

## DESCRIPTION

### RESIN MOLDING APPARATUS AND PRODUCTION METHOD FOR RESIN MOLDED ARTICLE

#### Technical Field

[0001]

The present invention relates to a resin molding apparatus and a production method for a resin molded article.

#### Background Art

[0002]

Conventionally, as a production method for a semiconductor device, there has been an idea of a method for performing a molding process for sealing the lead frame with resin, and then performing a gate breaking process for removing the remaining resin that are cull portions and runner portions, and a gate cutting process for removing the resin of the gate portion remaining after the gate breaking process, as disclosed in Patent Literature 1.

#### Citation List

##### Patent Literature

[0003]

Patent Literature 1: JP 4454399 B2

#### Summary of Invention

#### Technical Problem

[0004]

However, depending on the shape of the remaining unnecessary resin or of the resin-sealed package, sometimes the remaining unnecessary resin fails to be completely

removed, or the package becomes chipped, at the time of removing the unnecessary resin such as the gate portion remaining after the gate breaking process. Such a deficiency has resulted in a product defect.

[0005]

Therefore, the present invention has been made to solve the problem described above, and it is a main object of the present invention to reduce product defects, such as a failure in removing the remaining unnecessary resin or chipping of the package, at the time of removing the unnecessary resin remaining on a sealed substrate from which unnecessary resin including at least cull has been removed.

Solution to Problem

[0006]

In other words, a resin molding apparatus according to the present invention includes: a resin molding unit that forms a sealed substrate by sealing a substrate with resin; and a removing unit that removes unnecessary resin from the sealed substrate, wherein the removing unit includes a reversing conveyor mechanism including a substrate holding unit that holds the sealed substrate from which first unnecessary resin including at least cull has been removed, a reversing unit that rotates the substrate holding unit to reverse the sealed substrate topside down, and a substrate conveyor unit that conveys the sealed substrate having been reversed topside down by the reversing unit, to a processing stage for removing second unnecessary resin remaining on the sealed substrate.

Advantageous Effects of Invention

[0007]

According to the present invention configured as described above, when the remaining second unnecessary resin is removed from the sealed substrate from which

first unnecessary resin including at least cull has been removed, it is possible to reduce product defects such as a failure in removing the second unnecessary resin or chipping of the package.

#### Brief Description of Drawings

[0008]

FIG. 1 is a plan view schematically illustrating a configuration of a resin molding apparatus according to an embodiment of the present invention.

FIG. 2 is a plan view schematically illustrating pots, cavities, and resin passages connecting the pots and the cavities according to the embodiment.

FIG. 3 is a view schematically illustrating before and after first unnecessary resin is removed, and before and after second unnecessary resin is removed, in the sealed substrate in the embodiment.

FIG. 4 is a plan view schematically illustrating a configuration of a reversing conveyor mechanism according to the embodiment.

FIG. 5 is a longitudinal sectional view along an X direction schematically illustrating a configuration of a reversing conveyor mechanism according to the embodiment.

FIG. 6 is a longitudinal cross-sectional view taken along a Y direction, schematically illustrating before and after the sealed substrate is reversed by the reversing conveyor mechanism, in the embodiment.

FIG. 7 is a longitudinal cross-sectional view taken along an X direction, schematically illustrating before and after the sealed substrate is reversed by the reversing conveyor mechanism, in the embodiment.

FIG. 8 is a view illustrating an operation of a substrate conveyor unit in the reversing conveyor mechanism in the embodiment.

FIG. 9 is a schematic view illustrating a configuration of a second reversing conveyor mechanism, and the sealed substrate before and after being reversed, in the embodiment.

#### Description of Embodiments

[0009]

The present invention will be explained more in detail using some examples. However, the following explanations are not intended to limit the scope of the present invention in any way.

[0010]

As mentioned earlier, a resin molding apparatus according to the present invention includes: a resin molding unit that forms a sealed substrate by sealing a substrate with resin; and a removing unit that removes unnecessary resin from the sealed substrate, wherein the removing unit includes a reversing conveyor mechanism including a substrate holding unit that holds the sealed substrate from which first unnecessary resin including at least cull has been removed, a reversing unit that rotates the substrate holding unit to reverse the sealed substrate topside down, and a substrate conveyor unit that conveys the sealed substrate having been reversed topside down by the reversing unit, to a processing stage for removing second unnecessary resin remaining on the sealed substrate.

[0011]

With this resin molding apparatus, it is possible to turn the sealed substrate from which first unnecessary resin including at least cull has been removed, topside down and to convey the sealed substrate to the processing stage for removing the second unnecessary resin remaining on the sealed substrate. In this manner, defects such as failure in removing the second unnecessary resin or chipping of the package can

be reduced.

Specifically, even in a condition in which a product defect would occur, e.g., the second unnecessary resin would fail to be removed or the package would become chipped, if the second unnecessary resin is to be removed without reversing the sealed substrate topside down, by reversing the sealed substrate topside down and then removing the second unnecessary resin, the second unnecessary resin can be removed reliably, or chipping of the package can be prevented. By using the reversing conveyor mechanism in the manner described above, the second unnecessary resin on the sealed substrate can be removed in a manner suitable for the type of the sealed substrate.

In addition, by using the reversing conveyor mechanism, not only the visual inspection of the front surface of the sealed substrate but also the visual inspection of the rear surface of the sealed substrate can be performed from one direction. Therefore, the configuration of an apparatus for visual inspection can be simplified.

[0012]

As a configuration for removing the second unnecessary resin of the sealed substrate, it is possible to use a punching die to remove the second unnecessary resin by punching.

In this case, the processing stage will be a punching stage for punching the second unnecessary resin, and it is expected for the space between the punching stage and the punching die to be small.

In this configuration, in order to facilitate conveyance of the sealed substrate to the processing stage, preferably, the substrate conveyor unit conveys the sealed substrate slidably to the processing stage.

[0013]

In order to prevent the sealed substrate from falling off from the configuration

for reversing the sealed substrate topside down, preferably the substrate holding unit includes a setting surface on which the sealed substrate is placed, and a holding member that holds the sealed substrate on the setting surface.

In this configuration, in order not to obstruct the conveyance of the sealed substrate by the substrate conveyor unit, while allowing the holding member to hold the sealed substrate, the substrate holding unit preferably holds lateral sides of the sealed substrate in a conveyance direction of the substrate conveyor unit.

[0014]

Preferably, the reversing unit maintains the sealed substrate held by the substrate holding unit at a conveying height allowing the sealed substrate to be conveyed by the substrate conveyor unit, before and after the sealed substrate is reversed.

With this configuration, the substrate conveyor unit can convey the sealed substrate in both orientations not having been reversed topside down and having been reversed topside down, to the processing stage. As a result, the second unnecessary resin can be removed flexibly in a manner suitable for the type of the sealed substrate.

[0015]

In order to reduce the space required in rotating the substrate holding unit rotated by the reversing unit and reduce the size of the reversing conveyor mechanism, preferably the reversing unit rotates the sealed substrate that is rectangular and that is held by the substrate holding unit about a central axis in a longitudinal direction of the sealed substrate.

[0016]

A possible conventional substrate reversing mechanism is a configuration in which a rotation shaft member is connected to each end of a substrate holding unit

holding the sealed substrate, in the longitudinal direction of the substrate holding unit, and the substrate is reversed by rotating the rotation shaft members.

However, in this configuration, the rotation shaft member is provided at each end of the substrate holding unit, and therefore, the rotation shaft members become an obstacle, and obstruct the sealed substrate from being conveyed slidably from the substrate holding unit to the processing stage. For this reason, when the conventional substrate reversing mechanism is used, it is necessary to lift and transfer the sealed substrate to another intermediate stage, and then, further slide and to convey the sealed substrate from the intermediate stage to the processing stage. With such a structure, not only the number of steps is increased, but also the configuration of the apparatus becomes complicated, which leads to an increase in the apparatus size.

In order to solve these problems, preferably, the reversing unit include a rotation driving unit that is provided on a one end side of the substrate holding unit and that rotates the substrate holding unit, and a rotation guide unit that is provided on another end side of the substrate holding unit and that guides rotation of the substrate holding unit.

[0017]

At this time, as a specific embodiment for slidably conveying the sealed substrate to the processing stage, preferably, the substrate conveyor unit includes a slide portion that slides the sealed substrate from the one end side to the other end side of the substrate holding unit, and the rotation guide unit is provided so as to surround a passage section through which the sealed substrate slid by the slide portion is passed.

[0018]

As a specific embodiment of the rotation guide unit, preferably, the rotation guide unit includes an annular guide rail surrounding the passage section.

[0019]

Preferably, the rotation driving unit includes a rotation shaft member that is connected to one end of the substrate holding unit, a motor that is provided below the substrate holding unit, and a transmission mechanism that transmits rotation of the motor to the rotation shaft member.

With this configuration, the part above the substrate holding unit can be simplified, and the foot space of the reversing conveyor mechanism can be reduced.

[0020]

In order to stably convey the sealed substrate to the processing stage, preferably, the substrate conveyor unit includes a roller unit that collects the sealed substrate slid by the slide portion, and feeds the sealed substrate onto the processing stage.

[0021]

As a specific embodiment for removing both the first unnecessary resin and the second unnecessary resin in the removing unit, preferably, the removing unit includes a first removing unit that removes the first unnecessary resin, and a second removing unit that removes the second unnecessary resin, and the second removing unit includes the reversing conveyor mechanism.

[0022]

A production method for a resin molded article using the reversing conveyor mechanism described above is also an aspect of the present invention.

Specifically, a production method for a resin molded article according to the present invention is a production method for a resin molded article using the resin molding apparatus, the method including: a resin-sealing step of forming a sealed substrate by sealing a molded object with resin; a first removing step of removing first

unnecessary resin including at least cull from the sealed substrate; a first conveying step of conveying the sealed substrate from which the first unnecessary resin has been removed, to the substrate holding unit; a reversing step of rotating the substrate holding unit to reverse the sealed substrate held by the substrate holding unit, topside down; a second conveying step of conveying the sealed substrate having been reversed topside down to a processing stage for removing second unnecessary resin remaining on the sealed substrate; and a second removing step of removing the second unnecessary resin from the sealed substrate having been conveyed to the processing stage.

[0023]

Preferably, at the second removing step, the second unnecessary resin is removed by punching, and at the second conveying step, the sealed substrate having been reversed topside down is slidingly conveyed to the processing stage.

[0024]

When the substrate is stored in the substrate storage unit with the substrate reversed topside down, there may be issues such as that the sealed substrate becomes damaged, or the conventional substrate storage unit cannot be used, to begin with.

Therefore, preferably, the production method for a resin molded article according to the present invention include: a substrate unloading step of conveying the sealed substrate to a second substrate holding unit after the second removing step; a re-reversing step of rotating the second substrate holding unit to reverse the sealed substrate held by the second substrate holding unit, again; and a substrate storing step of storing the sealed substrate having been reversed again, in a substrate storage unit.

[0025]

<One embodiment of present invention>

One embodiment of a resin molding apparatus according to the present

invention will now be explained with reference to some drawings. Note that all of the drawings described below are schematic representations, with some omissions and exaggerations made as appropriate, to facilitate understanding. The same elements are denoted by the same reference numerals, and the descriptions thereof will be omitted as appropriate.

[0026]

<Basic configuration of resin molding apparatus 100>

The resin molding apparatus 100 according to this embodiment molds resin on a molded object W having some electronic components connected thereto, by transfer molding of a resin material J.

[0027]

Examples of the molded object W include a metal substrate, a resin substrate, a glass substrate, a ceramic substrate, a circuit board, a semiconductor substrate, a wiring substrate, and a lead frame, with or without wiring provided thereto. Example of the resin material J used for resin molding includes a composite material containing a thermosetting resin. The resin material J is a solid having a columnar tablet shape, for example. Examples of the electronic components connected to the front surface of the molded object W include electronic elements such as a bare chip, a resistance element, and a capacitor element. At least one of these electronic components are sealed with the resin.

[0028]

Specifically, as illustrated in FIG. 1, elements of the resin molding apparatus 100 include a supplying module A, a resin molding module B including two resin molding units, a first removing module C that is a first removing unit, a second removing module D that is a second removing unit, and a storage module E. Each of

these components (the modules A to E) are removable, and replaceable with the other components.

[0029]

A control unit CTL provided in the supplying module A controls the operations of the resin molding apparatus 100 including the modules A to E described below, for example. It is also possible for the control unit CTL to be provided to one of the modules B to E other than the supplying module A. The control unit CTL may be divided into a plurality of units, and provided to at least two of the modules A to E.

[0030]

<Supplying module A>

The supplying module A supplies the molded object W into the resin molding module B, and supplies the resin material J into the resin molding module B.

Specifically, the supplying module A includes a molded object supply unit 101 for supplying molded objects W, a molded object setting surface 102 for transferring the molded objects W, a resin material storage unit 103 for storing the resin material J, a resin material alignment unit 104 for aligning the resin material J, and a conveyor mechanism 105 for conveying the molded object W on the molded object setting surface 102 into the resin molding module B, and conveys the resin material J in the resin material alignment unit 104 to the resin molding module B. The conveyor mechanism 105 is movable at least in the X direction and the Y direction.

[0031]

<Resin molding module B>

The resin molding module B is a resin molding unit that seals the molded object W with resin, using the molded object W and the resin material J fed by the conveyor mechanism 105. Specifically, the resin molding module B includes a pair of

molding dies 106 including a lower mold having a pot 106a for receiving the resin material J and an upper mold provided in a manner facing the lower mold, and a clamping mechanism (not illustrated) for clamping the pair of molding dies 106.

[0032]

As illustrated in FIG. 2, at least one of the lower mold and the upper mold of the pair of molding dies 106 has a plurality of cavities 106b into which the resin material J is injected, and first resin passages 106c each having a cull portion and runner portions connecting the pot 106a to the cavities 106b, and second resin passages 106d each having a gate portion connecting the corresponding first resin passage 106c to a cavity 106b.

[0033]

When the molten resin material J is pushed out of the pot 106a by a plunger (not illustrated), with the pair of molding dies 106 clamped by the clamping mechanism, the molten resin material J is injected into the cavities 106b via the resin passages described above. The electronic components on a molded object W placed in each of the cavities 106b is thus sealed with the resin. The sealed substrates W1 thus formed have first unnecessary resin K1 that is remaining from the first resin passages 106c and second unnecessary resin K2 remaining from the second resin passages 106d (see FIG. 3). FIG. 3 illustrates an example in which two sealed substrates W1 are connected by the first unnecessary resin K1. In the first unnecessary resin K1, unnecessary resin corresponding to the cull portion is called a cull, and unnecessary resin corresponding to the runner portion is called a runner. In the second unnecessary resin K2, unnecessary resin corresponding to the gate portion is called a gate. In addition, the first unnecessary resin K1 is formed outside and inside of the sealed substrate W1 in a plan view, and the second unnecessary resin K2 is formed inside the sealed substrate W1 in a

plan view.

[0034]

<First removing module C>

The first removing module C is a first removing unit that performs what is called a gate breaking process, and removes the first unnecessary resin K1 formed on the sealed substrates W1 (see FIGS. 3(a) and 3(b)). The sealed substrates W1 are conveyed from the resin molding module B into the first removing module C by the conveyor mechanism 107 that is movable at least in the X direction and the Y direction, as illustrated in FIG. 1. Specifically, the first removing module C includes a setting plate 108 on which the sealed substrate W1 is placed. The setting plate 108 is movable between an unnecessary resin removal position GB and a conveyance position TP. At the unnecessary resin removal position GB, a removing mechanism (not illustrated) for removing the first unnecessary resin K1 from the sealed substrate W1 is provided.

[0035]

The sealed substrate W1 is conveyed from the resin molding module B, and is placed on the setting plate 108 at the unnecessary resin removal position GB, by the conveyor mechanism 107. Possible exemplary configurations of the removing mechanism for removing the first unnecessary resin K1 from the sealed substrate W1 include a configuration in which the first unnecessary resin K1 is removed by bending the portion where the sealed substrate W1 and the first unnecessary resin K1 are connected, and a configuration in which the first unnecessary resin K1 of the sealed substrate W1 is removed by pressing the unnecessary resin with a pressing member such as a pin.

[0036]

<Second removing module D>

The second removing module D is a second removing unit that performs what is called a gate cutting process, and removes the second unnecessary resin K2 remaining without being removed by the first removing module C (see FIGS. 3(c) to 3(e)). The sealed substrate W1 is conveyed from the first removing module C to the second removing module D by a conveyor mechanism 110 that is movable at least in the X direction. Specifically, the second removing module D punches to remove the second unnecessary resin K2 remaining on the sealed substrate W1. As illustrated in FIG. 1, the second removing module D includes a punching stage 111 on which the sealed substrate W1 is placed, a punching die 112 for punching the second unnecessary resin K2 remaining on the sealed substrate W1 on the stage 111, and a driving mechanism (not illustrated) for moving the punching die 112 and the stage 111 up and down relatively to each other, so that the second unnecessary resin K2 is punched thereby.

[0037]

<Storage module E>

As illustrated in FIG. 1, the storage module E stores the sealed substrate W1 (hereinafter, a resin molded article P) having the second unnecessary resin K2 removed by the second removing module D. The conveyance of a resin molded article P from the second removing module D to the storage module E is performed by a conveyor mechanism 113 that is movable at least in the X direction. Specifically, the storage module E includes a substrate storage unit 114 for storing the resin molded article P. The resin molded article P stored in the substrate storage unit 114 can be taken out, from the outside of the apparatus.

[0038]

<Reversing conveyor mechanism 2>

In this embodiment, the second removing module D is enabled to remove the

second unnecessary resin K2 after reversing the sealed substrate W1. Specifically, as illustrated in FIG. 1, the second removing module D includes a reversing conveyor mechanism 2 for reversing the sealed substrate W1 still having the remaining second unnecessary resin K2, topside down.

[0039]

An example of the sealed substrate W1 will now be explained. As illustrated in FIG. 3(c), in the sealed substrate W1 according to this embodiment, both the front and the rear surfaces of the molded object W are sealed with resin. The resin seal (package) formed on the front surface is thicker than the resin sealing (package) formed on the rear surface. If these sealed substrates W1 are punched on the front surface side, to remove the second unnecessary resin K2, defects occur, as the substrates are punched. For example, the resin sealing (package) may peel off from the rear surface of the molded object W or the package may become chipped. If the sealed substrates W1 are punched from the rear surface side, to remove the second unnecessary resin K2, the resin sealing (package) rarely peels off from the molded object W or the package rarely becomes chipped despite the punching, because the resin sealing on the front surface side is thicker.

[0040]

As illustrated in FIGS. 4 to 6, the reversing conveyor mechanism 2 includes a substrate holding unit 3 for holding the sealed substrate W1 having the first unnecessary resin K1 removed by the first removing module C, a reversing unit 4 for rotating the substrate holding unit 3 to reverse the sealed substrate W1 topside down, and a substrate conveyor unit 5 for conveying the sealed substrate W1 having been reversed topside down by the reversing unit 4 onto the punching stage 111.

[0041]

<Substrate holding unit 3>

As illustrated in FIGS. 4 to 6, the substrate holding unit 3 includes a setting surface 31 on which the sealed substrate W1 is placed, and holding members 32 for holding the sealed substrate W1 on the setting surface 31. The substrate holding unit 3 holds a rectangular sealed substrate W1, and has a configuration extending in the longitudinal direction correspondingly to the sealed substrate W1 (see FIG. 4). The substrate holding unit 3 according to this embodiment holds the sealed substrate W1 in such a manner that the longitudinal direction of the sealed substrate W1 is matched with the X direction.

[0042]

On the setting surface 31, the conveyor mechanism 110 picks up the sealed substrate W1 having the first unnecessary resin K1 removed, from the setting plate 108, at the conveyance position TP of the first removing module C, conveys the sealed substrate W1 while adjusting the orientation of the sealed substrate W1 to an orientation in which the sealed substrate W1 is to be placed on the setting surface 31, and places the sealed substrates W1 onto the setting surface 31, one after another, from the above. The respective lateral sides of the sealed substrate W1 in the longitudinal direction are placed on the setting surface 31 according to this embodiment, respectively, as particularly illustrated in FIG. 6.

[0043]

Each of the holding members 32 has an L-shaped cross section, for example, and is provided on each ends of the setting surface 31 in the longitudinal direction. The holding members 32 are provided rotatably with respect to the setting surface 31, and cover to hold the front surfaces of the respective lateral sides of the sealed substrate W1 placed on the setting surface 31 in the longitudinal direction. As illustrated in

FIG. 6, the holding members 32 are rotated by an actuator (not illustrated), between holding positions L for holding the sealed substrate W1 and release positions M (see a partial view in FIG. 6) to which the holding members 32 are rotated outwards from the respective holding positions L, to release the sealed substrate W1 held thereby.

[0044]

In this embodiment, the conveyance direction (X direction) of the substrate conveyor unit 5 is matched with the longitudinal direction of the sealed substrate W1, and the holding members 32 hold the respective lateral sides of the sealed substrate W1 along the conveyance direction of the substrate conveyor unit 5 (see FIG. 6). Because the holding member 32 holds the respective lateral sides of the sealed substrate W1 along the conveyance direction in the manner described above, the holding members 32 also function as a guide when the sealed substrate W1 is conveyed slidingly by the substrate conveyor unit 5.

[0045]

<Reversing unit 4>

The reversing unit 4 reverses the sealed substrate W1 held by the substrate holding unit 3, topside down, by rotating the substrate holding unit 3. The reversing unit 4 rotates the substrate holding unit 3 about the central axis of the rectangular sealed substrate W1 held by the substrate holding unit 3, in the longitudinal direction (X direction).

[0046]

The reversing unit 4 maintains the sealed substrate W1 held by the substrate holding unit 3 at a conveying height allowing the substrate conveyor unit 5 to convey the sealed substrate W1, before and after the sealed substrate is reversed. The reversing unit 4 according to this embodiment rotates the substrate holding unit 3 about

the central axis passing through the center of the side surfaces of the sealed substrate W1, as viewed from the longitudinal direction of the sealed substrate W1. The surface of the sealed substrate W1 facing upwards before the substrate is reversed (front surface) (see FIG. 6(a)) and the surface facing upwards after the substrate is reversed (rear surface) are substantially at the same height position (see FIG. 6(b)).

[0047]

Specifically, as illustrated in FIGS. 4 to 6, the reversing unit 4 includes a rotation driving unit 41 provided on one end side of the substrate holding unit 3 in the longitudinal direction (on the side opposite to the punching stage 111) and rotating the substrate holding unit 3, and a rotation guide unit 42 provided on the other end side of the substrate holding unit 3 in the longitudinal direction (the side of the punching stage 111) and guiding the rotation of the substrate holding unit 3.

[0048]

As particularly illustrated in FIG. 5, the rotation driving unit 41 includes a rotation shaft member 411 connected to one end of the substrate holding unit 3 in the longitudinal direction, a motor 412 provided below the substrate holding unit 3, and a transmission mechanism 413 that transmits the rotation of the motor 412 to the rotation shaft member 411. The rotation shaft member 411 is rotatably supported on a base 414 via a roller bearing 415. The transmission mechanism 413 according to this embodiment includes a driven pulley 413a provided on the rotation shaft member 411, a driving pulley 413b provided on the motor 412, and a transmission belt 413c stretched across the pulleys 413a and 413b. The transmission mechanism 413 may also be a mechanism using gears, a link mechanism, a constant velocity joint, or a universal joint, for example, as long as such a mechanism transmits rotation.

[0049]

As illustrated in FIGS. 4 to 6, the rotation guide unit 42 includes a guide rail 421 for guiding the rotation of the substrate holding unit 3, and a slider 422 that slides along the guide rail 421. The guide rail 421 is fixed to the base 414. The slider 422 is connected to the other end of the substrate holding unit 3 in the longitudinal direction, and for example, three sliders are provided in order to improve the stability of rotation (see FIG. 6).

[0050]

As illustrated in FIG. 6, the rotation guide unit 42 is provided so as to surround a passage section through which the sealed substrate W1 is passed, by being conveyed by the substrate conveyor unit 5. Specifically, the rotation guide unit 42 has an annular shape surrounding the passage section, about the rotation center that is the rotation shaft member 411 of the rotation driving unit 41. The rotation guide unit 42 according to this embodiment is provided so as to surround the substrate holding unit 3. The rotation guide unit 42 according to this embodiment can also be expressed as surrounding the sealed substrate W1 when the sealed substrate W1 passes, on a plane intersecting with the conveyance direction of the substrate conveyor unit 5, more specifically, a plane orthogonal to the conveyance direction of the substrate conveyor unit 5.

[0051]

<Substrate conveyor unit 5>

The substrate conveyor unit 5 conveys the sealed substrate W1 from the substrate holding unit 3 onto the punching stage 111 slidingly in the horizontal direction. Specifically, as illustrated in FIGS. 4 to 6, the substrate conveyor unit 5 includes a slide portion 51 sliding the sealed substrate W1 from one end of the substrate holding unit 3 (on the side opposite to the punching stage 111) to the other end (the side

of the punching stage 111) in the X direction, and a roller unit 52 collecting the sealed substrate W1 slid by the slide portion 51, and feeding the sealed substrate W1 onto the punching stage 111.

[0052]

The slide portion 51 includes a pushing member 511 for pushing the sealed substrate W1, a first moving mechanism 512 for moving the pushing member 511 along the conveyance direction (X direction), and a second moving mechanism 513 for moving the pushing member 511 along a direction (Y direction) orthogonal to the conveyance direction.

[0053]

The pushing member 511 pushing the sealed substrate W1 is configured not to interfere with the holding members 32, and specifically, as illustrated in FIG. 4, has pressing portions 511a disposed at a width narrower than that the position of the holding members 32 on respective lateral sides. In this embodiment, in order to push the sealed substrate W1 stably, the pushing member 511 is configured to come into contact with the sealed substrate W1 at two points on the short-hand side.

[0054]

As illustrated in FIG. 4, the first moving mechanism 512 includes a first guide rail 512a extending in the conveyance direction (X direction), a first slide portion 512b sliding on the first guide rail 512a, and a first driving unit (not illustrated) for moving the first slide portion 512b along the first guide rail 512a. The first driving unit is configured using a ball screw mechanism, a motor, or a cylinder mechanism, for example.

[0055]

As illustrated in FIG. 4, the second moving mechanism 513 includes a second

guide rail 513a extending in the direction orthogonal to the conveyance direction (Y direction), a second slide portion 513b sliding along the second guide rail 513a, and a second driving unit (not illustrated) for moving the second slide portion 513b along the second guide rail 513a. The second driving unit is configured using a ball screw mechanism, a motor, or a cylinder mechanism, for example. In this embodiment, an example in which the first slide portion 512b is provided with the second moving mechanism 513 has been explained, but it is also possible for the second slide portion 513b to be provided with the first moving mechanism 512.

[0056]

As illustrated in FIGS. 4 and 5, the roller unit 52 is provided between the substrate holding unit 3 and the punching stage 111, and includes an upper roller 52a and a lower roller 52b for nipping the sealed substrate W1 from vertical directions, and collecting the sealed substrate W1. In this embodiment, a pair of rollers 521 including an upper roller 52a and a lower roller 52b is provided on each lateral side of the sealed substrate W1 in the conveyance direction. The height position at which the sealed substrate W1 sent out by the roller unit 52 is set where the sealed substrate W1 slides onto the front surface of the punching stage 111, or between the front surface of the punching stage 111 and the rear surface of the punching die 112. The positional relationship between the roller unit 52 and the substrate holding unit 3 is set in such a manner that the sealed substrate W1 pushed out of the substrate holding unit 3 is collected by the roller unit 52. Note that a guide (not illustrated) may be provided between the substrate holding unit 3 and the roller unit 52 to assist the roller unit 52 to collect the sealed substrate W1.

[0057]

<Operation of substrate conveyor unit 5 >

An operation of the substrate conveyor unit 5 will now be explained with reference to FIGS. 7 and 8.

[0058]

The conveyor mechanism 110 conveys the sealed substrate W1 from the setting plate 108 located at the conveyance position TP onto the setting surface 31 of the substrate holding unit 3 (see FIG. 7(a)). When the substrate holding unit 3 is to be reversed by the reversing unit 4, the first moving mechanism 512 and the second moving mechanism 513 in the slide portion 51 retracts the pushing member 511 toward one side of the substrate holding unit 3 (see FIG. 8(a)). In this manner, the pushing member 511 of the slide portion 51 does not interfere with the rotation of the substrate holding unit 3.

[0059]

After the substrate holding unit 3 is rotated to reverse the sealed substrate W1 topside down (see FIG. 7(b)), the second moving mechanism 513 of the slide portion 51 advances the pushing member 511 to a position at which the pushing member 511 faces the short-hand side of the sealed substrate W1 (see FIG. 8(b)). The first moving mechanism 512 of the slide portion 51 then moves the pushing member 511 in the conveyance direction to push the sealed substrate W1 toward the roller unit 52 (see FIG. 8(c)). The first moving mechanism 512 then moves the pushing member 511 until the sealed substrate W1 is collected by the roller unit 52 (see FIG. 8(d)).

[0060]

When the sealed substrate W1 reaches the roller unit 52, the sealed substrate W1 become nipped between a pair of rollers 521, and sent out onto the punching stage 111 (see FIGS. 7(b) and 8(e)). At this time, the first moving mechanism 512 stops moving the pushing member 511. Thereafter, the first moving mechanism 512 and the

second moving mechanism 513 returns the pushing member to the retracted position (see FIG. 8(f)).

[0061]

<Second reversing conveyor mechanism 6 >

In this embodiment, the second removing module D is enabled to reverse the sealed substrate W1 having the second unnecessary resin K2 removed, again.

Specifically, as illustrated in FIG. 1, the second removing module D includes a second reversing conveyor mechanism 6 for reversing the sealed substrate W1 having the second unnecessary resin K2 removed, again, and returns the substrate to the original position.

[0062]

The second reversing conveyor mechanism 6 has the same configuration as a part of the reversing conveyor mechanism 2 but symmetrically with respect to the punching stage 111 therebetween. Specifically, as illustrated in FIG. 9, the second reversing conveyor mechanism 6 is provided between the punching stage 111 and the substrate storage unit 114, and includes a second substrate holding unit 7 for holding the sealed substrate W1 having the second unnecessary resin K2 removed, a second substrate conveyor unit 8 for conveying the sealed substrate W1 to the second substrate holding unit 7, and a second reversing unit 9 for rotating the second substrate holding unit 7 to reverse the sealed substrate W1 having the second unnecessary resin K2 removed.

[0063]

The second substrate holding unit 7 has the same configuration as the substrate holding unit 3 of the reversing conveyor mechanism 2. The setting surface 71 and the holding member 72 of the second substrate holding unit 7, however, are

configured in such a manner that, as compared to the above embodiment, the surfaces of the sealed substrate W1 before and after being reversed face opposite sides, so that the sealed substrate W1 having reversed by the second reversing unit 9 can be lifted and conveyed by the conveyor mechanism 113. In other words, before the second substrate holding unit 7 is reversed, the setting surface 71 positioned above the holding member 72, and after the second substrate holding unit 7 is reversed, the setting surface 71 is positioned below the holding member 72.

[0064]

The second substrate conveyor unit 8 is configured to collect the sealed substrate W1 pushed out from the punching stage 111, and to feed the sealed substrate W1 into the second substrate holding unit 7, and is configured to use a roller unit 81 having the same configuration as the reversing conveyor mechanism 2.

[0065]

The second reversing unit 9 includes a second rotation driving unit 91 provided to the second substrate holding unit 7 on the side opposite to the punching stage 111 and rotating the second substrate holding unit 7, and a second rotation guide unit 92 provided to the second substrate holding unit 7 on the side of the punching stage 111 and guiding the rotation of the second substrate holding unit 7. The configurations of the second rotation driving unit 91 and the second rotation guide unit 92 are the same as to those in the reversing conveyor mechanism 2.

[0066]

<Overall process of production method for resin molded article P>

An example of the operation of the resin molding apparatus 100 according to this embodiment will now be explained.

[0067]

#### (1) Resin-sealing step

The resin material J is supplied from the supplying module A into the lower mold of the resin molding module B, and the molded object W is supplied from the supplying module A into the lower mold of the resin molding module B. The resin molding module B thus seals the molded object W with the resin. As a result, the sealed substrate W1 having the first unnecessary resin K1 and the second unnecessary resin K2 is formed (see FIG. 3(a)).

[0068]

#### (2) First removing step

The sealed substrate W1 from the resin molding module B is placed on the setting plate 108, at the unnecessary resin removal position GB in the first removing module C, and the first unnecessary resin K1 is removed by the removing mechanism (see FIG. 3(b)).

[0069]

#### (3) First conveying step

The setting plate 108 is then moved to the conveyance position TP, and the sealed substrate W1 having the first unnecessary resin K1 removed in the first removing step is conveyed to and placed on the setting surface 31 of the substrate holding unit 3 included in the reversing conveyor mechanism 2, by the conveyor mechanism 110. When the sealed substrate W1 is placed on the setting surface 31, the holding members 32 are at their release positions. Once the sealed substrate W1 is placed, the holding members 32 move to their holding positions, and hold the respective lateral sides of the sealed substrate W1 (see FIGS. 6(a) and 7(a)).

[0070]

#### (4) Reversing step

The reversing unit 4 then rotates the substrate holding unit 3 by 180°, so that the held sealed substrate W1 is reversed topside down (see FIG. 3(d)). At this time, because the lateral sides of the sealed substrate W1 are held by the holding members 32, the sealed substrate W1 does not fall while being rotated. The reversed sealed substrate W1 is placed on surfaces of the holding members 32 facing upwards (see FIGS. 6(b) and 7(b)).

[0071]

#### (5) Second conveying step

After the sealed substrate W1 is reversed topside down, the slide portion 51 pushes the sealed substrate W1 in the longitudinal direction, until the sealed substrate W1 reaches the roller unit 52. The roller unit 52 collects the pushed sealed substrate W1, and feeds the substrate W1 onto the punching stage 111 (see FIGS. 7(b) and 8).

[0072]

The roller unit 52 may start being rotated before the slide portion 51 pushes out the sealed substrate W1, or may start being rotated during the time in which the slide portion 51 pushes the sealed substrate W1 and the sealed substrate W1 reaches the roller unit 52. The rotation of the roller unit 52 may be stopped after feeding the sealed substrate W1 onto the punching stage 111, or the roller unit 52 may be kept rotating.

[0073]

#### (6) Second removing step

Once the sealed substrate W1 is conveyed onto the punching stage 111, the second unnecessary resin K2 remaining on the sealed substrate W1 is removed with the punching die 112 (see FIG. 3(e)).

[0074]

(7) Third conveying step (substrate unloading step)

After the second removing step, the sealed substrate W1 having the second unnecessary resin K2 removed is conveyed from the punching stage 111 into the second substrate holding unit 7 of the second reversing conveyor mechanism 6 (see FIG. 9 (a)). At this time, the holding members 72 are at their holding positions.

[0075]

(8) Re-reversing step

The second reversing unit 9 then rotates the second substrate holding unit 7 by 180°, so that the sealed substrate W1 held thereby is reversed, again. At this time, because the lateral sides of the sealed substrate W1 are held by the holding members 72, the sealed substrate W1 does not fall while being rotated. In addition, the sealed substrate W1 is placed on the front surface of the setting surface 71 with its surfaces reversed again. As a result, the front surface of the sealed substrate W1, having the second unnecessary resin K2 removed, faces upward, and the rear surface of the sealed substrate W1 faces downward (see FIG. 7(b)).

[0076]

(9) Substrate storing step

After the sealed substrate W1 is re-reversed by the re-reversing step, the conveyor mechanism 113 stores the sealed substrate W1 in the substrate storage unit 114 in the storage module E (see FIG. 9 (b)). At this time, the holding members 72 of the second substrate holding unit 7 are at their release position (see FIG. 6(a)).

[0077]

<Advantageous effects achieved by present embodiment>

With the resin molding apparatus 100 according to this embodiment, because the sealed substrate W1 having the first unnecessary resin K1 removed can be reversed

topside down and conveyed to the punching stage 111, it is possible to reduce defects in products, such as failure in removing the remaining second unnecessary resin K2 or chipping of the package.

[0078]

Specifically, even in a condition in which a product defect would occur, e.g., the remaining second unnecessary resin K2 would fail to be removed or the package would become chipped, if the remaining second unnecessary resin K2 is to be removed without reversing the sealed substrate W1 topside down, by reversing the sealed substrate W1 topside down and then removing the remaining second unnecessary resin K2, the remaining second unnecessary resin K2 can be removed appropriately, and chipping of the package can be prevented. By using the reversing conveyor mechanism 2 in the manner described above, the second unnecessary resin K2 remaining on the sealed substrate W1 can be removed in a manner suitable for the type of the sealed substrate W1.

[0079]

In addition, because only the respective lateral sides of the sealed substrate W1 in the longitudinal direction are placed on the setting surface 31, and the portion other than the lateral sides of the sealed substrate W1 is left free, by using the reversing conveyor mechanism 2, not only the visual inspection of the front surface of the sealed substrate W1 but also the visual inspection of the rear surface of the sealed substrate W1 can be performed from one direction. Therefore, the configuration of the apparatus for visual inspection can be simplified.

[0080]

In addition, because the reversing conveyor mechanism 2 according to this embodiment is provided with the rotation guide unit 42 so as to surround the passage

section through which the sealed substrate W1 is passed, at the other end of the substrate holding unit 3, that is on the side to which the sealed substrate W1 is slid and conveyed, it is possible to convey the sealed substrate W1 onto the punching stage 111 by sliding the sealed substrate W1 in the horizontal direction. Therefore, it is not necessary to provide an intermediate stage between the conventional substrate reversing mechanism (configuration in which the rotation shaft members are provided at both ends of the substrate holding unit) and the punching stage 111, and to lift and to transfer the sealed substrate W1 onto the intermediate stage. As a result, the configuration of the apparatus for removing the second unnecessary resin K2 can be simplified, without increasing the number of steps, and the foot space of the apparatus can be reduced.

[0081]

Furthermore, in this embodiment, because the sealed substrate W1 having been reversed topside down by the second reversing conveyor mechanism 6 is reversed again, and is returned to the original orientation, there will be no issues such as that the sealed substrate W1 becomes damaged when the sealed substrate W1 is stored in the substrate storage unit 114, or the conventional substrate storage unit 114 cannot be used, to begin with.

[0082]

In addition, the second reversing conveyor mechanism 6 has a configuration for allowing the sealed substrate W1 to be horizontally slid from the punching stage 111 and placed on the second substrate holding unit 7, in the same manner as the reversing conveyor mechanism 2. Therefore, there is no need to provide an intermediate stage between the punching stage 111 and the conventional substrate reversing mechanism, and it is not necessary to lift the sealed substrate W1 from the intermediate stage and to transfer the sealed substrate W1 onto the conventional substrate reversing mechanism,

after the sealed substrate W1 is conveyed to the intermediate stage. As a result, when the sealed substrate W1 having the second unnecessary resin K2 removed is reversed again, the configuration of the apparatus can be simplified, and the foot space of the apparatus can be reduced, without increasing the number of steps.

[0083]

<Other modified embodiments>

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

[0084]

In the above embodiment, the sealed substrate W1 is reversed in the reversing conveyor mechanism 2, but depending on the type of the sealed substrate W1, it may not be necessary to reverse the sealed substrate W1 in the reversing conveyor mechanism 2 and/or the second reversing conveyor mechanism 6. In the setting surface 31 according to the above embodiment, the height position of the surface of the sealed substrate W1 facing upward (front surface) is substantially the same as the height position of the surface (rear surface) facing upward of the sealed substrate W1 after the sealed substrate W1 is reversed (see FIG. 6). Therefore, for example, in a condition in which a product defect would not occur even if the sealed substrate W1 is not reversed before being processed by the punching stage 111, the sealed substrate W1 may be conveyed to the punching stage 111 without being reversed by the reversing conveyor mechanism 2. In other words, the reversing conveyor mechanism 2 can be used as a simple conveyor mechanism, can support various types of the sealed substrates W1, and is excellent in versatility.

[0085]

In the above embodiment, the sealed substrate W1 having the second

unnecessary resin removed is reversed again by the second reversing conveyor mechanism 6, but it is also possible to store the sealed substrate W1 in the substrate storage unit 114 in the storage module E, without being reversed by the second reversing conveyor mechanism 6 again.

[0086]

The motor 412 according to the embodiment described above is configured to be connected to the rotation shaft member 411 via the transmission mechanism 413, but may be configured to be directly connected to the rotation shaft member 411, without the transmission mechanism 413.

[0087]

The supplying module A according to the embodiment described above may be divided into separate modules including a resin molded article supplying module and a resin material supplying module.

[0088]

In the above embodiment, the two resin molding modules are provided, but the number of resin molding modules may be one or three or more.

[0089]

It is also possible for the resin molding apparatus not to be modularized into modules, as in the embodiment described above.

[0090]

The resin material according to the embodiment described above has a tablet shape, but may be a solid resin material having a shape such as a sheet shape, a granular shape, a granulated shape, or a powder shape.

[0091]

In addition, the present invention is not limited to the embodiment described

above, and it should be needless to say that various modifications may be made within the scope not departing from the gist of the present invention.

#### Industrial Applicability

[0092]

According to the present invention, when remaining unnecessary resin is removed from a sealed substrate from which unnecessary resin including at least cull has been removed, it is possible to reduce product defects such as failure in removing the unnecessary resin or chipping of the package.

#### Reference Signs List

[0093]

|     |                                               |
|-----|-----------------------------------------------|
| 100 | resin molding apparatus                       |
| J   | resin material                                |
| W1  | sealed substrate                              |
| P   | resin molded article                          |
| K1  | first unnecessary resin                       |
| K2  | second unnecessary resin                      |
| B   | resin molding module (resin molding unit)     |
| C   | first removing module (first removing unit)   |
| D   | second removing module (second removing unit) |
| 2   | reversing conveyor mechanism                  |
| 3   | substrate holding unit                        |
| 31  | setting surface                               |
| 32  | holding member                                |
| 4   | reversing unit                                |
| 41  | rotation driving unit                         |

|     |                                   |
|-----|-----------------------------------|
| 411 | rotation shaft member             |
| 412 | motor                             |
| 413 | transmission mechanism            |
| 42  | rotation guide unit               |
| 421 | guide rail                        |
| 5   | substrate conveyor unit           |
| 51  | slide portion                     |
| 52  | roller unit                       |
| 111 | punching stage (processing stage) |
| 114 | substrate storage unit            |
| 7   | second substrate holding unit     |

## CLAIMS

1. A resin molding apparatus comprising:
  - a resin molding unit that forms a sealed substrate by sealing a substrate with resin; and
  - a removing unit that removes unnecessary resin from the sealed substrate, wherein the removing unit includes a reversing conveyor mechanismincluding
  - a substrate holding unit that holds the sealed substrate from which first unnecessary resin including at least cull has been removed,
  - a reversing unit that rotates the substrate holding unit to reverse the sealed substrate topside down, and
  - a substrate conveyor unit that conveys the sealed substrate having been reversed topside down by the reversing unit, to a processing stage for removing second unnecessary resin remaining on the sealed substrate.
2. The resin molding apparatus according to claim 1, wherein
  - the processing stage is a punching stage for punching the second unnecessary resin, and
  - the substrate conveyor unit conveys the sealed substrate slidingly to the processing stage.
3. The resin molding apparatus according to claim 1 or 2, wherein
  - the substrate holding unit includes a setting surface on which the sealed substrate is placed, and a holding member that holds the sealed substrate on the setting surface, and
  - the substrate holding unit holds lateral sides of the sealed substrate in a conveyance direction of the substrate conveyor unit.

4. The resin molding apparatus according to any one of claims 1 to 3, wherein the reversing unit maintains the sealed substrate held by the substrate holding unit at a conveying height allowing the sealed substrate to be conveyed by the substrate conveyor unit, before and after the sealed substrate is reversed.
5. The resin molding apparatus according to any one of claims 1 to 4, wherein the reversing unit rotates the sealed substrate that is rectangular and that is held by the substrate holding unit about a central axis in a longitudinal direction of the sealed substrate.
6. The resin molding apparatus according to any one of claims 1 to 5, wherein the reversing unit includes  
a rotation driving unit that is provided on a one end side of the substrate holding unit and that rotates the substrate holding unit, and  
a rotation guide unit that is provided on another end side of the substrate holding unit and that guides rotation of the substrate holding unit.
7. The resin molding apparatus according to claim 6, wherein the rotation driving unit includes  
a rotation shaft member that is connected to one end of the substrate holding unit,  
a motor that is provided below the substrate holding unit, and  
a transmission mechanism that transmits rotation of the motor to the rotation shaft member.
8. The resin molding apparatus according to claim 6 or 7, wherein the substrate conveyor unit includes a slide portion that slides the sealed substrate from the one end side to the other end side of the substrate holding unit, and the rotation guide unit is provided so as to surround a passage section through

which the sealed substrate slid by the slide portion is passed.

9. The resin molding apparatus according to claim 8, wherein the rotation guide unit includes an annular guide rail surrounding the passage section.

10. The resin molding apparatus according to claim 8 or 9, wherein the substrate conveyor unit includes a roller unit that collects the sealed substrate slid by the slide portion, and feeds the sealed substrate onto the processing stage.

11. The resin molding apparatus according to any one of claims 1 to 10, wherein the removing unit includes a first removing unit that removes the first unnecessary resin, and a second removing unit that removes the second unnecessary resin, and

the second removing unit includes the reversing conveyor mechanism.

12. A production method for a resin molded article using the resin molding apparatus according to any one of claims 1 to 11, the method comprising:

a resin-sealing step of forming a sealed substrate by sealing a molded object with resin;

a first removing step of removing first unnecessary resin including at least cull from the sealed substrate;

a first conveying step of conveying the sealed substrate from which the first unnecessary resin has been removed, to the substrate holding unit;

a reversing step of rotating the substrate holding unit to reverse the sealed substrate held by the substrate holding unit, topside down;

a second conveying step of conveying the sealed substrate having been reversed topside down to a processing stage for removing second unnecessary resin remaining on the sealed substrate; and

a second removing step of removing the second unnecessary resin from the

sealed substrate having been conveyed to the processing stage.

13. The production method for a resin molded article according to claim 12, wherein

the second removing step is a step of removing the second unnecessary resin by punching, and

the second conveying step is a step of slidingly conveying, to the processing stage, the sealed substrate having been reversed topside down.

14. The production method for a resin molded article according to claim 12 or 13, further comprising:

a substrate unloading step of conveying the sealed substrate to a second substrate holding unit after the second removing step;

a re-reversing step of rotating the second substrate holding unit to reverse the sealed substrate held by the second substrate holding unit, again; and

a substrate storing step of storing the sealed substrate having been reversed again, in a substrate storage unit.