# RESIN MOLDING APPARATUS AND METHOD FOR MANUFACTURING RESIN MOLDED PRODUCT

## BACKGROUND

Technical Field

**[0001]** The present disclosure relates to a resin molding apparatus and a method for manufacturing a resin molded product using the resin molding apparatus.

Description of Related Art

**[0002]** In order to protect electronic components from environmental factors such as light, heat, moisture, and so on, the electronic components are generally sealed in a resin. For this purpose, resin molding is carried out by a compression molding method, a transfer molding method or the like. In the compression molding method, a resin molding die including a lower mold and an upper mold is used, a resin material is supplied to a cavity of the lower mold, and the resin molding is carried out by installing a molding object (for example, a substrate on which the electronic components are mounted) in the upper mold and then clamping the lower mold and the upper mold while heating them to melt the resin material. In the transfer molding method, a cavity is provided in one of the upper mold and the lower mold, the molding object is installed in the other one, and then the resin molding is carried out by clamping the lower mold and the upper mold while heating them and supplying a resin into the cavity with a plunger.

**[0003]** In Patent Document 1, two examples are disclosed as a configuration for installing a molding object in an upper mold. In the first example, an air circuit which passes through the upper mold and has an opening in a clamping surface (lower surface) of the upper mold is provided, and a gas is suctioned from the opening through the air circuit by a vacuum pump so that the molding object is suctioned onto the clamping surface. In the second example, a chuck jaw is provided on the clamping surface of the upper mold, and an outer peripheral portion of the molding object is gripped by this chuck jaw.

Patent Documents

**[0004]** [Patent Document 1] Japanese Unexamined Patent Application, First

Publication No. 2016-198945 ([0021] and so on)

## SUMMARY

**[0005]** In the case in which the molding object is suctioned onto the clamping surface by suctioning the gas with the vacuum pump, when the vacuum pump stops for some reason, the suction of the gas is stopped, the suctioning cannot be maintained, and the molding object falls from the upper mold.

**[0006]** Meanwhile, when the molding object is gripped by the chuck jaw, a size of a resin molded product is restricted because a portion of the molding object gripped by the chuck jaw cannot be resin-molded.

**[0007]** An objective to be solved by the present disclosure is to provide a resin molding apparatus capable of reducing a possibility of a molding object falling from an upper mold and allowing as large a resin molded product as possible to be manufactured, and a method for manufacturing a resin molded product.

**[0008]** In an aspect of a resin molding apparatus according to the present disclosure, there is provided a resin molding apparatus including

a) an upper mold having a holding surface configured to hold a molding object on a lower side thereof,

b) a lower mold disposed to face the upper mold and having a cavity,

c) a first molding object suctioning mechanism provided in the holding surface and configured to cause a molding object to be suctioned onto the holding surface by suctioning a gas using a vacuum pump, and

d) a second molding object suctioning mechanism provided in the holding surface and configured to cause a molding object to be suctioned onto the holding surface in addition to the suctioning of the gas using the vacuum pump.

**[0009]** In an aspect of a method for manufacturing a resin molded product according to the present disclosure, there is provided a method for manufacturing a resin molded product using the resin molding apparatus described herein including

a molding object holding process of causing the molding object to be suctioned onto the holding surface by the first molding object suctioning mechanism and the second molding object suctioning mechanism,

a resin material supplying process of supplying a resin material into the cavity,

a mold clamping process of clamping the upper mold and the lower mold, and

a resin material curing process of heating the resin material at a temperature at which the resin material in the cavity is softened or melted and then curing the resin material.

**[0010]** In another aspect of a method for manufacturing a resin molded product according to the present disclosure, there is provided a method for manufacturing a resin molded product using the resin molding apparatus described herein including

a molding object holding process of causing the molding object to be suctioned onto the holding surface by the first molding object suctioning mechanism and the second molding object suctioning mechanism,

a mold clamping process of clamping the upper mold and the lower mold,

a resin material supplying process of supplying a softened or melted resin material into the cavity, and

a resin material curing process of curing the resin material supplied into the cavity.

**[0011]** According to the present disclosure, it is possible to reduce a possibility of a molding object falling from an upper mold and to allow as large a resin molded product as possible to be manufactured.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0012]** FIG. 1A is a schematic configuration view illustrating one embodiment (first embodiment) of a resin molding apparatus of a first aspect, and FIG. 1B is an enlarged view illustrating a molding die of the resin molding apparatus and a periphery thereof.

FIG. 2A is a perspective view and FIG.2B is a side view of a jaw portion in the resin molding apparatus of the first embodiment.

FIG. 3 is a schematic configuration view illustrating a molding object conveying mechanism included in the resin molding apparatus of the first embodiment.

FIG. 4A to FIG. 4F are a view illustrating an operation of the resin molding apparatus of the first embodiment and a method for manufacturing a resin molded product.

FIG. 5A to FIG.5D are an enlarged view illustrating an operation of the jaw portion and surrounding components thereof in the resin molding apparatus and the method for manufacturing a resin molded product of the first embodiment.

FIG. 6 is a schematic configuration view illustrating a modified example of the molding object conveying mechanism.

FIG. 7A is a schematic configuration view illustrating one embodiment (second embodiment) of a resin molding apparatus of a second aspect, and FIG. 7B is an enlarged view illustrating a molding die of the resin molding apparatus and a periphery thereof.

FIG. 8 is a schematic configuration view illustrating a molding object conveying mechanism included in the resin molding apparatus of the second embodiment.

FIG. 9A to FIG. 9D are a view illustrating an operation of the resin molding apparatus of the second embodiment and a method for manufacturing a resin molded product.

FIG. 10A and FIG. 10B are a schematic configuration view illustrating another embodiment (third embodiment) of the resin molding apparatus of the first aspect.

FIG. 11A is a top view of a lower mold of the resin molding apparatus of the third embodiment and FIG. 11B is a bottom view of an upper mold.

FIG. 12A to FIG. 12D are a view illustrating an operation of the resin molding apparatus of the third embodiment and a method for manufacturing a resin molded product.

FIG. 13A and FIG. 13B are a schematic configuration view illustrating another embodiment (fourth embodiment) of the resin molding apparatus of the second aspect.

FIG. 14A to FIG. 14D are a view illustrating an operation of the resin molding apparatus of the fourth embodiment and a method for manufacturing a resin molded product.

FIG. 15 is a schematic configuration view illustrating an example of a modularized resin molding unit

## DESCRIPTION OF THE EMBODIMENTS

**[0013]** (1) Resin molding apparatus of first aspect

In a resin molding apparatus according to a first aspect, a molding object is suctioned onto a holding surface by a molding object suctioning mechanism provided on the holding surface and is held by an upper mold. Additionally, a jaw portion is disposed below a molding object (inward of the molding object). Therefore, even when suctioning of the molding object onto the holding surface by the molding object suctioning mechanism does not work for some reason, the molding object will not fall.

**[0014]** Meanwhile, when the upper mold and a lower mold come within a jaw portion movement start distance from each other, the jaw portion is moved to an outer side of the molding object by a jaw portion moving mechanism, resin sealing can also be performed on a portion of a surface of the molding object below which the jaw portion was disposed. Accordingly, a large resin molded product can be manufactured. Here, the "jaw portion movement start distance" is defined as a distance between the upper mold and the lower mold in which no problem occurs even when the molding object suctioning mechanism does not function and the molding object falls from the upper mold (even when the jaw portion is not disposed below the molding object).

**[0015]** Further, since the jaw portion is for preventing the molding object from falling when the molding object cannot be suctioned onto the holding surface by the molding object suctioning mechanism, there may be a slight gap between the surface of the molding object and the jaw portion when the jaw portion is disposed below the molding object.

**[0016]** In the present disclosure, the molding object is, for example, a substrate, and more specifically, for example, a general substrate, a resin substrate, a wiring substrate, a wafer, a glass, a metal plate, and so on. However, the molding object in the present disclosure is not limited thereto, and it is arbitrary. Further, in the present disclosure, a member such as a chip may be mounted on one surface of the molding object or may not be mounted thereon.

**[0017]** In the resin molding apparatus according to the first aspect, the jaw portion moving mechanism preferably moves the jaw portion to an upper side of a lower end of

the molding object held on the holding surface when the upper mold and the lower mold come within the jaw portion movement start distance from each other.

**[0018]** The reason for this will be explained. Generally, in a resin molding apparatus, to easily release a resin molded product from a cavity after molding, a release film is stretched on an inner surface of the cavity before a resin material is supplied into the cavity. The release film has to cover a larger area than the clamping surfaces (close contact surfaces) of the upper and lower molds to take out the resin molded product later and to bring the clamping surfaces of the upper and lower molds into close contact with each other reliably. In the resin molding apparatus of Patent Document 1, a clearance portion for accommodating the chuck jaw when the clamping of the molds is performed with the chuck jaw holding the molding object is provided in the clamping surface of the lower mold, and a release film is also stretched on this clearance portion. Then, at the time of clamping of the molds, the chuck jaw pushes the release film into the clearance portion, and thus wrinkles can be generated on the release film and can be transferred to the resin molded product. On the other hand, in the resin molding apparatus of the first aspect, according to the configuration using the jaw portion moving mechanism which moves the jaw portion to the upper side of the lower end of the molding object when the upper mold and the lower mold come within the jaw portion movement starting distance from each other, there is no need to provide the clearance portion in the lower mold, and thus the jaw portion never pushes the release film into the clearance portion. Accordingly, it is possible to prevent the generation of wrinkles on the release film and to prevent the wrinkles from being transferred to the resin molded product.

**[0019]** In the resin molding apparatus of the first aspect, in a case in which the upper mold and the lower mold are separated from each other by a distance larger than a second jaw portion movement starting distance when the upper mold and the lower mold are opened, the jaw portion moving mechanism preferably further moves the jaw portion to a lower side of the molding object held on the holding surface. Accordingly, even when the molds are opened, in a case in which the molding object cannot be suctioned onto the holding surface by the molding object suctioning mechanism, since the molding object is held by the jaw portion, the molding object does not fall. Further,

the jaw portion movement starting distance and the second jaw portion movement starting distance may be the same as or different from each other.

**[0020]** The resin molding apparatus according to the first aspect may further include a pressing portion and an urging mechanism that urges the jaw portion below the molding object held on the holding surface, and the jaw portion can include a substantially horizontal rotating shaft, and a pressed portion which is provided at a lower portion of the holding surface closer to an outer side than the rotating shaft and which is pressed by the pressing portion when the upper mold and the lower mold come within the jaw portion movement starting distance from each other.

**[0021]** According to the resin molding apparatus of the first aspect including the pressed portion, the pressing portion and the urging mechanism, the jaw portion is disposed below the molding object by the urging mechanism urging the jaw portion until the upper mold and the lower mold come within the jaw portion movement starting distance from each other at the time of clamping of the molds. On the other hand, when the upper mold and the lower mold come within the jaw portion movement starting distance from each other, the jaw portion rotates about the rotating shaft to move from a lower side of the molding object to an outer side of the molding object by the pressing portion pressing the pressed portion, and the above-described effect can be obtained.

**[0022]** Here, when the jaw portion is rotated, the jaw portion can be moved to a position above a lower end of the molding object at an outer side of the molding object.

**[0023]** In the resin molding apparatus of the first aspect including the pressed portion, the pressing portion and the urging mechanism, the jaw portion further includes a second pressed portion at a position of the holding surface which is closer to an outer side than the rotating shaft and is different from the pressed portion. The second pressed portion can be used to move the jaw portion to an outer side of the molding object when the molding object is held on the holding surface and when the molding object is separated from the holding surface. At this time, the second pressed portion is pressed by a second pressing portion different from the pressing portion, and the second pressing portion may be provided outside the resin molding apparatus of the first aspect. Since the second pressed portion is provided at a position different from that of

the pressed portion, the second pressing portion and the pressing portion do not interfere with each other.

**[0024]** The resin molding apparatus of the first aspect including the second pressed portion may further include a molding object conveying mechanism including

a molding object placement table on which the molding object is placed,

a first lifting mechanism which lifts and lowers the molding object placement table,

a second lifting mechanism on which the first lifting mechanism is placed and which lifts and lowers the first lifting mechanism,

a second pressing portion provided on both sides of an upper end of the second lifting mechanism with the molding object placement table interposed therebetween to correspond to a lateral position of the second pressed portion, and

a lateral movement mechanism which moves the second lifting mechanism in a lateral direction so that the molding object placed on the molding object placement table moves between a position directly below the holding surface between the upper mold and the lower mold and a position away from a space between the upper mold and the lower mold.

**[0025]** The molding object before the resin molding can be carried onto the holding surface of the upper mold using the molding object conveying mechanism, as described below. First, the molding object is placed on the molding object placement table, and the second lifting mechanism (and the first lifting mechanism, the molding object placement table, and the molding object directly or indirectly mounted thereon) is moved to a space between the upper mold and the lower mold by the lateral movement mechanism. At that time, the second pressing portion corresponds to the lateral position of the second pressed portion of the jaw portion. The second lifting mechanism is lifted therefrom so that the second pressing portion presses the second pressed portion. Then, the jaw portion moves to the outer side of the holding surface. Next, the first lift mechanism is moved up until the molding object comes into contact with the holding surface. At that time, since the jaw portion is located at the outer side of the holding surface, it does not become a hindrance. The molding object is suctioned onto the holding surface by the molding object suctioning mechanism, and

then the first lifting mechanism and the second lifting mechanism are moved down. Therefore, the second pressing portion is separated from the second pressed portion, and the jaw portion moves to a lower side of the holding surface and the molding object held by the holding surface. After that, by the lateral movement mechanism, the second lifting mechanism (and the first lifting mechanism and the molding object placement table) moves to a position away from the space between the upper mold and the lower mold, and the compression molding can be performed.

**[0026]** Further, the molding object after the resin molding can be taken off of the holding surface of the upper mold using the molding object conveying mechanism. In this case, first, the second lifting mechanism (and the first lifting mechanism and the molding object placement table) is moved to the space between the upper mold and the lower mold by the lateral movement mechanism, and then the jaw portion is moved to the outer side of the holding surface by moving the second lifting mechanism upward and pressing the second pressed portion with the second pressing portion. Next, the first lifting mechanism is moved up, and the suctioning by the molding object suctioning mechanism is released, and thus the molding object is placed on the molding object placement table. After that, the first lifting mechanism and the second mechanism are moved down, and then the second lifting mechanism (and the first lifting mechanism, the molding object placement table and the molding object) is moved to a position away from the space between the upper mold and the lower mold by the lateral movement mechanism, and thus the molding object is taken off.

**[0027]** The resin molding apparatus of the first aspect including the pressed portion, the pressing portion and the urging mechanism may further include a lower mold pushing portion which extends downward from the upper mold and of which a lower end is in contact with an upper surface of the lower mold when the upper mold and the lower mold come within the jaw portion movement starting distance from each other and in which the pressing portion is installed, and an elastic member provided between the upper mold and the lower mold pushing portion.

**[0028]** According to the resin molding apparatus of the first aspect having the lower mold pushing portion and the elastic member, when the upper mold and the lower mold come within the jaw portion movement starting distance from each other at the time of

mold clamping, the pressing portion installed in the lower mold pushing portion presses the pressed portion, and thus the jaw portion moves from a lower side of the molding object to an upper side of a lower end of the molding object and the outer side of the molding object. Therefore, since the jaw portion moves only by power of the relative movement mechanism (clamping mechanism) of the upper mold and the lower mold, no additional power is required for moving the jaw portion. In addition, since a lower end of the lower mold pushing portion is in contact with the upper surface of the lower mold, a release film extending to an outer side of the cavity can be held by the lower mold pushing portion particularly when the release film is used. In this case, the jaw portion movement starting distance can be defined by a distance between the upper mold and the lower mold when the lower end of the lower mold pushing portion is in contact with the upper surface of the lower mold.

**[0029]** (2) Resin molding apparatus of second aspect

In a resin molding apparatus of a second aspect, since a first molding object suctioning mechanism for causing the molding object to be suctioned onto the holding surface by suctioning of gas using a vacuum pump, and a second molding object suctioning mechanism for causing the molding object to be suctioned onto the holding surface in addition to the suctioning of the gas using the vacuum pump are used, the suctioning of the molding object can be maintained by the second molding object suctioning mechanism even if the vacuum pump is stopped due to some reason. On the other hand, even if an operation of the second molding object suctioning mechanism is stopped, the suctioning of the molding object can be maintained by the first molding object suctioning mechanism. As described above, the possibility of the molding object falling from the upper mold can be reduced by using the two types of molding object suctioning mechanisms.

**[0030]** Further, in the resin molding apparatus of the second aspect, since it is not necessary to use the jaw portion, a size of the resin molded product to be manufactured can be increased.

**[0031]** Furthermore, since it is not necessary to use the jaw portion, it is possible to prevent generation of wrinkles on a release film when the release film is used and to prevent the wrinkles from being transferred to the resin molded product.

**[0032]** A vacuum ejector, a Bernoulli chuck, an electrostatic chuck, or the like can be used as the second molding object suctioning mechanism. Since the vacuum ejector is operated by compressed air which is stored and thus electric power is not normally required for a while, it is possible to maintain the suctioning of the molding object for a while even when the electric power is cut off due to a power failure or an emergency stop operation by an operator.

**[0033]** (3) Method for manufacturing resin molded product of first to fourth aspects

In a method for manufacturing a resin molded product of a first aspect, the resin molded product is produced by a compression molding method using the resin molding apparatus of the first aspect. In a method for manufacturing a resin molded product of a second aspect, the resin molded product is produced by a compression molding method using the resin molding apparatus of the second aspect. In a method for manufacturing a resin molded product of a third aspect, is the resin molded product is produced by a transfer molding method using the resin molding apparatus of the first aspect. In a method for manufacturing a resin molded product of a fourth aspect, the resin molded product is produced by a transfer molding method using the resin molding apparatus of the second aspect. In any method for manufacturing the resin molded product, a point in which the resin molding apparatus is operated as described above is different from that of the conventional method for manufacturing the resin molded product, and the other points are the same as those of the conventional method for manufacturing the resin molded product.

**[0034]** (4) Specific embodiments of resin molding apparatuses of first and second aspects and methods for manufacturing resin molded products of first to fourth aspects

Hereinafter, more specific embodiments of the resin molding apparatuses of the first and second aspects and the resin molded product manufacturing methods using the resin molding apparatuses will be described with reference to FIGS. 1 to 15.

**[0035]** (4-1) One embodiment (first embodiment) of resin molding apparatus of first aspect and method for manufacturing resin molded product of first aspect

(4-1-1) Configuration of resin molding apparatus of first embodiment

FIG. 1A and FIG. 1B illustrate a resin molding apparatus 10 which is one embodiment (first embodiment) of the resin molding apparatus of the first aspect. FIG.

1A illustrates the entire resin molding apparatus 10, and FIG. 1B illustrates an enlargement of a molding die and a periphery thereof. The resin molding apparatus 10 of the first embodiment is an apparatus for performing compression molding and includes a base 111, two tie bars 112 erected on the base 111, a lower movable platen 121 and an upper movable platen 122 held by the tie bars 112 to be vertically movable, a fixed platen 123 fixed to upper ends of the tie bars 112, and a toggle link 113 provided on the base 111 to move the lower movable platen 121 vertically. Further, the resin molding apparatus 10 includes a first lower mold 152A on an upper surface of the lower movable platen 121, a first upper mold 151A on a lower surface of the upper movable platen 122, a second lower mold 152B on an upper surface of the upper movable platen 122, and a second upper mold 151B on a lower surface of the fixed platen 123. The first upper mold 151A and the first lower mold 152A constitute a first molding die 15A, and the second upper mold 151B and the second lower mold 152B constitute a second molding die 15B. The resin molding apparatus 10 further includes a heat insulating material 141 near each of the platens and a heater 142 near each of the upper molds or the lower molds between each of the platens and each of the upper molds or the lower molds. In the embodiment, a plurality of columnar heat insulating members arranged in a two-dimensional manner are used as the heat insulating material 141, but other heat insulating materials such as a plate-shaped heat insulating material may be used.

**[0036]** Next, referring to FIG. 1B, configurations of the first molding die 15A and the second molding die 15B will be described. The first molding die 15A and the second molding die 15B have the same configuration. Therefore, each element of the first molding die 15A will be described below. In the explanation, a reference numeral with a suffix "A" changed to "B" is an element of the second molding die 15B.

**[0037]** The first molding die 15A includes the first upper mold 151A and the first lower mold 152A.

**[0038]** A lower surface of the first upper mold 151A is a first holding surface 1511A for holding the molding object, and a gas suction hole 1512A is provided in the first holding surface 1511A. The gas suction hole 1512A is connected to a vacuum pump 191 through a gas suction pipe 1513A provided in the first upper mold 151A and the heater 142, and a connecting pipe (not illustrated) connected to the gas suction pipe

1513A and having flexibility. The gas suction hole 1512A, the gas suction pipe 1513A, the connecting pipe and the vacuum pump 191 constitute a molding object suctioning mechanism 19. Further, a vacuum ejector may be used instead of the vacuum pump 191. Alternatively, instead of the molding object suctioning mechanism 19 illustrated here, a Bernoulli chuck, an electrostatic chuck or the like may be used as the molding object suctioning mechanism.

**[0039]** The first lower mold 152A includes a peripheral wall member 1521A formed of a rectangular frame in a planar shape (top view), a rectangular parallelepiped bottom surface member 1522A charged in the frame of the peripheral wall member 1521A, and an elastic member 1523A provided on a lower surface of the peripheral wall member 1521A. A space defined by the peripheral wall member 1521A and the bottom surface member 1522A is a cavity C to which a resin material is supplied. Further, the planar shape of the peripheral wall member 1521A can be a shape other than a rectangle such as a circle according to a shape of the resin molded product to be manufactured, and a shape of the bottom surface member 1522A can be appropriately changed according to the planar shape of the peripheral wall member 1521A.

**[0040]** A jaw portion 16 is provided on both sides of the first holding surface 1511A and sandwiches the first holding surface 1511A of the first upper mold 151A. FIG. 2A illustrates a perspective view of the jaw portion 16, and FIG. 2B is a side view thereof. The jaw portion 16 includes a jaw portion main body 161, a rotating shaft 162, a first pressed portion (corresponding to the pressed portion) 163, a second pressed portion 164, and an urging mechanism 165. The jaw portion main body 161 extends from an outer side of the first holding surface 1511A toward an inner side thereof and is disposed below the first holding surface 1511A and the molding object held on the first holding surface 1511A in a state in which it is urged by the urging mechanism 165 (FIG. 1B). The rotating shaft 162 is substantially horizontal, and the entire jaw portion 16 is rotatable around the rotating shaft 162. Both of the first pressed portion 163 and the second pressed portion 164 are provided at a lower portion of the entire jaw portion 16 which is closer to an outer side of the first holding surface 1511A than the rotating shaft 162. In a direction in which the rotating shaft 162 extends, the second pressed portion 164 is disposed on a center side of the jaw portion 16, and the first pressed portion 163

is disposed on both sides (that is, two places) of the second pressed portion 164. Further, the second pressed portion 164 is disposed below the first pressed portion 163. The urging mechanism 165 urges the entire jaw portion 16 so that the jaw portion main body 161 rotates around the rotating shaft 162 from the outer side of the first holding surface 1511A toward a lower side thereof. When the jaw portion main body 161 is located at a lower side position of the first holding surface 1511A by the urging of the urging mechanism 165, a pressing portion 173 to be described later comes into contact with the first pressed portion 163, and thus the jaw portion main body 161 is held at a position without further rotation of the entire jaw portion 16. Accordingly, the pressing portion 173, the first pressed portion 163 and the urging mechanism 165 serve as the jaw portion moving mechanism.

**[0041]** A lower mold pushing portion 17 is provided on a lateral side of the first holding surface 1511A and outside the jaw portion 16 (FIG. 1B). The lower mold pushing portion 17 has a lower mold pushing portion main body 171, a lower mold pushing portion elastic member 172, and a pressing portion 173. The lower mold pushing portion main body 171 is a bar member which extends downward and is provided so that the lower mold pushing portion elastic member 172 is interposed between the lower mold pushing portion main body 171 and the first upper mold 151A. The pressing portion 173 is a bar member which extends from the lower mold pushing portion main body 171 toward the jaw portion 16 and is provided at a height at which it comes into contact with the first pressed portion 163 when the mold clamping is not performed. Two pressing portions 173 are provided in one lower mold pushing portion 17 in correspondence with the provision of two first pressed portions 163 in one jaw portion 16.

**[0042]** Further, the resin molding apparatus 10 has a molding object conveying mechanism 80. As illustrated in FIG. 3, the molding object conveying mechanism 80 includes a molding object placement table 81 on which a molding object is placed, a first lifting mechanism 82 which lifts and lowers the molding object placement table 81, a second lifting mechanism 83 on which the first lifting mechanism 82 is placed and which lifts and lowers the first lifting mechanism 82, a second pressing portion 84 provided on both sides of an upper end of the second lifting mechanism 83 with the

molding object placement table 81 interposed therebetween, and a lateral movement mechanism 85 which moves the second lifting mechanism 83 in a lateral direction (a substantially horizontal direction, or a direction perpendicular to the drawings in FIG. 1A and FIG. 3). The lateral movement mechanism 85 moves the second lifting mechanism 83 in the lateral direction so that the molding object placed on the molding object placement table 81 moves between a position directly below the first holding surface 1511A between the upper mold 151A and the first lower mold 152A and a position away from a space between the first upper mold 151A and the first lower mold 152A. A lateral position of the second pressing portion 84 coincides with a lateral position of the second pressed portion 164 of the jaw portion 16 when lateral positions of the molding object placement table 81 and the first holding surface 1511A are aligned with each other. Further, although the first molding die 15A has been described here as an example, the same molding object conveying mechanism 80 is also provided for the second molding die 15B.

**[0043]** (4-1-2) Operation of resin molding apparatus of first embodiment and method for manufacturing resin molded product

An operation of the resin molding apparatus 10 of the first embodiment and a method for manufacturing the resin molded product will be described with reference to FIGS. 4 and 5. FIG. 4A to FIG. 4F illustrate an overall operation of the resin molding apparatus 10 of the first embodiment, and FIG. 5A to FIG.5D illustrate an enlargement of an operation of the jaw portion 16 and components therearound in the resin molding apparatus 10. Actually, the first molding die 15A and the second molding die 15B perform the same operation at the same time, but only the operation of the first molding die 15A will be described below except where otherwise noted.

**[0044]** Before the operation starts, as described above, the jaw portion main body 161 of the jaw portion 16 is located below a lower surface of the first holding surface 1511A (FIG. 5A).

**[0045]** First, the molding object S is placed on the molding object placement table 81 of the molding object conveying mechanism 80, and then the second lifting mechanism 83, the first lifting mechanism 82, the molding object placement table 81 and the molding object S directly or indirectly mounted thereon are moved to a space between

the first upper mold 151A and the first lower mold 152A of the first molding die 15A by the lateral movement mechanism 85. At the same time, the lateral position of the second pressing portion 84 provided at the upper end of the first lifting mechanism 82 is aligned with the lateral position of the second pressed portion 164. Next, the first lifting mechanism 82 is lifted by the second lifting mechanism 83, and the second pressed portion 164 is pressed by the second pressing portion 84 (FIG. 4A). Accordingly, the jaw portion 16 rotates, and the jaw portion main body 161 moves to the outer side of the first holding surface 1511A of the first upper mold 151A (FIG. 5B). In this state, the molding object placement table 81 is lifted by the first lifting mechanism 82, and the molding object S on the molding object placement table 81 is brought into contact with the first holding surface 1511A (FIG. 4B). At that time, since the jaw portion main body 161 is located outside the first holding surface 1511A, the jaw portion main body 161 does not hinder the upward movement of the molding object placement table 81.

**[0046]** Additionally, the molding object S on the molding object placement table 81 is suctioned onto the first holding surface 1511A by operating the vacuum pump 191 and suctioning air from the gas suction hole 1512A through the gas suction pipe 1513A. After that, the first lifting mechanism 82 lowers the molding object placement table 81,

the second lifting mechanism 83 lowers the first lifting mechanism 82, and also the second lifting mechanism 83, the first lifting mechanism 82, and the molding object placement table 81 are moved to the position laterally away from the space between the first upper mold 151A and the first lower mold 152A by the lateral movement mechanism 85 (FIG. 4C). Here, when the first lifting mechanism 82 is lowered, the pressing of the second pressed portion 164 by the second pressing portion 84 is released, and thus the jaw portion 16 rotates in a direction opposite to the direction of the pressing, and the jaw portion main body 161 moves downward (inward) from the first holding surface 1511A (FIG. 5C).

**[0047]** Next, a release film F is stretched on an inner surface of a cavity C of the first lower mold 152A by a release film stretching mechanism which is not illustrated.

Specifically, the stretching of the release film F is carried out by suctioning air from a space between the peripheral wall member 1521A and the bottom surface member 1522A by the vacuum pump 191 in a state in which an upper side of the cavity C and an upper surface of the peripheral wall member 1521A therearound are covered. At this time, the release film F is present not only on the inner surface of the cavity C but also on the upper surface of the peripheral wall member 1521A. Subsequently, a resin material P is supplied into the cavity C by a resin material supply mechanism (not illustrated) (FIG. 4D). Thereafter, the resin material P is melted by heating with the heater 142.

**[0048]** When the resin material P in the cavity C is melted, the lower movable platen 121 is moved up by the toggle link 113. Therefore, the first lower mold 152A on the lower movable platen 121 comes into contact with the first upper mold 151A and pushes up the first upper mold 151A and the upper movable platen 122, and also the second lower mold 152B on the upper movable platen 122 comes into contact with the second upper mold 151B. Since the second upper mold 151B is fixed to the fixed platen 123, the first upper mold 151A and the first lower mold 152A, and the second upper mold 151B and the second lower mold 152B are clamped.

**[0049]** In the first molding die 15A again, when the first molding die 15A is clamped, the first lower mold 152A approaches the first upper mold 151A. At this stage, the jaw portion main body 161 is present below the first holding surface 1511A, and even if the suctioning of the molding object S onto the first holding surface 1511A stops because the vacuum pump 191 stops or the like, the molding object S is accommodated by the jaw portion main body 161, it is possible to prevent the molding object S from falling. Further, when the first lower mold 152A approaches the first upper mold 151A to a first distance (the above-described jaw portion movement starting distance), the lower mold pushing portion main body 171 is brought into contact with the upper surface of the peripheral wall member 1521A of the first lower mold 152A. That is, the jaw portion movement starting distance can be defined by a distance between the first upper mold 151A and the first lower mold 152A with which the lower mold pushing portion main body 171 is in contact with the peripheral wall member 1521A. Further, when the first lower mold 152A approaches the first upper mold 151A, the lower mold pushing

portion elastic member 172 is compressed, and the pressing portion 173 pushes up the first pressed portion 163 of the jaw portion 16. Therefore, the jaw portion 16 rotates, and the jaw portion main body 161 moves to the outer side of the first holding surface 1511A of the first upper mold 151A (FIG. 5D). The first distance and a second distance to be described later are set to such a distance that even if the molding object suctioning mechanism does not function here and the molding object falls from the upper mold, no problem occurs. Accordingly, after that, although there is no protection by the jaw portion main body 161 until the first upper mold 151A and the first lower mold 152A are separated by the second distance by opening the molds after the mold clamping is carried out, no problem occurs even if the molding object falls.

**[0050]** After that, the first lower mold 152A further approaches the first upper mold 151A, and the first upper mold 151A and the first lower mold 152A are clamped (FIG. 4E). Then, a temperature at which the resin material in the cavity C is cured is maintained until the resin material is cured. At this time, since the jaw portion main body 161 is present on the outer side of the first holding surface 1511A, the resin molding can be performed over a wide range within the molding object S without hindering of the jaw portion main body 161. Further, at this stage, the jaw portion main body 161 is disposed above the lower end of the molding object S held onto the first holding surface 1511A (FIG. 5D). Therefore, the jaw portion main body 161 does not come into contact with the upper surface of the peripheral wall member 1521A, and there is no need to provide a concave portion (clearance portion) for releasing the jaw portion main body 161 on the upper surface of the peripheral wall member 1521A. Accordingly, the jaw portion main body 161 does not push the release film F to cause the wrinkles to be generated on the release film F.

**[0051]** After the resin material in the cavity C is cured, the lower movable platen 121 is moved down by the toggle link 113 to open the first molding die 15A and the second molding die 15B (FIG. 4F). In the first molding die 15A, when the first upper mold 151A and the first lower mold 152A are separated by the second distance (which is the same as the first distance in the embodiment), the lower mold pushing portion main body 171 is separated from the upper surface of the peripheral wall member 1521A, the pressing of the first pressed portion 163 by the pressing portion 173 is released, the jaw

portion 16 rotates in the direction opposite to the direction upon the pressing, and the jaw portion main body 161 moves downward (inward) of the first holding surface 1511A. Here, the jaw portion main body 161 can be in contact with a side surface of the resin molded product PS without reaching a lower surface of the resin molded product PS according to a thickness of a resin molded product PS formed on a lower side of the molding object S, but it is possible to prevent falling of the molding object S by the jaw portion main body 161 when the suctioning of the molding object S onto the first holding surface 1511A stops.

**[0052]** After opening of the molds, the molding object S on which the resin molded product PS is formed is taken out of the first holding surface 1511A by the molding object conveying mechanism 80. Specifically, first, the second lifting mechanism 83, the first lifting mechanism 82 and the molding object placement table 81 are conveyed to a space between the first upper mold 151A and the first lower mold 152A by the lateral movement mechanism 85, and the lateral position of the second pressing portion 84 is aligned with the lateral position of the second pressed portion 164. Subsequently, the jaw portion main body 161 is moved to the outer side of the first holding surface 1511A by the second lifting mechanism 83 lifting up the first lifting mechanism 82 and the second pressing portion 84 (the same as FIG. 5B), and further, the molding object placement table 81 is brought into contact with the lower surface of the resin molded product PS by the first lifting mechanism 82 lifting up the molding object placement table 81. After that, the suctioning of the molding object S by the molding object suctioning mechanism 19 is stopped, the first lifting mechanism 82 lifts down the molding object placement table 81 and the second lifting mechanism 83 lifts down the first lifting mechanism 82. Additionally, the lateral movement mechanism 85 moves the second lifting mechanism 83, the first lifting mechanism 82, the molding object placement table 81 and the molding object S outward from the space between the first upper mold 151A and the first lower mold 152A, and thus the molding object S can be taken out.

**[0053]** Further, instead of the above-described molding object conveying mechanism 80, a molding object conveying mechanism 80A illustrated in FIG. 6 can be used. The molding object conveying mechanism 80A includes a molding object placement table

81A, a lifting mechanism 83A which is provided below the molding object placement table 81A and lifts up and down the molding object placement table 81A, a second pressing portion 84A which is disposed around the molding object placement table 81A and at least a part of which is a pin formed of an elastic member, and a lateral movement mechanism 85A which laterally moves the lifting mechanism 83A. The lifting mechanism 83A used in this modified example can switch a magnitude of force for pushing up the molding object placement table 81A in two stages. In the forces for pushing up the molding object placement table 81A, a weaker one is a force with which the elastic member is not bent when the second pressing portion 84A is pressed against the second pressed portion 164, and a stronger one is a force with which the elastic member is bent when the second pressing portion 84A is pressed against the second pressed portion 164. A positional relationship between the molding object placement table 81A and the second pressing portion 84A is fixed (in this respect, a vertical positional relationship between the molding object placement table 81 and the second pressing portion 84 is different from that of the molding object conveying mechanism 80 which can be changed by the second lifting mechanism 83), and an upper surface of the molding object placement table 81A is located between an upper end and a lower end of the second pressing portion 84A.

**[0054]** An operation of the molding object conveying mechanism 80A will be described. After the molding object is placed on the molding object placement table 81A, the lifting mechanism 83A pushes up the molding object placement table 81A with the weaker one of the two strong and weak stages and causes the second pressing portion 84A to come into contact with the second pressed portion 164. Therefore, the second pressing portion 84A presses the second pressed portion 164 without bending the elastic member, rotates the jaw portion 16 and moves the jaw portion main body 161 to the outer side of the first holding surface 1511A of the first upper mold 151A (refer to FIG. 5B). At this point in time, since the upper surface of the molding object placement table 81A is located to be lower than an upper end of the second pressing portion 84A, the molding object on the molding object placement table 81A does not reach the first holding surface 1511A.

**[0055]** After that, the lifting mechanism 83A pushes up the molding object placement

table 81A with the stronger one of the two strong and weak stages. Then, the elastic member of the second pressing portion 84A is bent, and the upper surface of the molding object placement table 81A moves to a position higher than that before the elastic member is bent. Accordingly, the molding object on the molding object placement table 81A is brought into contact with the first holding surface 1511A. At that time, since the jaw portion main body 161 is located outside the first holding surface 1511A, the jaw portion main body 161 does not hinder the upward movement of the molding object placement table 81A. Subsequently, the molding object is suctioned onto the first holding surface 1511A by suctioning air from the gas suction hole 1512A. After that, the lifting mechanism 83A lifts down the molding object placement table 81A, thus the jaw portion 16 rotates in a direction opposite to that upon the pressing, and the jaw portion main body 161 moves downward (inward) of the first holding surface 1511A (refer to FIG. 5C).

**[0056]** (4-2) One embodiment of resin molding apparatus of second aspect and method for manufacturing resin molded product of second aspect

(4-2-1) Configuration of resin molding apparatus of second embodiment

FIG. 7A and FIG. 7B illustrate a resin molding apparatus 20 which is an embodiment (second embodiment) of the resin molding apparatus of the second aspect. FIG. 7A illustrates the entire resin molding apparatus 20, and FIG. 7B enlargedly illustrates a molding die and a periphery thereof. The resin molding apparatus 20 of the second embodiment includes the same base 111, tie bars 112, lower movable platen 121, upper movable platen 122, toggle link 113, heat insulating material 141, and heater 142 as those of the resin molding apparatus 10 of the first embodiment. A first lower mold 252A is provided on the upper surface of the lower movable platen 121, a first upper mold 251A is provided on the lower surface of the upper movable platen 122, a second lower mold 252B is provided on the upper surface of the upper movable platen 122, and a second upper mold 251B is provided on the lower surface of the fixed platen 123. The first upper mold 251A and the first lower mold 252A constitute a first molding die 25A, and the second upper mold 251B and the second lower mold 252B constitute a second molding die 25B. The first molding die 25A and the second molding die 25B have the same configuration. Therefore, each element of the first

molding die 25A will be described below. In the explanation, a reference numeral with a suffix "A" changed to "B" is an element of the second molding die 25B.

**[0057]** A lower surface of the first upper mold 251A is a first holding surface 2511A for holding the molding object, and a first gas suction hole 2512A1 and a second gas suction hole 2512A2 are provided in the first holding surface 2511A. The first gas suction hole 2512A1 is connected to a vacuum pump 291 through a first gas suction pipe 2513A1 provided in the first upper mold 251A and the heater 142, and a connecting pipe (not illustrated) having flexibility. The second gas suction hole 2512A2 is connected to a vacuum ejector 292 through a second gas suction pipe 2513A2 provided in the first upper mold 251A and the heater 142, and a connecting pipe (not illustrated) having flexibility. The vacuum ejector 292 is operated by compressed air supplied from a compressed air tank, and the compressed air is supplied from a compressor (not illustrated) to the compressed air tank. When the compressor cannot be operated due to a power failure or the like, the vacuum ejector 292 can be operated by the compressed air of the compressed air tank for a while. The first gas suction hole 2512A1, the first gas suction pipe 2513A1, the connecting pipe, and the vacuum pump 291 constitute a first molding object suctioning mechanism, and the second gas suction hole 2512A2, the second gas suction pipe 2513A2, the connecting pipe, and the vacuum ejector 292 constitute a second molding object suctioning mechanism.

**[0058]** The first lower mold 252A includes the same peripheral wall member 1521A, bottom surface member 1522A and elastic member 1523A as those of the first lower mold 152A of the first embodiment.

**[0059]** The resin molding apparatus 20 includes a lower mold pushing portion 27 having a lower mold pushing portion main body 271 and a lower mold pressing portion elastic member 272. However, the lower mold pushing portion 27 does not have a configuration corresponding to the pressing portion 173 of the lower mold pushing portion 17 of the first embodiment.

**[0060]** Further, the resin molding apparatus 20 has a molding object conveying mechanism 80B. As illustrated in FIG. 8, the molding object conveying mechanism 80B includes a molding object placement table 81B on which a molding object is placed,

a lifting mechanism 83B which lifts up and down the molding object placement table 81B, and a lateral movement mechanism 85B which laterally moves the molding object placement table 81B and the lifting mechanism 83A. The molding object conveying mechanism 80B does not include the configurations corresponding to the second pressing portion and the second lifting mechanism of the molding object conveying mechanism 80 in the resin molding apparatus 10 of the first embodiment does.

**[0061]** Further, the resin molding apparatus 20 does not include the jaw portion. In addition, here, the second molding object suctioning mechanism having the vacuum ejector 292 is used, but Bernoulli chuck, electrostatic chuck or the like can be used instead.

**[0062]** (4-2-2) Operation of resin molding apparatus of second embodiment and method for manufacturing resin molded product

An operation of the resin molding apparatus 20 of the second embodiment and a method for manufacturing a resin molded product will be described with reference to FIG. 9A to FIG. 9D. First, the molding object S is placed on the molding object placement table 81B of the object conveying mechanism 80B, and then the lifting mechanism 83B and the molding object placement table 81B are moved to a space between the first upper mold 251A and the first lower mold 252A of the first molding die 25A by the lateral movement mechanism 85B. Next, the molding object placement table 81B is lifted up by the lifting mechanism 83B, and thus the molding object S on the molding object placement table 81B is brought into contact with the first holding surface 2511A (FIG. 9A). Additionally, the vacuum pump 291 is operated to suction air from the first gas suction hole 2512A1 via the first gas suction pipe 2513A1, and the vacuum ejector 292 is activated to suction air from the second gas suction hole 2512A2 via the second gas suction pipe 2513A2, and thus the molding object S on the molding object placement table 81B is suctioned onto the first holding surface 2511A. After that, the molding object placement table 81B is lifted down by the lifting mechanism 83B, and the lifting mechanism 83B and the molding object placement table 81B are moved by the lateral movement mechanism 85B to a position laterally away from a space between the first upper mold 251A and the first lower mold 252A.

**[0063]** Next, a release film F is stretched on an inner surface of a cavity C of the first

lower mold 252A by a release film stretching mechanism which is not illustrated. The stretching of the release film F can be performed by the same method as that of the resin molding apparatus 10 of the first embodiment. Subsequently, the resin material P is supplied into the cavity C by a resin material supply mechanism (not illustrated) (FIG. 9B).

**[0064]** After that, the resin material P is melted by heating with the heater 142. When the resin material P in the cavity C is melted, the lower movable platen 121 is moved up by the toggle link 113. Therefore, like the resin molding apparatus 10 of the first embodiment, the first molding die 25A and the second molding die 25B are respectively clamped (FIG. 9C illustrates a clamping state of the first molding die 25A). After the mold clamping, a temperature at which the resin material in the cavity C is cured is maintained until the resin material is cured. After that, the first molding die 25A and the second molding die 25B are opened by the toggle link 113 lifting down the lower movable platen 121 (FIG. 9D).

**[0065]** After the opening of the molds, the molding object S on which the resin molded product PS is formed is taken out of the first holding surface 2511A by the molding object conveying mechanism 80A. Specifically, first, the lifting mechanism 83A and the molding object placement table 81B are moved to a space between the first upper mold 251A and the first lower mold 252A of the first molding die 25A by the lateral movement mechanism 85. Next, the molding object placement table 81B is lifted up by the lifting mechanism 83B, and the molding object S on the molding object placement table 81B is brought into contact with the first holding surface 2511A (the same as FIG. 9A). After that, the suctioning of the molding object S using the vacuum pump 291 and the vacuum ejector 292 is also stopped. Additionally, the lifting mechanism 83B lifts down the molding object placement table 81B, and the lateral movement mechanism 85 moves the lifting mechanism 83B and the molding object placement table 81B outward from the space between the first upper mold 251A and the first lower mold252A, and thus the molding object S can be taken out.

**[0066]** In the operation so far, since the first molding object suctioning mechanism using the vacuum pump 291 and the second molding object suctioning mechanism using the vacuum ejector 292 are used, even if the vacuum pump 291 and the compressor are

stopped due to a power failure, the supply of the compressed air from the compressed air tank of the second molding object suctioning mechanism to the vacuum ejector 292 is maintained for a while, and thus it is possible to maintain the suctioning of the molding object S for a while. Further, even if the vacuum ejector 292 is stopped due to a situation in which the compressor remains broken for a long time or the like, the suctioning of the molding object S can be maintained by the first molding object suctioning mechanism. For the above reasons, the resin molding apparatus 20 of the second embodiment can reduce the possibility of falling of the molding object from the upper mold.

**[0067]** Further, since the jaw portion is not used in the resin molding apparatus 20 of the second embodiment, it is possible to increase a size of the resin molded product to be manufactured without being obstructed by the jaw portion and to prevent the generation of the wrinkles in the release film.

**[0068]** (4-3) Another embodiment (third embodiment) of resin molding apparatus of first aspect and one embodiment of method for manufacturing resin molded product of third aspect

(4-3-1) Configuration of resin molding apparatus of third embodiment

FIG. 10A and FIG. 10B illustrate a configuration of a resin molding apparatus 30 of the third embodiment. FIG. 10A illustrates the entire resin molding apparatus 30, and FIG. 10B enlargedly illustrates a molding die and a periphery thereof. This resin molding apparatus 30 is an apparatus for performing transfer molding and includes a base 311, two tie bars 312 erected on the base 311, a movable platen 321 held by the tie bars 312 to be movable up and down, a fixed platen 323 fixed to upper ends of the tie bars 312, and a toggle link 313 provided on the base 311 to vertically move the movable platen 321. The elements described so far are the same as those of the resin molding apparatus 10 of the first embodiment, except that only one movable platen 321 is provided.

**[0069]** The resin molding apparatus 30 further includes a molding die 35. The molding die 35 has a lower mold 352 provided on an upper surface of the movable platen and an upper mold 351 provided on a lower surface of the fixed platen 323. As illustrated in FIG. 10B and FIG. 11A, in the lower mold 352, two cavities C defined by

peripheral wall members 3521 and bottom surface members 3522 are formed, and a pot 381 is disposed between two sets of peripheral wall members 3521 and bottom surface members 3522. A plunger 382 is inserted into the pot 381 from a lower side. A runner 383 which connects the pot 381 with the cavity C is provided on an upper surface of the peripheral wall member 3521. Upper surfaces of the pot 381 and the runner 383 are normally opened and are closed by a pot runner block described later only upon the mold clamping. A plurality of suction ports (indicated by circles in FIG. 11A) for suctioning the release film F are provided on an upper surface of the peripheral wall member 3521.

**[0070]** The upper mold 351 includes holding surfaces 3511 provided on upper sides of the two sets of peripheral wall members 3521 and the cavities C of the lower mold 352, the jaw portions 16 provided on both sides of each of the two holding surfaces 3511, and a lower mold pushing portion 17 provided at an outer side of the jaw portion 16. Since the elements of the jaw portion 16 and the lower mold pushing portion 17 are the same as those in the first embodiment, the reference numerals given in the first embodiment are attached as they are, and detailed description thereof will be omitted. A gas suction hole 3512 is provided in the holding surface 3511. The gas suction hole 3512 is connected to the vacuum pump 391 via a gas suction pipe 3513 and a connecting pipe (not illustrated) having flexibility. Further, the pot runner block is provided directly above the pot 381 and the runner 383 (FIG. 11B). One set of pot runner blocks are provided with the lower mold pushing portion 17 interposed therebetween in a vertical direction of FIG. 11B (accordingly, positions thereof do not interfere with a position of the lower mold pushing portion 17), and one set of pot 381 and runner 383 are also provided correspondingly side by side in a vertical direction of FIG. 11A.

**[0071]** The resin molding apparatus 30 further includes the molding object conveying mechanism 80 which is the same as that of the resin molding apparatus 10 of the first embodiment.

**[0072]** (4-3-2) Operation of resin molding apparatus of third embodiment and method for manufacturing resin molded product

An operation of the resin molding apparatus 30 of the third embodiment and a

method for manufacturing the resin molded product will be described with reference to FIG. 12A to FIG. 12D. Further, FIG. 12A to FIG. 12D illustrate only one set of the two sets of peripheral wall members 3521 and bottom surface members 3522 of the lower mold 352, and two sets of holding surfaces 3511, jaw portions 16, lower mold pushing portions 17 and so on of the upper mold 351, but each of the two sets of components is operated in the same manner.

**[0073]** First, the molding object conveying mechanism 80 is moved to a position between the upper mold 351 and the lower mold 352 by the same operation as that in the resin molding apparatus 10 of the first embodiment using the molding object conveying mechanism 80, the first lifting mechanism 82 is lifted up by the second lifting mechanism 83 so that the second pressed portion 164 is pressed by the second pressing portion 84, and also the first lifting mechanism 82 lifts up the molding object placement table 81 so that the molding object S is brought into contact with the holding surface 3511 (FIG. 12A). At that time, like the case of the first embodiment, since the jaw portion 16 is rotated by pressing the second pressed portion 164 of the jaw portion 16 with the second pressing portion 84 of the molding object conveying mechanism 80 and the jaw portion main body 161 moves to an outer side of the holding surface 3511 (refer to FIG. 5B), the jaw portion main body 161 does not hinder the upward movement of the molding object placement table 81. The molding object S is suctioned onto the holding surface 3511 by operating the vacuum pump 391 in a state in which the molding object S is in contact with the holding surface 3511 in this manner. After that, when the molding object placement table 81 is lifted down, the jaw portion 16 rotates, and the jaw portion main body 161 moves to a lower side of the holding surface 3511 and the molding object S. Accordingly, even when the vacuum pump 391 is stopped, the molding object S can be received by the jaw portion main body 161, and thus it is possible to prevent the molding object S from falling. After that, the molding object conveying mechanism 80 is removed from the position between the upper mold 351 and the lower mold 352.

**[0074]** Next, a solid resin material P is charged into the pot 381, and a release film F is stretched on the inner surface of the cavity C (FIG. 12B). When the release film F is stretched, gas is suctioned from a suction hole provided in the upper surface of the

peripheral wall member 3521.

**[0075]** Subsequently, the movable platen 321 is moved up by the toggle link 313 to perform the mold clamping. At that time, when the upper mold 351 and the lower mold 352 come closer to each other at the jaw portion movement starting distance or less, the lower mold pushing portion main body 171 comes into contact with the upper surface of the peripheral wall member 3521 of the lower mold 352, and when the upper mold 351 and the lower mold 352 come closer to each other, the lower mold pushing portion elastic member 172 is compressed, and the pressing portion 173 pushes up the first pressed portion 163 of the jaw portion 16. Therefore, the jaw portion 16 rotates, and the jaw portion main body 161 moves to the outer side of the holding surface 3511 of the upper mold 351 (refer to FIG. 5D). Accordingly, it is possible to perform the resin molding over a wide range within the molding object S without hindering of the jaw portion main body 161. Further, the jaw portion main body 161 does not come into contact with the upper surface of the peripheral wall member 3521, and there is no need to provide a concave portion (clearance portion) for releasing the jaw portion main body 161 in the upper surface of the peripheral wall member 3521. Therefore, the jaw portion main body 161 does not push the release film F to cause the wrinkles to be generated on the release film F.

**[0076]** After the mold clamping, the resin material P in the pot 381 is melted by heating with a heater (not illustrated), and the resin material P is extruded from the pot 381 by the plunger 382 (FIG. 12C). The resin material P extruded from the pot 381 passes through the runner 383 and is supplied into the cavity C. After the resin material P in the cavity C is cured, the movable platen 321 is moved down by the toggle link 313 to open the molds (FIG. 12D). Additionally, production of one resin molded product PS is completed by removing the molding object S from the holding surface 3511 of the upper mold 351 in the same method as in the case of the first embodiment.

**[0077]** (4-4) Another embodiment (fourth embodiment) of resin molding apparatus of second aspect and one embodiment of method for manufacturing resin molded product of fourth aspect

(4-4-1) Configuration of resin molding apparatus of fourth embodiment

FIG. 13A and FIG. 13B illustrate a configuration of a resin molding apparatus

40 of a fourth embodiment. FIG. 13A illustrates the entire resin molding apparatus 40, and FIG. 13B enlargedly illustrates a molding die and a periphery thereof. The resin molding apparatus 40 of the fourth embodiment include the same base 311, tie bars 312, toggle link 313, movable platen 321 and fixed platen 323 as those of the resin molding apparatus 30 of the third embodiment. A lower mold 352 is provided on the upper surface of the movable platen 321 and an upper mold 451 is provided on the lower surface of the fixed platen 323. The upper mold 451 and the lower mold 352 constitute a molding die. Since the lower mold 352 has the same configuration as that of the resin molding apparatus 30 of the third embodiment, the same reference numerals as those of the third embodiment are attached, and description thereof will be omitted.

**[0078]** A lower surface of the upper mold 451 is a holding surface 4511 which holds the molding object, and a first gas suction hole 45121 and a second gas suction hole 45122 are provided in the holding surface 4511. The first gas suction hole 45121 is connected to a vacuum pump 491 through a first gas suction pipe 45131 and a connecting pipe (not illustrated) having flexibility. The second gas suction hole 45122 is connected to a vacuum ejector 492 via a second gas suction pipe 45132 and a connecting pipe (not illustrated) having flexibility. Like the case of the second embodiment, the vacuum ejector 492 is operated using the compressed air supplied from the compressor to the compressed air tank.

**[0079]** The lower mold pushing portion 17 and the pot runner block (not illustrated) which are the same as those of the resin molding apparatus 30 of the third embodiment are provided in the upper mold 451. However, the pressing portion 173 of the lower mold pushing portion 17 of the resin molding apparatus 30 of the third embodiment is not provided in the embodiment. Further, the jaw portion 16 of the resin molding apparatus 30 of the third embodiment is not provided in the present embodiment.

**[0080]** The resin molding apparatus 40 further includes the molding object conveying mechanism 80A which is the same as that of the resin molding apparatus 20 of the second embodiment.

**[0081]** (4-4-2) Operation of resin molding apparatus of fourth embodiment and method for manufacturing resin molded product

An operation of the resin molding apparatus 40 of the fourth embodiment and

a method for manufacturing the resin molded product will be described with reference to FIG. 14 A to FIG. 14D. First, the molding object S is suctioned onto the holding surface 4511 using the molding object conveying mechanism 80A by the same method as in the resin molding apparatus 20 of the second embodiment (FIG. 14A). Here, in the suctioning onto the holding surface 4511, the vacuum pump 491 is operated to suction air from the first gas suction hole 45121 via the first gas suction pipe 45131, and the vacuum ejector 492 is activated to suction air from the second gas suction hole 45122 via the second gas suction pipe 45132. Therefore, even if the vacuum pump 491 and the compressor are stopped due to a power failure, the supply of the compressed air from the compressed air tank to the vacuum ejector 492 is maintained for a while, and thus it is possible to maintain the suctioning of the molding object S for a while. Further, even if the vacuum ejector 492 is stopped due to a situation in which the compressor remains broken for a long time or the like, the suctioning of the molding object S using the vacuum pump 491 can be maintained.

**[0082]** Next, a solid resin material P is charged into the pot 381, and a release film F is stretched on the inner surface of the cavity C (FIG. 14B). Subsequently, the mold clamping is carried out by moving the movable platen 321 upward with the toggle link 313. In this embodiment, since the jaw portion is not used, it is possible to perform the resin molding over a wide range within the molding object S without hindering of the jaw portion. Further, since the jaw portion does not come into contact with the upper surface of the peripheral wall member 3521 and it is not necessary to provide a concave portion (clearance portion) for releasing the jaw portion in the upper surface of the peripheral wall member 3521, the jaw portion does not cause the wrinkles to be generated on the release film F.

**[0083]** After the mold clamping, the resin material P in the pot 381 is melted by heating with a heater (not illustrated), the resin material P is extruded from the pot 381 by the plunger 382 and supplied into the cavity C through the runner 383 (FIG. 14C). After the resin material P in the cavity C is cured, the molds are opened by moving down the movable platen 321 with the toggle link 313 (FIG. 14D). Additionally, the molding object S is removed from the holding surface 4511 of the upper mold 451 by the same method as in the second embodiment, and thus the production of one resin

molded product PS is completed.

**[0084]** (4-5) Resin molding unit in which modules are combined

FIG. 15 illustrates a resin molding unit 50 using any one of the resin molding apparatuses (resin molding apparatuses performing compression molding) according to the first or second embodiment. Further, in FIG. 15 and the following description, an example using the resin molding apparatus 10 of the first embodiment will be described, but the resin molding apparatus 10 of the first embodiment can be replaced with the resin molding apparatus 20 of the second embodiment.

**[0085]** The resin molding unit 50 has a material receiving module 51, a molding module 52, and a dispensing module 53. The material receiving module 51 is a device for receiving the resin material P and the molding object S from the outside and delivering them to the molding module 52 and includes a resin material supply device 510 and a molding object receiving portion 511. One molding module 52 includes one set of the above-described resin molding apparatus 10. Three molding modules 52 are illustrated in FIG. 15, but the arbitrary number of molding modules 52 can be provided in the resin molding unit 50. Further, even after the resin molding unit 50 is assembled and starts to be used, it is possible to increase or decrease the number of the molding modules 52. The dispensing module 53 carries and holds the resin molded product produced by the molding module 52 from the molding module 52 and includes a resin molded product holding portion 531.

**[0086]** A main conveying device 56 for conveying a molding object S, a resin material transfer tray 58, and a resin molded product is provided in the resin molding unit 50 to pass through the material receiving module 51, one or a plurality of molding modules 52 and the dispensing module 53. Further, in each module, a sub-conveying device 57 for conveying the molding object S, the resin material transfer tray 58, and a resin molded product between the main conveying device 56 and the apparatus in the module is provided. In addition, the resin molding unit 50 has a power source and a controller (not illustrated) for operating the modules.

**[0087]** An operation of the resin molding unit 50 will be described. The molding object S is held in the molding object receiving portion 511 of the material receiving module 51 by an operator. The main conveying device 56 and the sub-conveying

device 57 convey the molding object S from the molding object receiving portion 511 to the resin molding apparatus 10 in one of the molding modules 52 and place the molding object S on the molding object placement table 81 of the molding object conveying mechanism 80 in the resin molding apparatus 10. Then, in the resin molding apparatus 10, the molding object S is installed on the first holding surface 1511A and the second holding surface by the method described above. After that, in the resin molding apparatus 10, a release film F is stretched on the cavity C of each of the first lower mold 152A and the second lower mold 152B.

**[0088]** Subsequently, the main conveying device 56 and the sub-conveying device 57 carries the resin material transfer tray 58 in the resin material supply device 510. In the resin material supply device 510, the resin material P is supplied to the resin material transfer tray 58.

**[0089]** The main conveying device 56 and the sub-conveying device 57 convey the resin material transfer tray 58 supplied with the resin material P to the resin molding apparatus 10 of the molding module 52 in which the molding object S is installed on the first holding surface 1511A and the second holding surface. Additionally, the resin material P is supplied to the cavities C of the first lower mold 152A and the second lower mold 152B of the resin molding apparatus 10. Then, the compression molding is performed in the resin molding apparatus 10. By performing the same operation as above with respect to the resin molding apparatus 10 of another molding module 52 while the compression molding is being performed in the resin molding apparatus 10, the compression molding can be performed in parallel so that a time among a plurality of molding modules 52 is shifted.

**[0090]** The resin molded product obtained by the compression molding is separated from the first holding surface 1511A and the second holding surface in the above-described method by the molding object conveying mechanism 80, then carried out from the resin molding apparatus 10 by the main conveying device 56 and the sub-conveying device 57 and carried and held in the resin molded product holding portion 531 of the dispensing module 53. A user appropriately takes out the resin molded product from the resin molded product holding portion 531.

**[0091]** The present invention is not limited to the above-described embodiments, and

many modified examples are possible by those skilled in the art within the technical spirit of the present invention.

[Reference Signs List]

**[0092]** 10, 20, 30, 40 Resin molding apparatus

111, 311 Base

112, 312 Tie bar

113, 313 Toggle link

121 Lower movable platen

122 Upper movable platen

123, 323 Fixed platen

141 Heat insulating material

142 Heater

15A, 25A First molding die

15B, 25B Second molding die

151A, 251A First upper mold

151B, 251B Second upper mold

1511A, 2511A First holding surface

1512A, 3512 Gas suction hole

1513A, 3513 Gas suction pipe

152A, 252A First lower mold

152B, 252B Second lower mold

1521A, 2521A, 3521 Peripheral wall member

1522A, 2522A, 3522 Bottom surface member

1523A, 2523A Elastic member

16 Jaw portion

161 Jaw portion main body

162 Rotating shaft

163 First pressed portion

164 Second pressed portion

165 Urging mechanism

17, 27 Lower mold pushing portion

171, 271 Lower mold pushing portion main body

172, 272 Lower mold pushing portion elastic member

173 Pressing portion

19 Molding object suctioning mechanism

191, 291, 391, 491 Vacuum pump

2512A1, 45121 First gas suction hole

2512A2, 45122 Second gas suction hole

2513A1, 45131 First gas suction pipe

2513A2, 45132 Second gas suction pipe

292, 492 Vacuum ejector

321 Movable platen

323 Fixed platen

35 Molding die

351, 451 Upper mold

3511, 4511 Holding surface

352 Lower mold

381 Pot

382 Plunger

383 Runner

50 Resin molding unit

51 Material receiving module

510 Resin material supply device

511 Molding object receiving portion

52 Molding module

53 Dispensing module

531 Resin molded product holding portion

56 Main conveying device

57 Sub-conveying device

58 Resin material transfer tray

80, 80A, 80B Molding object conveying mechanism

81, 81A, 81B Molding object placement table

82 First lifting mechanism

83 Second lifting mechanism

83A, 83B Lifting mechanism

84, 84A Second pressing portion

85, 85A, 85B Lateral movement mechanism

C Cavity

F Release film

P Resin material

PS Resin molded product

S Molding object

## CLAIMS

**WHAT IS CLAIMED IS:**

1. A resin molding apparatus comprising:

a) an upper mold having a holding surface configured to hold a molding object on a lower side thereof,

b) a lower mold disposed to face the upper mold and having a cavity,

c) a first molding object suctioning mechanism provided in the holding surface and configured to cause a molding object to be suctioned onto the holding surface by suctioning a gas using a vacuum pump, and

d) a second molding object suctioning mechanism provided in the holding surface and configured to cause a molding object to be suctioned onto the holding surface in addition to the suctioning of the gas using the vacuum pump.

2. The resin molding apparatus according to claim 1, wherein the second molding object suctioning mechanism causes the molding object to be suctioned onto the holding surface by suctioning of the gas using a vacuum ejector.

3. The resin molding apparatus according to claim 2, wherein the vacuum pump of the first molding object suctioning mechanism is driven by electric power and the vacuum ejector of the second molding object suctioning mechanism is driven by compressed air so as to prevent the falling of the molding object from the upper mold by the second molding object suctioning mechanism in case the electric power is cut off.

4. A method for manufacturing a resin molded product using the resin molding apparatus according to any one of claims 1 to 3, comprising:

causing the molding object to be suctioned onto the holding surface by the first molding object suctioning mechanism and the second molding object suctioning mechanism,

supplying a resin material into the cavity,

clamping the upper mold and the lower mold, and

heating the resin material at a temperature at which the resin material in the cavity is softened or melted and then curing the resin material.

5. A method for manufacturing a resin molded product using the resin molding apparatus according to any one of claims 1 to 3, comprising:

causing the molding object to be suctioned onto the holding surface by the first molding object suctioning mechanism and the second molding object suctioning mechanism,

clamping the upper mold and the lower mold,

supplying a softened or melted resin material into the cavity, and

curing the resin material supplied into the cavity.