to the electronic components P in the first reception part S1 are aligned, the
 5 stabilization member HA moves down. Then, the suction of some of the electronic components P (which will be identified later) is released so that these electronic components P may be arranged with a pitch of $2p$ in the first reception part S1. The electronic components arranged in the first reception part S1 after the release of suction are: electronic components 11, 13, 15, 22, 24, $\dots$, 71, 73, 75, 82, and 84.

10 [0034]

Subsequently, the stabilization member HA moves to a position above the second reception part S2 on the table TA. After the electronic components and the recesses which are provided corresponding to the electronic components P in the second reception part S2 are aligned, the stabilization member HA moves down. In this movement, the stabilization
 15 member HA does not move in the Y-direction. Then, the suction of some of the electronic components P, which will be identified later, is released so that these electronic components P may be arranged with a pitch of $2p$ in the second reception part S2. The electronic components arranged in the second reception part S2 after the release of suction are: electronic components 12, 14, 21, 23, 25, $\dots$, 72, 74, 81, 83, and 85. With the process thus
 20 far, as illustrated in Fig. 1(2), five electronic components P are arranged in each of the rows R1, $\dots$, and R8, and they are arranged in a zigzag pattern with a pitch of $2p$ in both the X-direction and Y-direction.

[0035]

After that, as illustrated in Fig. 2(1), in the conveying mechanism PU having the
 25 suction heads H1 through H5 with a pitch of p , the pitch is changed to $2p$. In this process, the

pitch of the suction heads H1 through H5 can be changed by using a known technique of changing the pitch of the pick-up units in a conveying apparatus (for example, refer to Japanese Unexamined Patent Application Publication No. 2004-039706).

[0036]

5 Next, the conveying mechanism PU moves down as illustrated in Fig. 2(2). Then, as illustrated in Fig. 2(3), the electronic components P contained in one row (one line of the row R1) and aligned along the X-direction, i.e. the electronic components 11, 13, 15, 12, and 14, are sucked by the suction heads H1 through H5, respectively. Then, the conveying mechanism PU moves up.

10 [0037]

Subsequently, the conveying mechanism PU conveys those five electronic components P onto a tray or a table which is used in the subsequent process. By repeating this operation a total of eight times, the conveying mechanism PU conveys all 40 electronic components P (refer to Fig. 1(2)) arranged on the table TA.

15 [0038]

As described thus far, with the present embodiment, first, a plurality of singulated electronic components P are collectively sucked and conveyed by the stabilization member HA, and arranged to be received in a zigzag pattern on the table TA. Second, in the case where the number of electronic components P contained in one row (one line) is odd, the
20 electronic components P arranged in a zigzag pattern are conveyed with half the number of operations compared to the number of operations in the conventional technique. Accordingly, the efficiency of conveying singulated electronic components P can be significantly increased.

25 SECOND EMBODIMENT

[0039]

A second embodiment of the apparatus for conveying electronic components according to the present invention will be explained with reference to Figs. 3 and 4. Fig. 3(1) is a plain view illustrating an initial state of electronic components to be conveyed by the conveying apparatus according to the present embodiment transparently viewed from above, and Figs. 3(2) and 3(3) are plain views each illustrating a problem which occurs while the electronic components are conveyed. Fig. 4(1) is a plain view illustrating an initial state of electronic components to be conveyed by the conveying apparatus according to the present embodiment transparently viewed from above, and Figs. 4(2) and 4(3) are plain views illustrating a state while the electronic components are conveyed. This embodiment is intended for the case where an even number of the electronic components P are placed in one row (one line) on the stage ST of Fig. 5(1).

[0040]

As illustrated in Fig. 3(1), the stabilization member HA collectively sucks and stabilizes 32 arranged electronic components P; four per row in eight rows. At this point, if the same operation as has been described with reference to Fig. 1 is performed in order to arrange the electronic components P in a zigzag pattern with a pitch of $2p$ on one table TA, the following two problems occur.

[0041]

The first problem is that if the electronic components 11, 13, 12, 14, 31, 33, 32, 34, $\dots$ are arranged in the rows R1, R3, $\dots$ of Fig. 3(2) with a pitch of $2p$, two electronic components P overlap at the positions indicated by "X" in the rows R2, R4, $\dots$. For example, at the position indicated by "X" in the row R2, the electronic component 24 and the electronic component 21 overlap each other. The second problem is that if the electronic components 22, 24, 21, 23, $\dots$ are arranged in the rows R2, $\dots$ with a pitch of $2p$ in

order to avoid the first problem, the electronic components P are not placed at the positions where a dashed square is drawn in the rows R1, R3,

[0042]

An operation of the conveying apparatus to solve these problems will be described with reference to Fig. 4. First, the stabilization member HA collectively sucks a plurality of electronic components P placed on the stage (see the stage ST illustrated in Fig. 5(1)) to stabilize them onto the lower surface of the stabilization member HA. At this point, as illustrated in Fig. 4(1), the electronic components 11 through 14, 21 through 24, ..., and 81 through 84 are sucked and stabilized on the lower surface of the stabilization member HA with a pitch of p in the X-direction and Y-direction.

[0043]

Next, the stabilization member HA moves to a position above the first reception part S1 on the table TA. After the electronic components P and the recesses provided corresponding to the electronic components P on the table TA are aligned, the stabilization member HA moves down. Then, the suction of some of the electronic components P (which will be identified later) is released so that these electronic components P may be arranged with a pitch of 2p in the first reception part S1. As illustrated in Fig. 4(2), the electronic components arranged in the first reception part S1 after the release of suction are: electronic components 11, 13, 22, 24, ..., 71, 73, 82, and 84. At this point, the electronic components 12, 14, 21, 23, ..., 72, 74, 81, and 83 remain stabilized on the stabilization member HA (see Fig. 4(1)). These electronic components are indicated by numerals which are not surrounded by a square in Fig. 4(2) for convenience of explanation.

[0044]

Subsequently, from the state illustrated in Fig. 4(2), the stabilization member HA (see Fig. 4(1)) and the table TA relatively move in the Y-direction by the distance equal to

the pitch p in the Y-direction. Specifically, the electronic components 12, 14, $\dots$ which remain stabilized on the stabilization member HA move in such a manner as to be located below (or above) the originally corresponding row by one row. In Fig. 4(2), the electronic components 12 and 14 move to the positions corresponding to the row R2. This movement is performed with a moving mechanism such as a motor. Either one of the stabilization member HA or the table TA may move in the Y-direction, or, both may move in the Y-direction.

[0045]

Next, the stabilization member HA moves to a position above the second reception part S2 on the table TA. After the electronic components P and the recesses provided corresponding to the electronic components P on the table TA are aligned, the stabilization member HA moves down. Then, the suction of some of the electronic components P (which will be identified later) is released so that these electronic components P may be arranged with a pitch of $2p$ in the second reception part S2. The electronic components arranged in the second reception part S2 after the release of suction are: electronic components 12, 14, 21, 23, $\dots$, 72, 74, 81, and 83. Accordingly, the electronic components 12 and 14 for example move as shown by the dashed arrows in Fig. 4(2) to be received in the second reception part S2. With these operations, the electronic components P are finally arranged as illustrated in Fig. 4(3). Hence, the resultant arrangement of the electronic components P is as follows: two in the top row R1, two in the undermost row (not shown), and four in each of the remaining rows R2, R3, $\dots$. For the entire table TA, they are arranged in nine rows in a zigzag pattern with a pitch of $2p$.

[0046]

After that, in the same manner as has been described with reference to Fig. 2, the electronic components P arranged in a zigzag pattern on the table TA are conveyed.

Specifically, by the conveying mechanism PU (see Fig. 2(2)), (two or four) electronic components P contained in one row (one line) are conveyed per one operation. By repeating this operation a total of nine times, all 32 electronic components P placed on the table TA are conveyed.

5 [0047]

As described thus far, with the present embodiment, first, a plurality of singulated electronic components P are collectively sucked and conveyed by the stabilization member HA and arranged to be received in a zigzag pattern on the table TA as in the first embodiment. Second, in the case where an even number of the electronic components P
10 contained in one row (one line), the electronic components P arranged in a zigzag pattern are conveyed with approximately half the number of operations compared to the number of operations in the conventional technique. Accordingly, the efficiency of conveying singulated electronic components P can be significantly increased.

[0048]

15 In the explanation of each embodiment, the stabilization member HA collectively sucked and conveyed a plurality of electronic components from the stage ST illustrated in Fig. 5(1). This is not the only configuration. Alternately, the stage ST itself may be inverted and moved to a position above the first reception part S1 and the second reception part S2.

[0049]

20 To make the pitch of the suction heads H1 through H5 changeable, plural kinds of conveying mechanisms PU each having a plurality of suction heads with a different pitch may be prepared so that an appropriate conveying mechanism PU may be selected and used in accordance with the pitch of the electronic components. This makes the pitch of the plural suction heads changeable.

25 [0050]

The pitch of the plurality of areas provided on the substrate, i.e. the pitch of the plurality of singulated electronic components, was set to be p in both the X-direction and Y-direction. This is not the only configuration. Even in the case where the pitches of a plurality of electronic components are different in the X-direction and Y-direction, the present invention can be applied.

[0051]

In the process of cutting (singulating) the resin-molded substrate M, a cutting mechanism (dicer) which uses a rotary blade was used. This is not the only configuration. A cutting mechanism using laser light, water jet, wire saw, band saw, or otherwise can be used. In addition, the resin-molded substrate M may be cut (half-cut) along virtual lines L to form grooves, and after that an external force may be applied to the resin-molded substrate M to separate it into each electronic component.

[0052]

The virtual lines L which correspond to cutting lines were straight lines and the planar shape of the singulated electronic components P was a square. This is not the only configuration. The planar shape of the singulated electronic components P may be rectangular. Furthermore, the virtual lines L which correspond to cutting lines may include a curve or polygonal line. For example, in manufacturing electronic components whose outer border includes a curve or polygonal line (e.g. a kind of memory card), the present invention can be applied.

[0053]

It should be noted that the present invention is not limited to each previously-described embodiment, and can be at will and appropriately combined, changed or selected according to necessity without any departure from the scope of the present invention.

CLAIMS

1. An apparatus for conveying singulated electronic components, for conveying a plurality of electronic components manufactured by resin-molded chips, each mounted
5 on one of a plurality of grid areas provided on a substrate, to form a resin-molded substrate, and then singulating the resin-molded substrate by each area, comprising:

a stabilization member having a lower surface onto which the plurality of electronic components arranged at all positions of cells in a checkered pattern are to be collectively sucked after the resin-molded substrate is singulated;

10 a stabilization release mechanism for selectively releasing a suction of the plurality of electronic components stabilized on the stabilization member to unfix the plurality of electronic components;

a table capable of being located below the stabilization member;

a first reception part provided on the table; and

15 a second reception part provided adjacent to the first reception part on the table,

wherein the stabilization release mechanism releases, when the stabilization member is located above the first reception part, a suction of electronic components at positions corresponding to one color of a checkered pattern among the plurality of electronic components sucked onto the stabilization member, and releases, after the
20 stabilization member moves from a position above the first reception part to a position above the second reception part, a suction of other plurality of electronic components sucked onto the stabilization member, so that all the electronic components are arranged in a zigzag pattern with a constant pitch in the first reception part and the second reception part.

2. The apparatus for conveying singulated electronic components according to claim 1, comprising a moving mechanism for relatively moving the stabilization member and/or the table, wherein:

in a case where a number of electronic components in a direction orthogonal to a border line between the first reception part and the second reception part is odd, the moving mechanism moves the stabilization member and/or the table in a direction orthogonal to the border line after the electronic components are received in the first reception part, and in a case where the number of electronic components in a direction orthogonal to the border line is even, the moving mechanism moves, after the electronic components are received in the first reception part, the stabilization member and/or the table in a direction orthogonal to the border line and along a direction parallel to the border line by a center-to-center interval at which the electronic components were arranged in the direction when they were arranged at all positions of the cells.

3. The apparatus for conveying singulated electronic components according to claim 1 or 2, comprising:

a conveying mechanism for collectively sucking and conveying electronic components contained in one line along one direction in the checkered pattern, among the plurality of electronic components received in a zigzag pattern on the table; and

a plurality of sucking mechanisms provided at predetermined center-to-center intervals in the conveying mechanism, each of the sucking mechanisms being for sucking one of the electronic components,

wherein the center-to-center intervals of the sucking mechanisms can be changed.

4. A method for conveying singulated electronic components, for conveying a

plurality of electronic components manufactured by resin-molded chips, each mounted on one of a plurality of grid areas provided on a substrate, to form a resin-molded substrate, and then singulating the resin-molded substrate by each area, comprising steps of:

collectively sucking, after the resin-molded substrate is singulated, the plurality of
5 electronic components arranged at all positions of cells in a checkered pattern onto a lower surface of a stabilization member;

aligning the stabilization member and a first reception part provided in a table capable of receiving the plurality of electronic components;

selectively releasing a suction of the plurality of electronic components stabilized
10 on the stabilization member in order that electronic components at positions corresponding to one color of a checkered pattern among the plurality of electronic components are received in the first reception part;

aligning the stabilization member and a second reception part provided adjacent to the first reception part on the table; and

15 selectively releasing a suction of the plurality of electronic components stabilized on the stabilization member in order that electronic components at positions corresponding to a different color of the checkered pattern are received in the second reception part, so that all the electronic components are arranged in a zigzag pattern with a constant pitch in the first reception part and the second reception part.

20

5. The method for conveying singulated electronic components according to claim 4, comprising a step of relatively moving the stabilization member and/or the table according to cases, wherein: in the step of moving, in a case where a number of electronic components in a direction orthogonal to a border line between the first reception part and
25 the second reception part is even, the stabilization member and/or the table is moved, after

the electronic components are received in the first reception part, in a direction orthogonal to the border line and moved along a direction parallel to the border line by a center-to-center interval at which the electronic components were arranged in the direction when they were arranged at all positions of the cells.

5

6. The method for conveying singulated electronic components according to claim 4 or 5, comprising steps of:

collectively sucking and conveying, by using a conveying mechanism, electronic components contained in one line along one direction in the checkered pattern, among the
10 plurality of electronic components received in a zigzag pattern on the table; and

changing predetermined center-to-center intervals, at which a plurality of sucking mechanisms are provided in the conveying mechanism, each of the sucking mechanisms being for sucking one of the electronic components.