

RESIN MOLDING APPARATUS AND RESIN MOLDING METHOD

FIELD OF TECHNOLOGY

The present invention relates to effective technologies about a resin molding apparatus and a resin molding method.

BACKGROUND TECHNOLOGY

For example, in case of resin-molding a WLP (Wafer Level Package), a mold set, which comprises: a lower mold on which a large-size work (e.g., a substrate on which a plurality of chip parts are mounted and electrically connected thereto by bonding wires) is disposed; and an upper mold having a recessed part (forming a cavity when clamping the work), is used. However, in case that the work is compression-molded by supplying a resin onto the work disposed in the mold set, the resin mounted on a center part of the work will flow outward, so defective molded products will be often produced due to voids generated by entrapment of air, wire sweep, etc.

On the other hand, in case of using a mold set whose lower mold has a cavity (lower cavity), a resin is supplied to the cavity, and chip parts and bonding wires of a work are dipped in the resin melted in the cavity, so that resin molding can be performed. By performing the resin molding in the cavity of the lower mold, producing defective products, which will be produced by voids, wire sweep, etc., can be restrained. For example, the mold set having such lower mold is disclosed in Japanese Laid-open Patent Publication No. 2004-148621 (Patent Document 1).

The Patent Document 1 discloses that a release film is deformed along with a shape of the cavity outside of the mold set, and then the release film and the resin are conveyed into and set in an inner part of the mold set in a state where the resin is supplied to a preform part

(bottom part) which corresponds to a bottom of the cavity.

PRIOR ART DOCUMENT

PATENT DOCUMENT

Patent Document 1: Japanese Laid-open Patent Publication No.
2004-148621

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

In the Patent Document 1, the release film is, for example, a film having predetermined softness, extensibility and heat resistance. By heating the release film at a certain degree of temperature, the release film will be heat-shrunk toward the center and uneven wrinkles will be formed in the release film. Further, for example, in case of deforming the release film along the shape of the cavity, strain is considerably accumulated in the release film.

Therefore, if the release film is disposed on the preheated mold set in a state where the release film is deformed along the shape of the cavity, the release film cannot maintain the desired shape. So, wrinkles and gaps between the wrinkles will be sometimes formed in the release film. By forming the wrinkles or gaps, there are problems that the wrinkles or overlap of the wrinkles will be copied in an outer surface of a molded product and that a resin will leak through the gap of the overlapping part.

An object of the present invention is to provide a technology for improving quality of molded products. The object, other objects and new characteristics of the present invention will be clarified by the descriptions of the present specification and the attached drawings.

MEANS FOR SOLVING THE PROBLEMS

An outline of the present invention will be briefly explained.

A resin molding apparatus of an embodiment of the present invention, in which a work is resin-molded by closing an upper mold and a lower mold having a cavity and filling the cavity with a resin, is characterized in that the lower mold comprises: a lower mold cavity piece for configuring a bottom of the cavity; a lower mold clamper for configuring sides of the cavity; a film loader capable of holding and conveying a film on which the resin has been loaded; and a sucking section for sucking the film, which is disposed so as to cover an end face of the lower mold cavity piece and an end face of the lower mold clamper, that the lower mold cavity piece is capable of moving relative to the lower mold clamper, that the film loader disposes the film on the lower mold, in which the end face of the lower mold cavity piece is held level with the end face of the lower mold clamper, so that the resin is located above the lower mold cavity piece, and that the sucking section sucks and holds the film so as to conform to an inner face of the cavity and supplies the resin to the cavity.

The resin molding apparatus of another embodiment of the present invention, in which a work is resin-molded by closing a first mold and a second mold having a cavity and filling the cavity with a resin, is characterized in that the second mold comprises: a cavity piece for configuring a bottom of the cavity; a clamper for configuring sides of the cavity; a movable section for moving the cavity piece relative to the clamper; a sucking section for sucking a film, which is disposed so as to cover the end face of the cavity piece and the end face of the clamper, and that a film loader conveys the film in a flat state and disposes the film on the end face of the cavity piece and the end face of the clamper, in the flat state, with maintaining the end face of the cavity piece level

with the end face of the clamper.

A resin molding method of the present invention is performed in a resin molding apparatus, in which a work is resin-molded by closing an upper mold and a lower mold having a cavity and filling the cavity with a resin, the resin molding method is characterized in that the lower mold comprises: a lower mold cavity piece for configuring a bottom of the cavity; a lower mold clamper for configuring sides of the cavity; a film loader capable of holding and conveying a film on which the resin has been loaded; and a sucking section for sucking the film, which is disposed so as to cover an end face of the lower mold cavity piece and an end face of the lower mold clamper, and that the resin molding method comprises: (a) a step of disposing the film, by the film loader, to the lower mold, in which the end face of the lower mold cavity piece and the end face of the lower mold clamper are held level with each other, so as to dispose the resin above the lower mold cavity piece; and (b) a step of relatively moving the lower mold cavity piece with respect to the lower mold clamper, with sucking the film by the sucking section, so as to form the cavity, thereby the film is sucked and held with conforming to an inner face of the cavity and the resin is supplied to the cavity in a state where the resin is loaded on the film.

In the present invention, the film is disposed in a flat state, and then the film can be deformed with conforming to the shape of the cavity, so that forming wrinkles or overlap of the film, for example, can be prevented. Therefore, producing defective products having bad external appearances can be prevented, and resin leakage from the overlap part of the film can be prevented, so that quality of molded products can be improved. By forming the cavity in the lower mold, chip parts (e.g., semiconductor chips, chip capacitors) and bonding wires, for example, can be dipped into the resin melted in the cavity, so that producing

low-quality molded products caused by voids, wire sweep, etc. can be reduced.

Preferably, in the resin molding apparatus, the film loader has a hand section including: a holding face for holding the film; a recessed part being formed in the holding face so as to act as a clearance of the resin loaded on the film; and an air path being communicate with a part of the holding face, which is located around the recessed part, so as to suck the film.

With the above described structure, the resin can be supplied to the cavity with maintaining conditions (e.g., shape, quantity) of the resin loaded on the film. Further, the film can be sucked and held without being bent by weight of the resin loaded thereon.

Preferably, in the resin molding apparatus, the loader has a rolled shutter section for opening and closing the holding face, the film is held and conveyed by the shutter section in a state where the shutter section is closed, and the film is disposed onto the lower mold in a state where the shutter section is opened.

With the above structure, the film can be held flat, by the shutter section, without being bent by a weight of the resin loaded on the film. Further, in case of disposing the film on the lower mold, the shutter section can be rolled to reduce an occupied space.

Preferably, in the resin molding apparatus, the loader has a heating section and a cooling section.

With the above described structure, the film and the resin load thereon can be auxiliarily heated and cooled.

Preferably, in the resin molding apparatus, an upper part of the lower mold cavity piece is separable, an upper part of the lower mold clamper is separable, the upper part of the lower mold cavity piece and the upper part of the lower mold clamper are connected by a connecting

member, and the loader conveys the film, which covers the end faces of the upper part of the lower mold cavity piece and the upper end face of the upper part of the lower mold clamber in a state where the end faces of the upper part of the lower mold cavity piece and the upper end face of the upper part of the lower mold clamber are level with each other.

With the above described structure, the film and the resin loaded thereon can be stably disposed in the mold set.

Preferably, in the resin molding apparatus, a ring-shaped upper plate and a ring-shaped lower plate are further comprised, the lower plate has a step-shaped part, which is formed in an outer edge part, recessed from an upper plate side face and extended in a circumferential direction, a film plate section is constituted by the upper plate and the lower plate, the film is pinched between the plates, the step-shaped part of the lower plate is fitted to an inner part of the upper plate, and the lower mold clamber has a step-shaped part, which is formed in an outer edge part, recessed from the end face and extended in a circumferential direction, the film plate section is fitted by fitting the step-shaped part of the lower mold clamber to an inner part of the lower plate.

With the above described structure, the film can be maintained flat by a simple mechanism and disposed to the lower mold in an unchanged state.

Preferably, in the resin molding apparatus, an upper part of the lower mold cavity piece is separable, and the upper part of the lower mold cavity piece is floating-supported so as to make the end faces of the upper part of the lower mold cavity piece level with the end faces of the lower mold clamber while opening the molds.

With the above described structure, the end face of the lower mold cavity piece and the end face of the lower mold clamber need not be level with each other by downwardly pressing the lower mold clamber by,

for example, a conveying section, so that a structure and actions of the conveying section can be simplified. Further, the upper part of the lower mold cavity piece is floating-supported when the film is loaded on the lower mold, so that heat shrink of the film can be prevented, overheat of the resin loaded on the film can be prevented and heating the film can be easily adjusted.

Preferably, in the resin molding apparatus, the lower mold clasper has a plurality of pins, which are floating-supported and capable of projecting from the end face of the lower mold clasper, and the plurality of pins are projected from the end face of the lower mold clasper so as to support the work and retracted in the lower mold clasper while clamping the work.

With the above described structure, the fall of the work, which has been held by the upper mold before clamping, can be prevented.

EFFECT OF THE INVENTION

Simply stated, the effect obtained by the typical embodiment of the present invention is improvement of quality of the molded products.

BRIEF DESCRIPTION OF THE DRAWINGS

[Fig. 1] is an entire configuration diagram of a resin molding apparatus of embodiments of the present invention, which shows planar layout.

[Fig. 2] is an explanation view showing actions of a resin supply section for supplying granular resin.

[Fig. 3] is a schematic sectional view of a press section of a first embodiment of the present invention, which shows a step of resin-molding.

[Fig. 4] is a schematic sectional view of the press section, which

shows a resin-molding step following the step shown in Fig. 3.

[Fig. 5] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 4.

[Fig. 6] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 5.

[Fig. 7] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 6.

[Fig. 8] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 7.

[Fig. 9] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 8.

[Fig. 10] is a schematic sectional view of the press section of a second embodiment of the present invention, which shows a step of resin-molding.

[Fig. 11] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 10.

[Fig. 12] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 11.

[Fig. 13] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 12.

[Fig. 14] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 13.

[Fig. 15] is a schematic sectional view of the press section of a third embodiment of the present invention, which shows a step of resin-molding.

[Fig. 16] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 15.

[Fig. 17] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 16.

[Fig. 18] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 17.

[Fig. 19] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 18.

[Fig. 20] is a schematic sectional view of the press section of a fourth embodiment of the present invention, which shows a step of resin-molding.

[Fig. 21] is an exploded sectional view of a film plate section shown in Fig. 20.

[Fig. 22] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 20.

[Fig. 23] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 22.

[Fig. 24] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 23.

[Fig. 25] is a schematic sectional view of the press section of a fifth embodiment of the present invention, which shows a step of resin-molding.

[Fig. 26] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 25.

[Fig. 27] is a schematic sectional view of the press section of a sixth embodiment of the present invention, which shows a step of resin-molding.

[Fig. 28] is a schematic sectional view of the press section of a modified embodiment of the present invention, which shows a step of resin-molding.

[Fig. 29] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 28.

[Fig. 30] is a schematic sectional view of the press section of a

modified embodiment of the present invention, which shows a step of resin-molding.

[Fig. 31] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 30.

[Fig. 32] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 31.

[Fig. 33] is a schematic sectional view of the press section of a seventh embodiment of the present invention, which shows a step of resin-molding.

[Fig. 34] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 33.

[Fig. 35] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 34.

[Fig. 36] is a schematic sectional view of the press section, which shows a resin-molding step following the step shown in Fig. 35.

[Fig. 37] is a front explanation view of the resin molding apparatus of an eighth embodiment of the present invention, which shows an opening state.

[Fig. 38] is a plan view of a movable platen shown in Fig. 37.

[Fig. 39] includes Figs. 39A and 39B, which are sectional views of a mold set being performing a mold-closing step following the step shown in Fig. 37.

[Fig. 40] includes Figs. 40A-40C, which are sectional views showing the mold set of another example and its mold-closing steps.

[Fig. 41] includes Figs. 41A-41C, which are sectional views showing the mold set of further example and its mold-closing steps.

EMBODIMENTS OF THE INVENTION

In the following embodiments of the present invention, the

description will be divided into a plurality of sections, but they are basically not independent of each other, one section relates to modified examples, details, etc. of a part or all of another section. Thus, a same symbol is applied to structural members having the same function, and explanation will not be repeated. Further, effects obtained by the same structure will not be repeated.

Numbers of structural members (including numbers of pieces, numeric values, quantities, ranges, etc.) are not limited to the described numbers except in case that the number is especially specified and that the number is theoretically clearly limited, so the numbers may be smaller or greater than the described ones. Further, as to shapes of structural members, the shapes include substantially similar shapes except in case that the shape is especially specified and that the shape is theoretically clearly excluded.

(First Embodiment)

Firstly, a resin molding apparatus 100 of the present embodiment will be explained with reference to Fig. 1. Fig. 1 is an entire configuration diagram of the resin molding apparatus 100. The resin molding apparatus 100 not only performs resin molding but also examines resin-molded works (molded products), thermally cures (post-cures) the good products and accommodates the good products.

The resin molding apparatus 100 includes various processing sections: a work supply section 110; resin supply sections 120; press sections 130; a work examination/cooling section 140; a curing section 150 (curing furnace); and a work accommodating section 160. Further, the resin molding apparatus 100 includes a control section 170 for controlling various processing steps. Each of the processing sections may be one unit, but a plurality of (e.g., two) the resin supply sections 120 and press sections 130 are provided in the present embodiment.

Since the processes taking a longer time than others are performed by a plurality of the processing sections, production efficiency of the entire resin molding apparatus 100 can be improved.

The resin molding apparatus 100 includes a robot mechanism section 180 having a conveying robot for conveying works and resins between the processing sections. The conveying robot is, for example, an articulated robot, which is capable of rotating and linearly moving and in which a hand is provided to a front end. In the resin molding apparatus 100, the processing sections are disposed to enclose the robot mechanism section 180 (the conveying robot). With this structure, conveying distances of the works and resins (their conveying routes are shown by dotted lines in Fig. 1) can be shortened, so that the works can be efficiently conveyed. Note that, a linear conveying mechanism, e.g., air cylinder, linear motor mechanism, may be employed, instead of the robot mechanism section 180, so as to convey the works and resins between the processing sections.

The work supply sections 110 (see Fig. 1) supply the resins to the press sections 130 in which the resin molding process will be performed. Each of the work supply sections 110 has magazines (not shown), in each of which a plurality of the works (members to be resin-molded) are accommodated. The works supplied from the magazine are temporarily mounted on a work mounting part (not shown) of the robot mechanism section 180 by the conveying robot of the robot mechanism section 180, and then the works are conveyed to the press sections 130 by loaders 190 (conveying sections) of the press sections 130.

The resin supply sections 120 (see Fig. 1) supply the resins to the press sections 130, in which the resin molding process will be performed. The resin supply section 120 will be explained with reference to Fig. 2. Fig. 2 is an explanation view showing actions of the resin supply section

120 which supplies grain type resin R (granular resin).

As shown in Fig. 2, the resin supply section 120 includes: a resin storing section 121 for storing the granular resin R; a plurality of small resin storing sections 122; and a plurality of troughs 123 for supplying the granular resins R to resin supply areas (supply targets). Each of the troughs 123 is communicated to the corresponding resin storing sections 122, and they are moved by an X-Y drive mechanism (not shown). The resin storing section 121 is fixed and capable of storing a large amount of the granular resin R and distributes the granular resins R to the small resin storing sections 122. Then, the granular resins R are sent from the resin storing sections 122 to the trough 123, by an electromagnetic feeder, and dropped onto the resin supply areas and formed into a prescribed shape (e.g., flat shape).

At least one pair of the resin storing section 122 and the trough 123 is required, but a time for dropping the granular resins R onto the resin supply areas can be shortened by providing a plurality of pairs (e.g., three pairs shown in Fig. 2). Three pairs of the resin storing section 122 and the trough 123 are connected by a connecting member 124. By this connection, a same amount of the granular resins R can be simultaneously supplied to the resin supply areas, by one electromagnetic feeder, without providing the electromagnetic feeder to each of the pairs. By providing a plurality of resin supplying units as described above, accurate amount of the granular resins R can be quickly supplied. Similarly, a plurality of dispensers for supplying liquid resins may be provided. In this case too, accurate amount of the liquid resins can be quickly supplied.

The supply target of the resin supply section 120 is a release film F. The release film F has prescribed softness, extensibility and heat resistance, and it is, for example, FEP film, PET film,

fluorine-impregnated glass cloth, polychlorinated vinylidene film, PTFE film or ETEF film. The rolled release film F, which is the resin supply target, is extended onto a support table 125 by one of holding members 126 and held, at a position where a width of the release film becomes a predetermined width, by the holding members 126, and then the release film is cut into a prescribed shape (e.g., strip shape) with the predetermined width for one resin molding process by a cutting member 127 (e.g., cutter).

Supplying the resins to the release film F (the resin supply areas) is performed by: firstly moving the troughs 123 in a direction of arranging the resin supply areas of a first row (e.g., X-direction) with supplying the granular resins R; and then moving the troughs toward the resin supply areas of a second row (e.g., Y-direction) after completing the resin supply for the resin supply areas of the first row. Next, the granular resins R are supplied to the resin supply areas of the second row with moving the troughs 123 in the direction of arranging the resin supply areas of the second row (e.g., X-direction), and the troughs are moved toward the resin supply areas of a third row (e.g., Y-direction) after completing the resin supply for the resin supply areas of the one row. Further, the granular resins R are supplied to the resin supply areas with moving the troughs 123 in the direction of arranging the resin supply areas of the third row (e.g., X-direction), and the entire resin supply is completed after completing the resin supply for the resin supply areas of the final one row.

By employing the above described resin supply section 120, the granular resins R can be supplied (loaded) to the prescribed resin supply areas (square measure), with a prescribed thickness (height), within a prescribed time. The granular resins R loaded on the release films F are conveyed to the loader 190, together with the release film F, by the robot

mechanism section 180, and then conveyed into the press section 130 by the loader 190. Namely, the release film F acts as a carrier film for conveying the resins R.

The press sections 130 (see Fig. 1) resin-mold the works to form molded parts (resin-molded parts). Details of the resin molding process will be explained later. The molded work is temporarily mounted on the work mounting part (not shown) of the robot mechanism section 180, and then transferred to the conveying robot of the robot mechanism section 180.

The examination/cooling section 140 (see Fig. 1) examines the molded works (molded products) and cools the heated works. The cooling section may be separated from the work examination section, but the structure of the examination/cooling section can be made compact by disposing the work cooling section in a vacant space of the work examination section.

The work examination section examines, for example, thicknesses of the works, external appearance thereof, etc. Results of the examinations are sent to and processed by the control section 170. For example, an external appearance of the product is examined, by partially or entirely imaging the product, if there are molding failures, e.g., insufficient resin filling, in the product or not. The product quality and operation data, e.g., types of failure, images, are stored in a storing unit of the control section 170. If a failure, e.g., more insufficient resin filling than expected, is detected, the entire operation of the resin molding apparatus is stopped and maintenance is performed so as to prohibit continuously producing defective molded products. Upon completing the examination, the work is conveyed from a work transferring position of the work examination/cooling section 140 to the curing section 150.

The molding resins on the works are thermally cured (post cured) in the curing section 150 (see Fig. 1). The curing section 150 is closed, by an open/close door (not shown), with respect to the outside, and the inner side is heated at a predetermined temperature. When the work held by the conveying robot approaches to the curing furnace 150, the open/close door is opened; when the conveying robot moves away after setting the work inside, the open/close door is closed, and the resin on the work is thermally cured for a predetermined time. After thermally curing the resin, the work is conveyed from the curing section 150 by the conveying robot, cooled in the work examination/cooling section 140, and further conveyed to the work accommodating section 160.

The work accommodating section 160 (see Fig. 1) accommodates the works as the final processing step of the resin molding apparatus 100. The work accommodating section 160 has magazines as well as the work supply section 110, and the works (molded products) are accommodated in the magazines by the conveying robot of the robot mechanism section 180.

Next, the press section 130 of the resin molding apparatus 100 of the present embodiment will be explained with reference to Fig. 3. Fig. 3 is a schematic sectional view of the press section 130. In Fig. 3, the work W to be molded is shown. In the work W, chip parts 11 (e.g., semiconductor chips) are mounted on a substrate 10 (e.g., circuit board) by die bonding, and the substrate 10 and the chip parts 11 are electrically connected to each other by bonding wires (not shown).

The press section 130 has a mold set 30 (i.e., an upper mold 31 and a lower mold 32). In the present embodiment, the lower mold 32 is a movable mold and the upper mold 31 is a fixed mold, but the upper mold 31 may be a movable mold and the lower mold 32 may be a fixed mold, or the upper and lower molds 31 and 32 may be movable molds.

In the mold set 30, the work W is held by the upper mold 31, and a cavity 33 (constitutes a molding cavity C when the work is clamped) is formed in the lower mold 32. The mold set 30 includes a lower mold cavity piece 34 for configuring a bottom of the cavity 33 and a lower mold clamper which encloses the lower mold cavity piece and configures sides (side walls) of the cavity 33. In the mold set 30, by moving the lower mold cavity piece 34 relative to a lower mold clamper 35, a depth (height) of the cavity 33 is varied and a volume of the molding cavity C is also varied.

A structure of the upper mold 31 will be concretely explained. The upper mold 31 includes an upper mold base 36, an upper mold insert 37 and an upper mold clamper 40. The upper mold insert 37, which has a heater, not shown, for heating the work W, is fixed on a lower face of the upper mold base 36, and the upper mold clamper 40 is provided to the upper mold base and capable of moving upward and downward. The upper mold clamper 40 is a plate-shaped die and a through-hole 41 is formed therein. The upper mold insert 37 is inserted in the through-hole 41 of the upper mold clamper 40. Namely, the upper mold clamper 40 encloses the upper mold insert 37.

The upper mold clamper 40 is suspended (floating- sustained) from the upper mold base 36 by elastic members 42 (e.g., springs), which constitute a movable part, so that the upper mold clamper can be moved upward and downward. As to a relationship of the fixed upper mold insert 37 and the movable upper mold clamper 40 with respect to the upper mold base 36, the upper mold insert 37 is capable of moving relative to the upper mold clamper 40 by extending and contracting the elastic members 42.

In case that the mold set is opened and the elastic members 42 are not actuated (not influenced by an external force), a lower face (lower

end face) of the upper mold insert 37 is located at a position (higher position) higher than a lower face (lower end face) of the upper mold insert 37. In other words, the lower face of the upper mold clamber 40 is located at a position (lower position) lower than the lower face (lower end face) of the upper mold insert 37. By forming the height difference and forming a closed space (chamber) with the upper mold clamber 40 and the lower mold clamber 35 when closing the mold set, the resin molding can be performed with reducing pressure. Further, by moving the upper mold insert 37 relative to the upper mold clamber 40, the work W can be clamped at a constant height regardless of a thickness of the work W.

The upper mold 31 includes a sealing member 43 (e.g., O-ring), which is provided between an outer circumferential face of the upper mold insert 37 and an inner circumferential face of the through-hole 41 of the upper mold clamber 40. The sealing member 43 seals a gap between the outer circumferential face of the upper mold insert 37 and the inner circumferential face of the through-hole 41 of the upper mold clamber 40 so as to form an air path 41A (see Fig. 7).

In the upper mold clamber 40, an air path 44 communicated to the air path 41A is formed between the inner circumferential face of the through-hole 41 and the outside of the mold. The air path 44 is communicated to a pressure reducing section 45 (e.g., pump) located outside of the mold. Inner pressure of the molding cavity C is reduced by the pressure reducing section 45 via the air paths 41A and 44.

Note that, the upper mold 31 has a work holding part for holding the work W (see Fig. 27). The work holding part is constituted by an air path 90 communicated to an end face of the upper mold insert 37, and the work W is held by actuating a pressure reducing section 91 communicated the air path 90 to suck a rear face of the substrate 10 of

the work toward the lower face of the upper mold insert 37. Further, the work holding part may be a claw mechanism provided to the end face of the upper mold insert 37 or an electrostatic chuck capable of holding the work W.

Next, the lower mold 32 will be explained. The movable lower mold 32 is moved, by a known mold clamping mechanism in which a movable lower mold platen is moved upward and downward by a transmitting mechanism (e.g., toggle link, screw shaft) driven by a driving source (e.g., electric motor), so as to open and close the mold set. In this case, a moving speed and a pressurizing force, etc. for moving the lower mold 32 upward and downward can be optionally set.

The lower mold 32 includes: a lower mold base 46; the lower mold cavity piece 34; and the lower mold clamber 35. The lower mold cavity piece 34 is fixed on an upper face of the lower mold base 46. The lower mold clamber 35 is capable of moving upward and downward. The lower mold clamber 35 is a plate-shaped die and a through-hole 47 is formed therein. The lower mold cavity piece 34 is inserted in the through-hole 47 of the lower mold clamber 35. Namely, the lower mold clamber 35 encloses the lower mold cavity piece 34. The lower mold cavity piece 34 has a heater, not shown, so as to heat a resin R.

In the lower mold clamber 35, the lower mold clamber 35 is floating-supported above the lower mold base 46 by elastic members 50 (e.g., springs), which constitute a movable part, so that the lower mold clamber can be moved upward and downward. As to a relationship of the fixed lower mold cavity piece 34 and the movable lower mold clamber 35 with respect to the lower mold base 46, the lower mold cavity piece 34 is capable of moving relative to the lower mold clamber 35 by extending and contracting the elastic members 50.

In case that the mold set is opened and the elastic members 50 are

not actuated (not influenced by an external force), an upper face (upper end face) of the lower mold cavity piece 34 is located at a position (lower position) lower than an upper face (upper end face) of the lower mold clamber 35. By forming the height difference and moving the lower mold cavity piece 34 relative to the lower mold clamber 35, the depth of the cavity 33 (the volume of the molding cavity C) can be varied.

The lower mold 32 includes a sealing member 51 (e.g., O-ring), which is provided between an outer circumferential face of the lower mold cavity piece 34 and an inner circumferential face of the through-hole 47 of the lower mold clamber 35. The sealing member 51 seals a gap between the outer circumferential face of the lower mold cavity piece 34 and an inner circumferential face of the through-hole 47 of the lower mold clamber 35 so as to form an air path 47A (see Fig. 5). Since the cavity 33 is constituted by the upper face of the lower mold cavity piece 34 and the inner circumferential face of the through-hole 47 of the lower mold clamber 35, the air path 47A is communicated to a corner part between the bottom and the side of the cavity 33.

In the lower mold clamber 35, an air path 52 communicated to the air path 47A is formed between the inner circumferential face of the through-hole 47 and the outside of the mold. The air path 52 is communicated to a sucking section 53 (e.g., pump) located outside of the mold. By actuating the sucking section 53 to suck air via the air paths 47A and 52, a center part of the release film F is sucked and held with conforming to the shape of the cavity 33.

In the lower mold clamber 35, an air path 54 is formed between the upper face of the lower mold clamber 35 and the outside of the mold. The air path 54 is communicated to a sucking section 55 (e.g., pump). By actuating the sucking section 55 so as to suck air via the air path 54, an outer edge part of the release film F is sucked and held on a clamping

face of the lower mold clasper 35.

A loader 190 (see Fig. 1), which includes a work loader 56 for conveying the work W to the upper mold 31 and a film loader 57 for conveying the resins R and the release film F to the lower mold 32, is provided for each of the press sections 130. In the loader 190, the work loader 56 and the film loader 57 are capable of transferring the work W and the release film F from the robot mechanism section 180 to the inside of the press section 130, and they are independently driven by driving mechanisms, not shown, so as to feed the works W and the release film F to the press sections 130 and taking out the works therefrom. Note that, the film loader 57 of the loader 190 may receive the resins R and the release film F from the robot mechanism section 180, and the resins R and the release film F may be conveyed to the resin supply sections 120, by the robot mechanism section 180, for supply.

The work loader 56 has a supporting plate 60 and a supporting section 61 and positioning sections 62. A plane region of the supporting plate 60 is broader than, for example, that of the through-hole 41 of the upper mold clasper 40. The supporting section 61, which is formed into a plane ring-shape and has a prescribed height, is provided on an upper face of the supporting plate 60. Further, in the upper face of the supporting plate 60, a plurality of the positioning sections 62 (e.g., pins), which have a prescribed height, are provided in an outer part of the supporting section 61.

A plane enclosed by the supporting section 61 is located inside of and formed along an outer edge of the substrate 10 of the work W, and an area of the plane region and that of the substrate 10 are made as same as possible. The height of the supporting section 61 is higher than that of parts (e.g., thicknesses of chip parts 11, heights of bonding wires) mounted on the substrate 10 of the work W. With this structure, the work

W is supported, in an outer edge part of the surface of the substrate 10, by the supporting section 61 without the supporting plate 60 contacting (interfering with) the chip parts 11 and the bonding wires (not shown).

The positioning sections 62 are capable of contacting the inner circumferential face of the through-hole 41 of the upper mold clamber 40, so that the work loader 56 can be positioned with respect to the upper mold insert 37, and planar positions of the positioning sections are, for example, corners of the plane rectangular-shaped through-hole 41 of the upper mold clamber 40. Further, the height of the positioning sections 62 is designed to make the work W contact the inner circumferential face of the through-hole 41 before transferring the work to the upper mold insert 37. With this structure, the positioning sections 62 correctly position the work W in a prescribed area of the lower face of the upper mold insert 37.

By employing the work loader 56 having the above described structure, the rear face of the substrate 10 of the work W is brought into contact with the lower face of the upper mold insert 37, and the work W is transferred to the upper mold 31. In this step, the substrate 10 is pressed, by the supporting section 61, onto the lower face of the upper mold insert 37, so that the substrate 10 (work W) is held by the holding part of the upper mold 31.

The film loader 57 has a hand section 63 for sucking and holding the release film F on which the resins R have been loaded. The hand section 63 includes: a holding face (sucking face) 64 for holding the release film F; an air path 65 communicated to the holding face 64; and recessed parts 66 formed in the holding face 64.

A size of the holding face 64 (i.e., size of a plane region of the hand section 63) is designed, for example, to suck the strip-shaped release film F along an outer edge of a plane region of the film. A

plurality of the recessed parts 66 are arrayed in a $n \times m$ matrix (at least one of n and m is two or more) in the holding face 64 of the hand section 63. In the hand section 63, air paths 65 are formed between the holding face 64 (e.g., an outer edger part of the holding face 64, parts of the holding face 64 between the recessed parts 66) and outside of the hand section 63 so as not to interfere with the recessed parts 66. The air paths 65 communicated to the holding face 64 are formed around the recessed parts 66 (between the adjacent recessed parts 66). The air paths 65 are communicated to a sucking section 67 (e.g., pump) located outside of the hand section 63. With this structure, the release film F is sucked at positions around each of the resins R, and the release film can be held with applying tension to the outer edge parts, so that the release film F can be sucked and held, in a flat state, without being bent by weights of the resins R. Note that, in the present embodiment, the flat state of the release film F means that the release film F is not bent and warped and is capable of sufficiently conveying the resins R to and setting the same into the mold set 30, so the perfect flat state is not always required.

The film loader 57 having the above described structure sucks the release film F through the air paths 65 around the recessed parts 66, with securing clearances with respect to the resins R loaded on the release film F, by the recessed parts 66. With this structure, the release film F is held on the holding face 64 in the flat state (without being deformed), and the resins R and the release film F are transferred to the lower mold 32. Since the clearances with respect to the resins R are secured by the recessed parts 66, conditions (e.g., shapes, quantities) of the resins R loaded on the release film F can be maintained. Note that, in the present embodiment, the resins R are respectively loaded on a plurality of the areas (corresponding to the recessed parts 66) in the release film F without loading the resins on the entire release film F. Note that,

depending on strength of the release film F and weights of the resins R, the release film F may be held by sucking the outer edge part thereof only.

Next, a resin molding method performed in the resin molding apparatus 100 (actions of the resin molding apparatus 100) will be explained with reference to Figs. 3-9. Figs. 3-9 are schematic sectional views of the press section 130 performing the resin molding process.

In the resin molding apparatus 100 of the present embodiment, the release film F is disposed on a parting face of the lower mold 32. By using the release film F, leakage of the resin from a gap between the lower mold cavity piece 34 and the lower mold clamber 35 can be prevented. Clogging of the resin between the lower mold cavity piece 34 and the lower mold clamber 35 can be prevented, so that the relative movement of the lower mold cavity piece 34 with respect to the lower mold clamber 35 can be secured. Note that, depending on the strength of the release film F and the weights of the resins R, the release film F may be held by sucking the outer edge part thereof only.

As shown in Fig. 3, the work loader 56 conveys the work W into the mold set 30 from the outside when the mold set is opened.

While opening the mold set 30, the film loader 57 conveys the resins R and the release film F into the mold set. Before this conveyance, the resins R are loaded (supplied) onto the release film F, and the release film F is cut into the prescribed shape (e.g., strip shape) (see Fig. 2). The release film F is sucked on the holding face 64 of the sucking section 67 and conveyed in the flat state. Note that, the sucking actions of the sucking section 67, etc. are indicated by arrows (see Fig. 3, etc.).

Successively, as shown in Fig. 4, the work loader 56 is moved upward to transfer the work W to the upper mold 31. Concretely, the positioning sections 62 are brought into contact with the inner

circumferential face of the through-hole 41 of the upper mold clamber 40 by moving the work loader 56 upward, and then the rear face of the substrate 10 is brought into contact with the lower face of the upper mold insert 37. Next, the substrate 10 (work W) is held on the lower face of the upper mold insert 37 by the work holding section (not shown). Therefore, the work W can be transferred from the work loader 56 to the upper mold 31.

As shown in Fig. 4, the film loader 57 is moved downward to transfer the release film F, on which the resins R have been loaded, to the lower mold 32 so as to start melting the resins R. Firstly, the holding face 64 is brought into contact with the upper face of the lower mold clamber 35, with the release film F, by moving the film loader 57 downward, and then the elastic members 50 are contracted (by moving the movable section). Namely, the lower mold clamber 35 is pressed and moved downward by moving the film loader 57 downward. Next, the film loader 57 is moved downward until the upper face (upper end face) of the lower mold cavity piece 34 is level with the upper face (upper end face) of the lower mold clamber 35. Note that, the release film F may be transferred to the lower mold 32 by moving the lower mold 32 upward instead of moving the film loader 57 downward.

In the above described step, the resins R loaded on the release film F are melted by being heated in the lower mold cavity piece 34. The release film F is held on the holding face 64 of the film loader 57 in the flat state. Namely, in the lower mold 32, the film loader 57 disposes the flat release film F so as to locate the resins R above the lower mold cavity piece 34 in the state where the upper face (upper end face) of the lower mold cavity piece 34 and the upper face (upper end face) of the lower mold clamber 35 are held level with each other. Note that, the release film F should be flat at least when the release film is disposed

(supplied) onto the lower mold 32. As shown in Fig. 4, in case that the holding face 64 of the film loader 57 has the shape and the size capable of pressing the cavity 33 with the release film F, the release film F can be easily supplied to the flat lower mold 32 by only moving the film loader 57 downward until reaching the end face of the lower mold cavity piece 34 without forming wrinkles.

Next, the flat release film F, which has been disposed to cover the upper face of the lower mold cavity piece 34 and the upper face of the lower mold clamber 35, is sucked and held by the sucking sections 53 and 55 in the state where the upper face of the lower mold cavity piece 34 and the upper face of the lower mold clamber 35 are level with each other. Then, the resins R and the release film F are transferred from the film loader 57 to the lower mold 32. Note that, the sucking sections 53 and 55 may be actuated by a same system or separate systems.

Successively, as shown in Fig. 5, the work loader 56, which has held the work W, is moved downward. With this action, the work loader 56 leaves from the work W. Therefore, the work W is held by the upper mold 31 only.

Further, as shown in Fig. 5, the film loader 57 is moved upward, with sucking the flat release film F through the air paths 47A, 52 and 54 of the sucking sections 53 and 55, to extend the elastic members 50 (actuate the movable part). The lower mold cavity piece 34 is moved relative to the lower mold clamber 35, by the elastic members 50, so as to form the cavity 33. In this step, the outer edge part of the release film F is sucked by the sucking section 55 and the parts of the release film F corresponding to the corners of the cavity 33 are sucked by the sucking section 53, the release film F is deformed with conforming to the inner face of the cavity 33. Therefore, the release film F is sucked and held in the state where the release film conforms to the inner face of the cavity

33.

Further, the resins R are supplied to the cavity 33 with sucking and holding the release film F conforming to the inner face of the cavity 33. Since the film loader 57 disposes the resins R above the lower mold cavity piece 34 with the release film F, the resins R can be supplied to the cavity 33 in that state even if the cavity 33 is formed by moving the lower mold cavity piece 34 relative to the lower mold clamber 35. Therefore, the resins R can be supplied to the bottom part of the cavity 33 without displacing and losing shapes of the resins R. By supplying the resins R to the cavity 33 in the desired state, producing defective products, which will be caused by voids, wire sweep, etc., can be reduced.

Next, the work loader 56 and the film loader 57 are moved away from the inside of the mold set 30 as shown in Fig. 6.

Next, the movable lower mold 32 is moved upward to close (clamp) the mold set 30. Concretely, the lower mold 32 is moved upward to the position where the lower mold clamber 35 and the upper mold clamber 40 clamp the release film F. With this action, the inside of the mold set 30 including the cavity 33 is air-tightly closed. In this step, the pressure reducing section 45 is actuated so as to reduce an inner pressure of the mold set 30 including the cavity 33 (air-purge therefrom) through the air paths 41A and 44. By reducing the inner pressure of the mold set 30 and purging air therefrom, mixing air into the melted resins R in the resin-molding step can be prevented, so that forming voids in molded products can be prevented.

Next, as shown in Fig. 8, the movable lower mold 32 is further moved upward until the upper face of the lower mold clamber 35 contacts the outer edge part of the substrate 10 with the release film F. In this step, elasticity of the elastic members 42 is smaller than that of the

elastic members 50, so the upper mold clamber 40 contracts the elastic members 42 with upward movement of the lower mold 32 (lower mold clamber 35). With this action, the work W is clamped by the upper mold insert 37 (upper mold 31) and the lower mold clamber 35 (lower mold 32), and the surface of the substrate 10 and the lower face of the upper mold clamber 40 are level with each other. By moving the upper mold insert 37 relative to the upper mold clamber 40, the work W can be clamped at a constant height regardless of a thickness of the work W.

Next, as shown in Fig. 9, the movable lower mold 32 is further moved upward so as to dip the chip parts 11 into the melted resins R which have been melted by heat of the mold set, and then the melted resins R filling the molding cavity C (cavity 33) is thermally cured so as to resin-mold the work W. In this step, the lower mold clamber 35 contacts the upper mold 31 through the substrate 10 and is prohibited from further moving, so that the elastic members 50 are contracted by the upward movement of the lower mold 32 (lower mold base 46). By controlling an upper limit position of the lower mold 32 (i.e., contraction length of the elastic members 50), the work can be resin-molded with a desired mold thickness (at a desired molding position). By this step, the molded product is almost completed.

Next, the mold set is opened in a state where the work W (molded product) is held, on the upper mold 31, by the work holding section, and the release film F is held, on the lower mold 32, by the sucking sections 53 and 55. In this step, the work W can be easily released from the mold by using the release film F. As described above, the work W is conveyed to the work examination/cooling section 140 and the curing section 150, and then accommodated in the work accommodating section 160.

By using the resin molding apparatus 100 of the present embodiment, the release film F can be disposed in the flat state, and the

release film F can be deformed with conforming to the shape of the cavity 33. Namely, the release film F is never supplied to the mold set 30 with forming wrinkles or overlapping parts. Therefore, copying wrinkles in an outer face of the molded product and leakage of the resin through the overlapping part can be prevented, so that quality of the molded products can be improved. Further, the cavity 33 is formed in the lower mold 32, and the chip parts 11 and bonding wires (not shown), for example, are dipped into the melted resins R supplied on the entire surface of the cavity 33, so that flow of the resins R can be highly limited and producing defective products, which will be caused by voids, wire sweep, etc., can be reduced.

(Second Embodiment)

Unlike the first embodiment, the present embodiment is characterized in that the work loader 56 disposes (sets) the work W, together with a jig (a lower part of the upper mold insert 37), to the upper mold 31 and that the film loader 57 has a heating section, a cooling section and a shutter section. In the following description, the characteristic points will be mainly explained with reference to Figs. 10-14. Figs. 10-14 are schematic sectional views of the press section 130 of the present embodiment.

With increasing the size of the work W (substrate 10), the work W will be much bent (warp); in case that the work loader 56 (supporting section 61) merely holds the outer edge part of the surface of the substrate 10 as described in the first embodiment, it is difficult to hold the work W in the mold due to occurrence of deformation cause by its own weight, and the work will drop while being conveyed. Thus, in the present embodiment, deformation of the large substrate 10 is prevented by pressing the rear face of the substrate with a plate-shaped jig 37A (member), and the work W is conveyed, by the work loader 56, together

with the jig 37A. For example, the upper mold insert 37 and the jig 37A are composed of a same material (e.g., stainless steel). Therefore, the jig 37A can be regarded as a separable lower part of the upper mold insert 37.

In case of forming a plurality of the recessed parts 66 in the film loader 57 as well as the first embodiment, the resins R cannot be loaded in prescribed regions, which correspond to peripheries of the recessed parts 66 (where the air paths 65 communicating to the holding face 64 are formed), of the release film F. But, in case that one recessed part 66 having a large opening part is formed in the hand section 63 and the resin R is extensively loaded on the release film F, it will be difficult to flatly hold the release film F due to deformation of the release film F caused by a weight of the resin R. Thus, in the present embodiment, a shutter section 70, which is capable of holding the release film F, on which the resin R is loaded, under the opening part of the hand section 63, is provided.

The film loader 57 of the present embodiment will be concretely explained. The film loader 57 has the roll-shaped shutter section 70 capable of opening and closing the holding face 64. While opening the holding face 64 (in an opening state), the shutter section 70 is wound, by a driving section not shown, to evacuate; and while closing the holding face 64 (in a closing state), the shutter section 70 is extended toward the holding face 64. With this structure, the film loader 57 conveys the release film F with supporting the release film F by the shutter section 70 in the closing state, and disposes the release film F onto the lower mold 32 while the shutter section 70 is in the opening state.

The shutter section 70 is constituted by a windable member, e.g., thin metal plate, thin plastic plate. Preferably, the shutter section 70 has a suitable shape or is composed of a suitable material capable of

reducing frictional resistance to the release film F. By employing such shutter section 70, the release film F can be wound without being bent. Preferably, the shutter section 70 includes a core 71, which is a supporting shaft extending a direction perpendicular to a film winding direction, so as to hold the release film F in the flat state.

By employing the film loader 57, the shutter section 70 is capable of holding (supporting) the release film F in the flat state without bending the release film F by the weight of the resin R loaded on the release film F and set in the recessed part 66. When the release film F is disposed onto the lower mold 32, the shutter section 70 is wound, so that an occupied space of the shutter section can be reduced. Note that, the shutter section 70 need not be windable, so the holding face may be opened and closed by a plate-shaped member so as to hold the release film F (i.e., resin R).

The film loader 57 includes a cooling section 72 and a heating section 73. With this structure, the release film F and the resin R load thereon can be auxiliarily cooled and heated. By including a heating section in the shutter section 70, the release film F is preheated, so that the release film F can securely conform to the shape of the cavity 33. In this case, the core 71 may be, for example, a line heating unit acting as the heater.

Successively, a resin molding method performed in the resin molding apparatus 100 (actions of the resin molding apparatus 100) of the present embodiment will be explained

As shown in Fig. 10, the work loader 56 conveys the jig 37A and the work W into the mold set 30 from the outside while the mold set is opened.

While opening the mold set 30, the film loader 57 conveys the resin R and the release film F thereinto. In this step, the cooling section

72 is turned on (or off) and the heating section 73 is turned off so as to prevent the resin R from being overheated by radiant heat from the mold set, so that heating the release film F and the resin R can be prevented.

The closed shutter section 70 holds and conveys the resin R loaded on the release film F into the mold set 30. The release film F is sucked by the sucking section 67, held on the holding face 64 and conveyed in the flat state.

Next, as shown in Fig. 11, the work loader 56 is moved upward so as to transfer the jig 37A and the work W to the upper mold 31. Concretely, the positioning sections 62 are brought into contact with the inner circumferential face of the through-hole 41 of the upper mold clamber 40 by the upward movement of the work loader 56, and then the jig 37A holding the work W is brought into contact with the lower face of the upper mold insert 37. Next, the work W and the jig 37A are held on the lower face of the upper mold insert 37 by the work holding section (not shown). With this action, the work W is transferred from the work loader 56 to the upper mold 31.

As shown in Fig. 11, the film loader 57 is moved downward. Concretely, the holding face 64 is firstly brought into contact with the upper face of the lower mold clamber 35, with the release film F and the shutter section 70, by moving the film loader 57 downward, and then the elastic members 50 are contracted (moving the movable part). Namely, the lower mold clamber 35 is moved downward by the downward movement of the film loader 57. Next, the film loader 57 is moved downward until the upper face of the lower mold cavity piece 34 and the upper face of the lower mold clamber 35 are level with each other. Note that, if the cooling section 72 is turned on, it is preferable to turn off the cooling section 72 in the step shown in Fig. 11 so as not to reduce a temperature of the mold set 30.

Next, as shown in Fig. 12, the work loader 56 is moved downward. With this action, the work loader 56 leaves from the work W. The work W is held by the upper mold 31.

Further, as shown in Fig. 12, the release film F on which the resin R is loaded is transferred to the lower mold 32. Concretely, firstly the shutter section 70 is wound, and then the flat release film F is disposed onto the lower mold 32, in which the upper face of the lower mold cavity piece 34 and the upper face of the lower mold clamper 35 have been level with each other, by the film loader 57, in a state where the resin R is disposed above the lower mold cavity piece 34. Next, the flat release film F is held on a parting face of the lower mold 32, in which the upper face of the lower mold cavity piece 34 and the upper face of the lower mold clamper 35 have been level with each other, by the sucking sections 53 and 55. With this action, the resin R and the release film F are transferred from the film loader 57 to the lower mold 32. By turning the heating section 73 on, the resin R can be heated by the heat of the lower mold 32 (from the lower side) and the heat from the upper side, so that melting time of the resin can be shortened. Therefore, productivity can be improved.

Next, as shown in Fig. 13, the elastic members 50 are extended (moving the movable part) by moving the film loader 57 upward in a state where the sucking sections 53 and 55 sucking the flat release film F through the air paths 47A, 52 and 54. The elastic members 50 move the lower mold cavity piece 34 relative to the lower mold clamper 35 so as to form the cavity 33. In this step, the outer edge part of the release film F is sucked by the sucking section 55 and the parts of the release film F corresponding to the corners of the cavity 33 are sucked, so that the release film F can deform with conforming to the inner face of the cavity 33. Therefore, the release film F can be sucked and held with conforming

to the inner face of the cavity 33.

In this step, by sucking and holding the release film F with conforming to the inner face of the cavity 33, the resin R can be supplied to the cavity 33 without being deformed. In other words, the resin R is disposed above the lower mold cavity piece 34, with the release film F, by the film loader 57, so the resin R can be supplied to the cavity 33 without being deformed even if the lower mold cavity piece 34 is moved relative to the lower mold clamber 35 to form the cavity 33. Therefore, the resin R can be supplied to the bottom of the cavity 33 without being deformed and displaced.

Next, as shown in Fig. 14, the work loader 56 and the film loader 57 are evacuated from the inside of the mold set 30. Then, the molded product is produced by the steps shown in Figs. 7-9 of the first embodiment.

(Third Embodiment)

In the second embodiment, the film loader 57 includes the hand section 63, which sucks and holds a mounting surface of the release film F on which the resin R is loaded, and the shutter section 70, which supports the opposite surface of the release film F. On the other hand, the present embodiment is characterized in that a jig (member) for supporting the resin R and the release film F is used as the film loader 57 and disposed (set) in the lower mold 32. In the following description, the characteristic points will be mainly explained with reference to Figs. 15-19. Figs. 15-19 are schematic sectional views of the press section 130 of the present embodiment.

In the shutter section 70 for supporting the release film F, the shutter section 70 must be wound (detached) when disposing the release film F onto the lower mold 32, as well as the second embodiment. In this step, there is a possibility that the resin R on the release film F will be

collapsed and unevenly distributed. Thus, in the present embodiment, a plate-shaped jig 34A is brought into contact with the lower surface of the release film F so as to hold the flat state of the release film F, the release film F is conveyed, by the film loader 57, together with the jig 34A, and the jig 34A contacting the release film F is used as the lower mold 32. Namely, for example, the jig 34A and the lower mold cavity piece 34 are composed of a same material (e.g., stainless steel), so that an upper part of the lower mold cavity piece 34 can be regarded as a separable part.

The film loader 57 and the press section 130 of the present embodiment will be explained concretely. The film loader 57 includes: the jig 34A being the upper separable part of the lower mold cavity piece 34; and a jig 35A being an upper separable part of the lower mold clamper 35. The jig 34A is disposed in a through-hole of the jig 35A, and an outer circumferential face of the jig 34A and an inner circumferential face of the jig 35A are connected by a plurality of connecting members 74 so as to lift and support the jig 34A. The connecting members 74 are capable of being used as a movable section, which moves the jig 35A upward and downward relative to the jig 34A like leaf springs.

The jigs 34A and 35A have different thicknesses, and the jig 34A is thinner than the jig 35A. In a state where no external force is applied, an end face of the jig 34A and an end face of the jig 35A are held level with each other by the connecting members 74. For example, in a state where the press section 130 is opened and no external force is applied to the elastic members 50 (i.e., not affected from the outside), a height of an upper face of a lower part of the lower mold cavity piece 34 is equal to that of an upper face of a lower part of the lower mold clamper 35. In the present embodiment, by making the thickness difference (height difference) between the jigs 34A and 35A and moving the jig 34A (the upper part of the lower mold cavity piece 34) relative to the jig 35A (the

upper part of the lower mold clamber 35), the depth of the cavity 33 (capacity of the molding cavity C) can be varied.

The press section 130 of the present embodiment includes pressing sections 75 and 76 for pressing the upper surface of the release film F (the surface on which the resin R is loaded). The pressing section 75 is constituted by two ring-shaped members having different external shapes and formed like a flange so as to press the release film F around the resin R, and faces an end face of an outer periphery of the jig 34A. The pressing section 76 faces an end face of the jig 35A so as to press the outer edge part of the release film F toward the lower mold clamber 35.

The film loader 57 conveys the flat release film F to the end face of the jig 34A and the end face of the jig 35A with maintaining the end faces level with each other. With this action, the release film F and the loaded resin R can be stably disposed in the mold set 30.

Successively, a resin molding method performed by the resin molding apparatus 100 of the present embodiment (resin molding method of the resin molding apparatus 100) will be explained.

As shown in Fig. 15, while opening the mold set 30, the work loader 56 conveys the work W from the outside of the mold set. In the state of opening the mold set 30, the film loader 57 conveys the resin R and the release film F into the mold set.

Before the above described conveying actions, the rolled release film F, for example, is fed and the resin R is loaded (supplied) onto the release film F in the resin supply section 120 in the state where the end face of the jig 34A and the end face of the jig 35A are level with each other. Next, the release film F is cut into the prescribed shape (e.g., strip shape) (see Fig. 2), and the cut release film F can be disposed on the end face of the jig 34A and the end face of the jig 35A in a flat state because the both end faces have been level with each other. The release film and

the resin are supplied to the press section 130 by the robot mechanism section 180 and the loader 190.

Next, as shown in Fig. 16, the work loader 56 is moved upward so as to transfer the work W to the upper mold 31.

As shown in Fig. 16, the film loader 57 is moved downward. Concretely, the jig 35A is brought into contact with the upper face of the lower mold clamber 35 by moving the film loader 57 downward. By this step, the release film F is flatly disposed onto the lower mold 32, in which the end face of the jig 34A (the upper part of the lower mold cavity piece 34) and the end face of the jig 35A (the upper part of the lower mold clamber 35) are maintained level with each other, by the film loader 57. Note that, in this state, the jig 34A does not contact the upper face of the lower mold cavity piece 34.

Next, as shown in Fig. 17, the work loader 56 is moved downward. With this action, the work loader 56 leaves from the work W.

As shown in Fig. 17, the release film F is sucked by the sucking sections 53 and 55. Concretely, the outer edge part of the release film F is sucked by the sucking section 55, and the center part of the release film F is sucked by the sucking section 53, so that the jig 34A, which is capable of moving upward and downward relative to the jig 35A, is moved downward by the connecting members 74 (moving the movable part).

The lower mold cavity piece 34 is moved relative to the lower mold clamber 35 by the connecting members 74, so that the cavity 33 can be formed. In this step, the outer edge part of the release film F is sucked by the sucking section 55, and the parts of the release film F corresponding to the corners of the cavity 33 are sucked by the sucking section 53, so that the release film F can be sucked and held with conforming to the inner face of the cavity 33.

The resin R is supplied to the cavity 33 as it is in the state where the release film F is sucked and held with conforming to the inner face of the cavity 33. Since the resin R is disposed on the jig 34A, with the release film F, by the film loader 57, the resin R is supplied to the cavity 33, without changing the state, even if the cavity 33 is formed. Therefore, the resin R can be supplied to the bottom of the cavity 33 without collapsing the shape and displacing the position.

Next, as shown in Fig. 18, the film loader 57 is moved upward, with sucking the release film F by the sucking section 53 and 55 through the air paths 52 and 54, so as to transfer the resin R and the release film F to the lower mold 32.

Next, as shown in Fig. 19, the work loader 56 and the film loader 57 are evacuated from the inside of the mold set 30. Then, the molded product is produced by the steps shown in Figs. 7-9 of the first embodiment.

(Fourth Embodiment)

In the first embodiment, the release film F is flatly sucked and held by the hand section 63 of the film loader 57. On the other hand, in the present embodiment, the film loader 57 includes a jig (member) for holding and disposing (setting) the release film F as a plate, onto the lower mold 32. In the following description, the characteristic points will be mainly explained with reference to Figs. 20-24. Figs. 20 and 22-24 are schematic sectional views of the press section 130 of the present embodiment. Fig. 21 is an exploded sectional view of the film loader 57 (a film plate section) shown in Fig. 20.

The press section 130 of the present embodiment will be explained concretely. The film loader 57 includes a ring-shaped upper plate 80 and a ring-shaped lower plate 81, so that the release film F can be pinched from the upper and lower sides and can be held in a state of being

stretched from all circumferential directions (see Fig. 21 especially). In Fig. 21, the lower plate 81 is formed like a flange, so an outer circumferential edge of the upper plate 80-side face is recessed and formed into a step-shaped part 82 extending in the circumferential direction. The release film F is pinched between the upper plate 80 and the lower plate 81, and the upper plate 80 is fitted to the step-shaped part 82 (small diameter part) in a state where an inner diameter part 80a is corresponded to the step-shaped part, so that the film plate section (film loader 57) is constituted (see Fig. 20 especially). The release film F can be flatly stretched in the inner circumferences of the upper plate 80 and the lower plate 81.

Note that, in case of using the same-sized ring-shaped plates 80 and 81, the film plate section is formed by fixing the two plates to each other by, for example, inserting bolts into through-holes formed in the outer edge parts of the ring-shaped plates (with avoiding the release film F).

The outer circumferential edge of the lower mold clasper 35 is recessed and formed into a step-shaped part 83 extending in the circumferential direction. The film plate section (film loader 57) is fitted and fixed to the step-shaped part 83 of the lower mold clasper 35 in a state where an inner diameter part 81a of the lower plate 81 is corresponded to the step-shaped part. In the present embodiment, the release film F can be flatly held by the simple structure, and the release film F can be disposed onto the lower mold 32 in the flat state.

Successively, a resin molding method performed by the resin molding apparatus 100 of the present embodiment (resin molding method of the resin molding apparatus 100) will be explained.

As shown in Fig. 20, in the state of opening the mold set 30, the work loader 56 conveys the work W from the outside of the mold set. In

the state of opening the mold set 30, the film loader 57 conveys the resin R and the release film F into the mold set.

Before the above described conveying actions, the film plate section is formed by pinching the release film F between the upper plate 80 and the lower plate 81 as shown in Fig. 21, and the resin R is loaded (supplied) on the release film F of the film plate section.

Next, as shown in Fig. 22, the work loader 56 is moved upward so as to transfer the work W to the upper mold 31.

As shown in Fig. 22, the film loader 57 is moved downward to transfer the release film F, on which the resin R is loaded, to the lower mold 32. Concretely, firstly the lower face of the lower plate 81 is brought into contact with and fixed to the upper face of the step-shaped part 83 of the lower mold clamber 35 by moving the film loader 57 downward, and then the elastic members 50 are contracted (moving the movable part). Namely, the lower mold clamber 35 is moved downward by moving the film loader 57 downward. Next, the film loader 57 is moved downward until the upper face (upper end face) of the lower mold cavity piece 34 and the upper face (upper end face) of the lower mold clamber 35 are level with each other.

In this step, the film loader 57 holds and stretches the flat release film F. Namely, the film loader 57 disposes the flat release film F on the lower mold 32, in which the upper face of the lower mold cavity piece 34 and the upper face of the lower mold clamber 35 are level with each other, in the state where the resin R is disposed above the lower mold cavity piece 34.

Next, the sucking section 53 sucks and holds the flat release film F, which has covered the upper face of the lower mold cavity piece 34 and the upper face of the lower mold clamber 35 in the state where the both end faces are level with each other.

Next, as shown in Fig. 23, the work loader 56 is moved downward. By this action, the work loader 56 leaves from the work W. Therefore, the work W is held by the upper mold 31 only. Next, the work loader 56 is moved to evacuate from the inside of the mold set 30.

As shown in Fig. 23, the film loader 57 is moved upward, with sucking the flat release film F by the sucking section 53 through the air paths 47A and 52, so as to extend the elastic members 50 (moving the movable part). The lower mold cavity piece 34 is moved, by the elastic members 50, relative to the lower mold clamber 35 so as to form the cavity 33. In this step, the outer edge part of the release film F is fixed by fitting the step-shaped part 83 of the lower mold clamber 35 to the inner diameter part 81a of the lower plate 81, and the parts of the release film F corresponding to the corners of the cavity 33 are sucked by the sucking section 53, so that the release film F is deformed with conforming to the inner face of the cavity 33. Therefore, the release film F is sucked and held with conforming to the inner face of the cavity 33.

By sucking and holding the release film F with conforming to the inner face of the cavity 33, the resin R is supplied to the cavity 33 in the shape as it is. In other words, the film loader 57 disposes the resin R, with the release film F, above the lower mold cavity piece 34, so the resin R can be supplied to the cavity 33 in the shape as it is even if the cavity 33 is formed by moving the lower mold cavity piece 34 relative to the lower mold clamber 35. Therefore, the resins R can be supplied to the bottom of the cavity 33 without displacing the resins R and losing shapes thereof. By supplying the resins R to the cavity 33 in the desired state, producing defective products, which will be caused by voids, wire sweep, etc., can be reduced.

Next, as shown in Fig. 24, the movable lower mold 32 is moved upward to close (clamp) the mold set 30. With this action, the release

film F is clamped, namely the film plate section (film loader 57) is clamped between the upper mold 31 and the lower mold 32. Then, the molded product is produced by the steps shown in Figs. 8 and 9 of the first embodiment.

(Fifth Embodiment)

In the first embodiment, the upper face of the lower mold cavity piece 34 and the upper face of the lower mold clamber 35 are made level with each other by downwardly pressing and moving the lower mold clamber 35 with the film loader 57 (hand section 63). On the other hand, in the present embodiment, the plate-shaped jig 34A (the upper part of the lower mold cavity piece 34) is floating-supported in the lower mold 32, and the upper face of the jig 34A and the upper face of the lower mold clamber 35 are made level with each other. In the following description, the characteristic points will be mainly explained with reference to Figs. 25 and 26. Figs. 25 and 26 are schematic sectional views of the press section 130 of the present embodiment. Fig. 21 is an exploded sectional view of the film loader 57 (a film plate section) shown in Fig. 20.

The press section 130 of the present embodiment will be explained concretely. The press section 130 has the plate-shape jig 34A, which is the separable upper part of the lower mold cavity piece 34. Further, the press section 130 has a plurality of supporting pins 84, which can be moved upward and downward with respect to the lower mold base 46, and elastic members 85 (e.g., springs) whose number is equal to that of the supporting pins 84. With this structure, the jig 34A is floating-supported by the supporting pins 84 and the elastic members 85, which constitute the movable part, so as to make the upper face of the jig 34A (upper part of the lower mold cavity piece 34) and the upper face of the lower mold clamber 35 level with each other in the opened state of

the mold set. Note that, the plate-shaped jig 34A may be moved upward and downward, without using the elastic members 85, by a driving mechanism, e.g., air cylinder, servo motor.

Successively, a resin molding method performed by the resin molding apparatus 100 of the present embodiment (resin molding method of the resin molding apparatus 100) will be explained.

As shown in Fig. 25, in the state of opening the mold set 30, the resin R and the release film F are conveyed into the mold set and transferred to the lower mold 32. In this step, the release film F is flatly disposed onto the lower mold 32, in which the upper face of the jig 34A (upper part of the lower mold cavity piece 34) and the upper face of the lower mold clamber 35 are level with each other, by the film loader 57. Then, the sucking sections 53 and 55 begin to suck the release film F.

Next, the sucking sections 53 and 55 suck the release film F as shown in Fig. 26. Concretely, the outer edge part of the release film F is sucked by the sucking section 55, and air in a space under the release film F is sucked by the sucking section 53, so that the jig 34A, which is capable of moving upward and downward relative to the lower mold clamber 35, is moved downward with contracting the elastic members 85 (moving the movable part).

The cavity 33 is formed by moving the jig 34A (upper part of the lower mold cavity piece 34) relative to the lower mold clamber 35 by the elastic members 85. In this step, the outer edge part of the release film F is sucked by the sucking section 53, the parts of the release film F corresponding to the corners of the cavity 33 are sucked by the sucking section 53, so that the release film F is deformed with conforming to the inner face of the cavity 33. With this action, the release film F can be sucked and held with conforming to the inner face of the cavity 33.

When the release film F is sucked and held with conforming to the

inner face of the cavity 33, the resin R is supplied to the cavity 33 as it is. Since the resin R is disposed above the jig 34A, with the release film F, by the film loader 57, the resin R can be supplied to the cavity 33 with keeping the original state despite the cavity 33 being formed. Therefore, the resin R can be supplied to the bottom of the cavity 33 without losing the shape of the resins R and displacing the same. Then, the molded product is produced by the steps shown in Figs. 7-9 of the first embodiment.

In the above described method, for example, the end face of the lower mold cavity piece 34 and the end face of the lower mold clamper 35 need not be made level with each other by moving the lower mold clamper 35 downward by the film loader 57, so that the actions and the structure of the film loader 57 (e.g., output power of a driving motor, stroke reduction) can be simplified. Since the jig 34A (upper part of the lower mold cavity piece 34) is floating-supported when the release film F is disposed on the lower mold 32, heat shrink of the release film F can be prevented, over heat of the resin R loaded on the release film F can be prevented and heat control can be easily performed.

(Sixth Embodiment)

In the first embodiment, an inner pressure of the closed mold set 30 including the cavity 33 is reduced (air-purged) in the state where the inside of the mold set 30 is air-tightly closed as explained with reference to Fig. 7. In this step, there is a possibility that the substrate 10 will be dropped by reduction of the sucking force for sucking the substrate, which is caused by air suction for the pressure reduction, in case that the substrate 10 (work W) is held on the upper mold 31 by a work holding section (i.e., an air path 90 and a sucking section 91) of the upper mold 31. Unlike the first embodiment described above, the present embodiment is characterized in that the substrate 10 is pressed onto the

upper mold 31 and supported when the decompression space is formed with floating-supporting a plurality of pins in the lower mold clamber 35. In the following description, the characteristic points will be mainly explained with reference to Fig. 27. Fig. 27 is a schematic sectional view of the press section 130 of the present embodiment.

In the press section 130, a plurality of pin 86, which are provided in the lower mold clamber 35 and arranged along the periphery of the through-hole 47 of the lower mold clamber 35. In the press section 130, the pins 86 are attached in the inner parts of the lower mold clamber 35 and capable of moving upward and downward relative to the lower mold clamber 35, and elastic members 87 (e.g., springs), whose number is equal to that of the pins 86, are provided.

When the decompression space is formed, the pins 86 are floating-supported by the elastic members 87 constituting the movable part so as to support the work W in a state where the pins are projected from the end face of the lower mold clamber 35 and contact the surface of the substrate 10 through the release film F. In the state of clamping the work W (see Fig. 8), the pins 86 are retracted in the lower mold clamber 35. Therefore, dropping the work W, which has been held by the upper mold 31 before being clamped, can be prevented.

Note that, in Fig. 27, when the decompression space is formed by sucking air by the pressure reducing section 45 through the air path 44, the sucking path is seemed like being closed, but the pins 86 are partially disposed, so pressure reduction is not hindered.

(Seventh Embodiment)

In the first embodiment, one of side surfaces of the work W (substrate 10) is resin-molded; on the other hand, in the present embodiment, both surfaces of the work W are resin-molded. In the following description, the characteristic points will be mainly explained

with reference to Figs. 33-36. Figs. 33-36 are schematic sectional views of the press section 130 of the present embodiment.

The work W of the present embodiment is formed into a wafer shape (plate shape) and includes: the substrate 10 having one surface 10a and an opposite surface 10b; and a plurality of ball-shaped bumps 11A and 11A (first parts and second parts) which are formed on the both surfaces 10a and 10b. The bumps 11A and 11A on the both surfaces 10a and 10b are resin-molded so as to form resin-molded parts 14 and 15 (see Fig. 36), so that the work W can be molded as a product (molded product).

The resin-molded wafer-shaped work W is called WLP (Wafer Level Package). Note that, the parts provided on the work W are not limited to the wiring bumps 11A, chip parts (e.g., semiconductor chips, MEMS chips, chip capacitors) may be provided thereon, and both of the wiring parts and chip parts may be provided thereon. The substrate 10 may be not only an ordinary substrate but also a carrier on which parts are temporarily mounted, a semiconductor wafer, etc.

In the present embodiment, the work W, which is not resin-molded and in which the parts (bumps 11A) on the both surfaces are exposed (see Fig. 33), or another work, whose one surface is resin-molded and in which the parts (bumps 11A) on the opposite surface are exposed (see Fig. 35), is separately supplied by the robot mechanism section 180 (see Fig. 1). Therefore, the press section 130 of the present embodiment has a plate-shaped first jig 12 (see Fig. 33) and a plate-shaped second jig 13 (see Fig. 35).

The jigs 12 and 13 are selectively attached to the lower face of the upper mold insert 37 when clamping the work W by the upper mold 31 and the lower mold 32. The jig 12 has a plurality of first openings 12a (see Fig. 33), whose size is larger than mounting ranges of the bumps

11A for semiconductor chips to be produced, which are formed in the surface 10a. In other words, the first openings 12a are formed by overlapping the work W and the jig 12 with each other with avoiding overlapping the parts, i.e., bumps 11A. The jig 13 has one second opening 13a (see Fig. 35), which is larger than the openings 12a.

The jig 12 is mounted on the surface 10a of the work W in a state where the bumps 11A are accommodated in the openings 12a (i.e., clearances with respect to the bumps 11A are secured by the openings 12a) (see Fig. 33). On the other hand, the jig 13 is mounted on the surface 10b of the work W in a state where the resin-molded part 15 is accommodated in the opening 13a (i.e., a clearance with respect to the resin-molded part 15 is secured by the opening 13a) (see Fig. 35). In the present embodiment, by using the jigs 12 and 13, the work W can be clamped with escaping (avoiding) the bumps 11A and the resin-molded part 15 (see Figs. 34 and 36).

The jigs 12 and 13 are exchangeable, so different products can be produced in the same mold set 30 by exchanging the jig. Note that, the jig 12 or 13 may be fixed to the upper mold 31.

In the present embodiment, the loader 190 overlaps the jig 12 or 13 with the work W, which has been transferred from the robot mechanism section 180, and then conveys them to the press section 130. Further, the loader 190 detaches the jig 12 or 13 from the molded work W, which has been transferred from the press section 130, and transfers the detached jig to the robot mechanism section 180. By preparing the jig 12 or 13 by the loader 190 as described above, the work W can be transferred into the press section 130 with the jig 12 or 13.

Successively, a resin molding method performed by the resin molding apparatus 100 of the present embodiment (resin molding method of the resin molding apparatus 100) will be explained.

Concretely, a method for separately forming the resin-molded parts 14 and 15 on the both surfaces (surfaces 10a and 10b) of the work W as a product (a two-stage molding method including a primary molding and a secondary molding) will be explained.

Firstly, the loader 190 accommodates the bumps 11A of the work W, which has conveyed by the robot mechanism section 180, in the openings 12a and disposes the jig 12 on the one surface 10a of the work W. In this case, to dispose the jig 12 by the loader 190, the robot mechanism section 180 may convey the work W only, so the robot mechanism section 180 whose conveyable weight is small can be employed, so that production cost of the resin molding apparatus can be reduced.

Next, the work W and the jig 12 are conveyed into the opened mold set 30, from the outside, by the work loader 56 (see Fig. 3), and the work W is transferred to the upper mold 31 together with the jig 12 (see Fig. 33). With this action, the work W can be held on the surface of the upper mold 31.

Concretely, the jig 12 is brought into contact with the lower face of the upper mold insert 37 in a state where the surface 10a of the work W faces toward the lower mold 32, and the work W (substrate 10) is sucked and held on the surface of the upper mold 31 (upper mold insert 37), by the work holding section (not shown), with the jig 12. Since the openings 12a for escaping the bumps 11A formed on the surface 10a of the work W (substrate 10) are formed in the jig 12, the bumps 11A, for example, can be protected. Note that, a recessed part may be formed in the lower face of the upper mold insert 37, without using the jig 12, so as to escape the bumps 11A.

Further, the film loader 57 (see Fig. 3) conveys the resin R and the release film F into the opened mold set 30, and then the resin R and the

release film F are transferred from the film loader 57 to the lower mold 32 (see Fig. 33). In this step, the flat release film F is deformed with conforming to the inner face of the cavity 33, the release film F is sucked and held on the surface of the lower mold 32 including the cavity 33, and the resin R is supplied to the cavity 33 of the lower mold as it is.

Note that, by using the release film F, resin leakage through a gap between the lower mold insert 34 and the lower mold clamber 35 can be prevented. Note that, in case that the resin R can be conveyed without the problem of the leakage, the release film F may be omitted.

Next, as shown in Fig. 34, the movable lower mold 32 is moved upward, all of the bumps 11A formed on the surface 10b are dipped into the resin R which has melted at a temperature of the mold set, and then the lower mold insert 34 is moved, with clamping the work W between the upper mold 31 and the lower mold 32, to a molding position. Then, the resin R filling the molding cavity C of the lower mold is thermally cured so as to resin-mold the work W. With this action, the resin-molded part 15 is formed on the surface 10b of the work W.

Further, the work W (molded product) is held on the upper mold 31 by the work holding section, and the mold set is opened in a state where the release film F is held on the lower mold 32 by the sucking sections 53 and 55. In this step, by using the release film F, the work W can be easily released from the mold. Further, as described above, the work W is conveyed to the work accommodating section 160, via the work examination/cooling section 140 and the curing section 150, and finally accommodated therein (see Fig. 1).

Next, the work W, in which the resin-molded part 15 has been formed on the surface 10b, is accommodated in the magazine, and the magazine is conveyed to the work supply section 110. In this step, the work W is previously inverted so as to form the resin-molded part 14 on

the surface 10a of the work W, so that the secondary molding is ready to perform. Note that, in case of forming the resin-molded part 14, the jig 12 is exchanged to the jig 13, and the above described molding steps are performed as well as the manner for forming the resin-molded part 15.

Next, the robot mechanism section 180 disposes the jig 13 onto the surface 10b of the work W in a state where the resin-molded part 15 of the work W, which has been conveyed to the loader 190, is accommodated in the opening 13a. In this case, a size of the opening 13a of the jig 13 is larger than that of a plane region of the resin-molded part 15, namely, the opening is broader than the upper face of the lower mold insert 34, which constitutes the molding cavity C for forming the resin-molded part 15.

Next, the work loader 56 (see Fig. 3) conveys the work W and the jig 13 into the opened mold set 30 from the outside and transfers the work W to the upper mold 31 together with the jig 13 (see Fig. 35). Since the opening 13a for escaping the resin-molded part 15 formed on the surface 10b of the work W (substrate 10), the resin-molded part 15, for example, can be protected. Note that, a recessed part may be formed in the lower face of the upper mold insert 37, without using the jig 13, so as to escape the resin-molded part 15.

Further, the film loader 57 (see Fig. 3) conveys the resin R and the release film F into the opened mold set 30, and then the resin R and the release film F are transferred from the film loader 57 to the lower mold 32 (see Fig. 35). In this step, the flat release film F is deformed with conforming to the inner face of the cavity 33, the release film F is sucked and held on the surface of the lower mold 32 including the cavity 33, and the resin R is supplied to the cavity 33 of the lower mold as it is.

The resin R is used to form the resin-molded part 14, so if an amount and quality of the resin are the same as those of the resin

forming the resin-molded part 15, the bumps 11A can be molded in the same shape. Note that, in the present embodiment, if the mounted parts, e.g., bumps 11A, on the substrate 10 have different heights, a suitable volume of the resin R may be used for each of the parts. In this case, different types of resins may be used so as to prevent forming warp caused by thickness variation of the molded parts or select suitable resins according to functions of the mounted parts.

Next, as shown in Fig. 36, the movable lower mold 32 is moved upward, all of the bumps 11A formed on the surface 10b are dipped into the resin R which has melted at the temperature of the mold set, and then the lower mold insert 34 is moved, with clamping the work W between the upper mold 31 and the lower mold 32, to the molding position. Then, the resin R filling the molding cavity C of the lower mold is thermally cured to resin-mold the work W. With this action, the resin-molded part 14 is formed on the surface 10a of the work W.

Further, the work W (molded product) is held on the upper mold 31 by the work holding section, and the mold set is opened in the state where the release film F is held on the lower mold 32 by the sucking sections 53 and 55. In this step, by using the release film F, the work W can be easily released from the mold. Further, as described above, the work W is conveyed to the work accommodating section 160, via the work examination/cooling section 140 and the curing section 150, and finally accommodated therein (see Fig. 1).

Further, end faces of the resin-molded parts 14 and 15 are ground to expose the bumps 11A, and the work is divided into pieces, each of which corresponds to one chip, by dicing, so as to produce packages (resin-molded products), in each of which the bumps are formed on the both surfaces. Note that, in case that the work W to be molded is constituted by the substrates 10, in each of

which the bumps 11A are formed on one surface only and whose the other surfaces are adhered to each other, packages, in each of which connection terminals are formed on one surface, can be efficiently produced by: peeling the substrates 10 from each other; and dividing the substrates into areas each of which corresponds to one chip.

In the present embodiment, the both surfaces 10a and 10b the plate-shaped work W can be resin-molded by the compression molding manner. Further, the resin mold can be performed by supplying the resin R to the cavity 33 of the lower mold (molding cavity C of the lower mold), so that large size works W too can be molded efficiently.

In case that the resin-molded part 14 is formed, by conveying the work W to the press section 130 without accommodating the work in the work accommodating section 160, after forming the resin-molded part 15 on one of surfaces of the work W, the resin-molded parts 14 and 15 can be continuously formed.

In the above described embodiment, the release film F may be conveyed in a state where a resin holding plate for flatly holding the resin R is sandwiched between the resin R and the release film F, instead of using the shutter section 70 for flatly holding the resin R and the release film F. The resin holding plate may be, for example, a metal plate, a glass plate, a silicon wafer, etc. or a structure member, e.g., lead frame, substrate. In this case, the resin holding plate may be removed after completing the resin molding or left in the package so as to use as a functional layer, e.g., heat radiating layer, electromagnetic shielding layer, filter layer, lens layer, wavelength conversion layer, gas permeation preventing layer, cable layer. By using the resin holding plate adhered on the work W, the resin R and the release film F can be conveyed in the flat state by such high-functionable plate, so that

high-functionable products can be easily produced. Note that, the resin holding plate may be used with the shutter section 70.

(Eighth Embodiment)

In the press section of the resin molding apparatus of the first embodiment, the mold set is opened and closed by a known clamping mechanism. On the other hand, in the present embodiment, the resin molding apparatus having a clamping mechanism for clamping a large work W (e.g., WLP) will be explained. In the resin molding apparatus of the present embodiment, closing mold can be precisely performed with highly keeping parallelism of a movable platen, and quality of a molded product can be improved by highly increasing a final resin pressure.

A preferred embodiment of the resin molding apparatus having the clamping mechanism of the present invention, which opens and closes the mold set, will be explained with reference to the accompanying drawings. The resin molding apparatus 201 comprises a mold set 204, which is constituted by an upper mold 202 and a lower mold 203, and a clamping mechanism 205 for opening and closing the mold set 204.

In Fig. 37, the clamping mechanism 205 is provided to a rectangular base section 206. The base section 206 and a fixed platen 207 are connected by tie bars 208, which are respectively located at corners (four corners, see Fig. 38). The upper mold 202 is sustained by a fixed platen 207, and the lower mold 203 is sustained on a front face (upper face) -side of a movable platen 209. The movable platen 209 is guided, in the vertical direction, by the tie bars 208 penetrating therethrough.

A ball screw mechanism 210 (first open/close mechanism), which is connected to the movable platen 209 and which closes the mold set 204, with the fixed platen 207, until reaching a first clamping force, is provided on a rear side of the movable platen 209.

Concretely, four screw shafts 211 are provided, on the inner side of the tie bars 208, in the base section 206, and the screw shafts 211 are respectively rotated by four first driving motors 212 (servo motors). The first driving motors 212 are synchronously driven, and their speeds can be highly precisely controlled by servo control. Four fixed nuts 213, which are screwed with the screw shafts 211, are provided on the rear side of the movable platen 209. In Fig. 38, the tie bars 208 and the screw shafts 211 are located at diagonal positions of the base section 206 (movable platen 209) at regular intervals. Note that, number of the ball screw mechanisms 210 is not limited as far as it is three or more.

A toggle link mechanism 214 (second open/close mechanism) is provided in a rear center part of the movable platen 209. The toggle link mechanism 214 is connected to the movable platen 209, closes the mold set with a second clamping force, which is greater than the first clamping force, and maintains a final resin pressure. Concretely, a screw shaft 215 and a second driving motor 216 (servo motor) for rotating the screw shaft 215 are provided in a center part of the base section 206. A movable nut 217 is screwed with the screw shaft 215. A link connecting part 218 is integrated with the movable nut 217. Note that, by using belt mechanisms, the driving motors 216 and 212 may be provided to a side part of the base section 206.

The toggle link mechanism 214 is a so-called booster mechanism and increases (amplifies) an output power of the second driving motor 216, by a toggle link structure constituted by link members described later, and the increased output power is applied to the movable platen 209. Concretely, an end of each of link members 219 is rotatably connected to the link connecting part 218. The other end of each of the link members 219 is rotatably connected to an upper vertex part of each of triangle links 220. One of bottom vertex parts of each of the triangle

links 220 is rotatably connected to the base section 206, and the other bottom vertex parts thereof is rotatable connected to one end of each of slide link members 221. The other end of each of the slide link members 221 is rotatably connected to each of connecting parts 209a provided on the rear face of the movable platen 209. With this structure, in the toggle link mechanism 214, the second driving motor 216, with which the movable nut 217 is screwed, actuates the connecting parts 209a provided on the rear face of the movable platen 209.

The first driving motors 212 and the second driving motor 216 are controlled by a control section 222. Pressure sensors 223 are respectively provided to the tie bars 208. The control section 222 detects the clamping pressure of the mold set 204 from data of the pressure sensors 223 and controls the first driving motors 212 and the second driving motor 216, so that the mold clamping action performed by the ball screw mechanisms 210 and the toggle link mechanism 214 is controlled.

Concretely, when starting the mold closing action, the control section 222 synchronously drives the first driving motors 212 and the second driving motor 216, clamps the work W supplied to the mold set 204, with the first clamping force, by the ball screw mechanisms 210 and the movable platen 209, changes a pressurizing state produced by the ball screw mechanisms 210 to another pressurizing state produced by the toggle link mechanism 214 and clamps the work with the second clamping force, which is greater than the first clamping force and applied to the movable platen 209 by the toggle link mechanism 214.

An example of the mold set 204 will be explained with reference to Fig. 40A. In the upper mold 202, an upper mold base 202a is supported by a fixed platen 7. An upper mold insert 202b is attached to the upper mold base 202a. A work holding section 202c, which sucks and

holds the work W in a state where the work and a clamping face are held level with each other, is formed in the upper mold insert 202b.

In the lower mold 203, a lower mold base 203a is supported by the movable platen 209. A recessed part is forming in a clamping face of the lower mold base 203a, a lower mold cavity piece 203b is supported in the recessed part, and a lower mold clasper 203c encloses the lower mold cavity piece and is biased and supported by coil springs 203d. The lower mold clasper 203c projects upward from an upper face of the lower mold cavity piece 203b, so that a lower mold cavity 203e is formed. The release film F covering the lower mold cavity 203e is sucked and held.

The release film F is sucked and held on the clamping face of the upper mold. The release film F has a thickness of about 0.5 mm, heat resistance, softness and extensibility, and can be easily peelable from the surface of the mold, so the preferable release film is, for example, PTFE film or ETEF film, PET film, FEP film, fluorine-impregnated glass cloth, polypropylene film, or single layer or multilayer film mainly composed of polychlorinated vinylidene.

Next, an example of the open/close action of the clamping mechanism 205 and the resin-molding action will be explained with reference to Figs. 37, 39A, 39B and 40A-40C.

In Fig. 37, the work W is supplied into the mold set 204, by a supply unit not shown, while opening the mold set 204. Note that, the cavity 203e of the lower mold 203 has been previously covered with the release film F, which is sucked and held thereon.

As shown in Fig. 40A, the work W (e.g., substrate on which semiconductor chips are mounted, semiconductor wafer) is sucked and held on the work holding section 202c of the upper mold 202, and the molding resin R (e.g., liquid resin, granular resin, particle resin (powder

resin), sheet resin, tablet resin) is supplied to the mold cavity 203e covered with the release film F. Note that, the resin R may be supplied to the mold cavity 203e together with the release film F.

When the mold closing action is started, the control section 222 synchronously actuates the first driving motors 212 and the second driving motor 216. In Fig. 39A, by actuating the first driving motors 212, the four screw shafts 211 of the ball screw mechanism 210 are rotated, and the movable platen 209, which is screw-fitted with the fixed nuts 213, is moved upward, with keeping parallelism with respect to the fixed platen 207, by the rotation of the screw shafts 211. Namely, the lower mold 203 (i.e., parting face thereof) is moved upward with keeping parallelism with respect to the upper mold 202 (i.e., parting face thereof).

By actuating the second driving motor 216, the movable nut 217 connected to the toggle link mechanism 214, which is screw-fitted with the screw shaft 215, is moved upward, connection links 219, which are respectively connected to the both ends of the link connecting part 218, are inclined sideward, and the triangle links 220 are turned to be raised, so that the slide link members 221 are pressed upward. In this step, by forming a space between the slide link members 221 and the connecting parts 209a, no load is applied to the toggle link mechanism 214 through the movable platen 209.

As shown in Fig. 40B, the coil springs 203d are contracted in a state where the lower mold clasper 203c contacts the work W (substrate) and the upper mold insert 202b through the release film F. Therefore, a tightly closed space (decompression space, closed space) is formed in the mold set 204, and the mold cavity 203e of the lower mold (cavity space) is filled with the resin R. In this step, by moving the movable platen 209 upward with keeping the

parallelism, the movable platen is moved close to the fixed platen 207 with keeping parallelism with respect thereto. Therefore, the clamping action of the upper mold 202 and the lower mold 203 can be performed with keeping the parallelism. Note that, when the resin R is extended toward an outer edge of the cavity 203e to fill the cavity 203e (cavity space) like a case of supplying the resin to the center part of the cavity 203e as shown in Fig. 40, a mold clamping speed can be suitably controlled by the ball screw mechanism 210.

When the mold clamping action is continued and the four pressure sensors 223 respectively detect the first clamping force (e.g., total of 36 tons, pressure of the resin R), the first driving motors 212 are stopped, but the second driving motor 216 is continuously actuated. With this action, the pressurizing unit for pressurizing the movable platen 209 is changed from the ball screw mechanism 210 to the toggle link mechanism 214 for taking over the pressurizing state, and the toggle link mechanism further pressurizes until the pressure sensors 223 respectively detect the second clamping force (e.g., total 125 tons, final resin pressure), which is greater than the first clamping force. With this action, in Fig. 39B, the movable nut 217 is further moved upward along the screw shaft 215, and the slide link members 221, which are connected to the connecting parts 209a of the movable platen 20, are raised with the triangle links 220. Note that, the movable platen 209 may be pressurized by both of the ball screw mechanism 210 and the toggle link mechanism 214 without stopping the first driving motors 212. Further, the ball screw mechanism 210 may be actuated without pressurizing.

In the mold set 204, as shown in Fig. 40C, the pressure applied to the movable platen 209 is increased in the state where the upper mold

insert 202b contacts the lower mold clasper 203c, so that the coil springs 203d of the lower mold clasper 203c are contracted, the pressure of the resin R filling the mold cavity 203e is maintained at the final resin pressure, and the resin R is thermally cured.

As described above, the work W supplied to the mold set 204 is clamped, by the movable platen 209 actuated by the ball screw mechanism 210, with the first clamping force, so that the tightly closed space is formed in the mold set 204. By changing the pressurizing unit from the ball screw mechanism 210 to the toggle link mechanism 214, the movable platen 209 is clamped, until reaching the second clamping force which is greater than the first clamping force, by the toggle link mechanism 214, so that the resin R can be thermally cures at the final resin pressure.

Therefore, the mold clamping action can be highly precisely performed with keeping the parallelism of the movable platen 209, and the final resin pressure can be set at high pressure, so that quality of the molded products can be improved. Namely, the mold clamping is performed by the ball screw mechanism 210 with highly precisely controlling a driving amount until starting the step of filling the resin R in which the parallelism and the clamping speed are especially important; and the clamping and pressurizing actions are performed, by the toggle link mechanism 214 in which an output power of the second driving motor 216 can be increased, after completing the step of filling the resin R in which the pressurizing force is especially important, so that performances required before and after closing the mold set 204 can be obtained.

The toggle link mechanism 214 for increasing the output power of the second driving motor 216 is used as the clamping mechanism 205 for opening and closing the mold set 204; thus, in

comparison with a case that the mold opening and closing actions are performed by only a linear driving mechanism without using, for example, a booster mechanism, the servo motors (i.e., first driving motors 212 and second driving motor 216) whose output powers are smaller can be employed; further, the screw shaft 211 can be thinner; so, the resin molding apparatus can be smaller in size, electric power consumption can be reduced and a production cost of the apparatus can be reduced. Therefore, this resin molding apparatus can be applied to resin-mold the large work W without increasing costs.

In Figs. 40A-40C, the work W is held by the upper mold 202 of the mold set 204 and the resin R is supplied to the cavity formed in the lower mold 203, but the inverted structure may be employed.

Namely, in Fig. 41A, the upper mold base 202a of the upper mold 202 is sustained by the fixed platen 207. A recessed part is formed in the clamping face of the upper mold base 202a, an upper mold cavity piece 202d is sustained in the recessed part, and an upper mold clamber 202e enclosing the upper mold cavity piece is biased and suspended by coil springs 202f. The upper mold clamber 202e is downwardly projected from a lower face of the upper mold cavity piece 202d, so that a cavity 202g of the upper mold is formed. The release film F is sucked and held to cover the cavity 202g.

In the lower mold 203, the lower mold base 203a is supported by the movable platen 209. A lower mold insert 203f is attached to the lower mold base 203a. A work holding section 203g for sucking and holding the work W, in a state where the work is held level with the clamping face, is formed in the lower mold insert 203f.

As shown in Fig. 41A, in the state of opening the mold set 204, the work W (e.g., substrate on which semiconductor chips are mounted,

semiconductor wafer) is supplied to the work holding section 203g of the lower mold 203, and the molding resin R (e.g., liquid resin, granular resin, particle resin (powder resin), sheet resin, tablet resin) is supplied. The resin R may be previously supplied onto the work W before supplying the work to the work holding section 203g. The release film F covering the cavity 202g of the upper mold 202 is sucked and held.

By starting the mold closing action by actuating the ball screw mechanism 210, the coil springs 202f are contracted, in a state where the upper mold clamber 202e contacts the work W (substrate) and the lower mold insert 203f with release film F, as shown in Fig. 41B. With this action, the tightly closed space (decompression space, closed space) is formed in the mold set 204, and the resin R is supplied into the cavity 202g of the upper mold.

When the clamping force of the mold set 204 reaches the first clamping force and the pressurizing unit is changed from the ball screw mechanism 210 to the toggle link mechanism 214, the pressure applied to the movable platen 209 is increased, in the state where the upper mold clamber 202e contacts the lower mold insert 203f, and the coil springs 202f of the upper mold clamber 202e are contracted as shown in Fig. 41C, so that the resin pressure in the cavity is increased to a final clamping pressure and a prescribed resin pressure is applied to the resin R and maintained so as to thermally cure the resin R.

With the above described structure, the control section 222 synchronously controls the ball screw mechanism 210 and the toggle link mechanism 214 when the mold closing action is started, the work W supplied to the mold set 204 is clamped, with the first clamping force, by the ball screw mechanism 210 through the movable platen 209, so that the tightly closed space can be formed in the mold set 204 by closing the mold set 204. By changing the pressurizing unit from the ball screw

mechanism 210 to the toggle link mechanism 214 and clamping the movable platen 209, with the second clamping force greater than the first clamping force, by the toggle link mechanism 214, the resin R can be thermally cured at the final resin pressure.

Therefore, the resin molding apparatus 201 can be applied for resin-molding large works W and made smaller in size, the parallelism and the clamping speed of the mold set 204 can be precisely maintained, and a production cost of the resin molding apparatus can be reduced, as well as the previously described structure. Note that, a hydraulic press mechanism may be employed instead of the toggle link mechanism 214. In this case too, quality of molded products can be improved by keeping the parallelism the movable platen 209 while closing the mold set, precisely closing the mold set and increasing the final resin pressure to the high pressure. Further, other booster mechanisms may be employed instead of the toggle link mechanism 214.

Further, the above described ball screw mechanism 210 may actuate the movable platen 209 so as to open and close the mold set, and the toggle link mechanism 214 may pressurize and actuate the only the lower mold cavity piece 203b shown in Fig. 40. In this case, through-holes are formed in the lower mold base 203a and the movable platen 209, and a pressurizing member is penetrated through the through-holes and connected to the connecting parts 209a, so that the lower mold cavity piece 203b can be separately moved. With this structure, the pressurizing force applied to the resin R from the lower mold cavity piece 203b and the clamping force can be separately controlled, so that the clamping force can be restrained with optionally increasing the resin pressure, and the resin molding step can be performed, without reducing the resin pressure, even if output power of the entire apparatus is restrained. A clamping manner performed by the

ball screw mechanism 210 only and another clamping manner performed by the ball screw mechanism 210 and the toggle link mechanism 214 may be selected according to the required pressurizing force. Further, by moving only the lower mold cavity piece 203b upward to project from the lower mold 203, the mold can be easily cleaned.

The present invention has been explained on the basis of the embodiments, but the present invention is, of course, not limited to the embodiments and can be variously modified without departing the scope of the invention.

In the first embodiment, the resin R is granular resin. Besides the granular resin, the resin R may be, for example, film-shaped resin or film-shaped resins having different sizes and being stacked like a mountain.

Concretely, the work W and the resin R shown in Figs. 28 and 29 may be employed for resin molding. As shown in these drawings, the work W, in which the chip parts 11 are flip-chip-mounted on the substrate 10, may be employed. In this case, film-shaped resins or granular resin being formed into a center convex shape may be employed as the resin R. In this case, when the resin molding is performed after supplying the work W and the resin R, the chip parts 11 are sequentially dipped into the melted resin R from the center chip part 11, as shown in Fig. 29, while further clamping the closed mold set, as well as the above described embodiment. In this step, the melted resin R flows outwardly from the center part of the substrate 10. Therefore, in case of resin-molding the work W in which the chip parts 11 are flip-chip-mounted, spaces between the chip parts 11 and the substrate 10 can be easily under-filled.

In the first embodiment, the resins R having the same amount are simultaneously supplied (mounted) onto the release film F including the

resin supply areas by a plurality of the troughs 123. A dispenser having a plurality of nozzles capable of supplying resin having a property of fluidity, e.g., granular resin or liquid resin, may be employed instead of the troughs 123. By the dispenser, extending the time required to supply the resin, which is caused by increase of amount of the resin to be supplied (increase of the resin supply areas), can be prevented. Further, for example, if the nozzles are dispersedly disposed with respect to the resin supply areas, the resin can be evenly supplied.

In the first embodiment, when the clamping mechanism opens and closes the mold set, the lower mold cavity piece 34 is moved relative to the lower mold clamber 35 by extending and contracting the elastic members 50. Besides the clamping mechanism, another mechanism for changing the height of the lower mold clamber 35 may be separately provided.

For example, a mechanism for changing the height of the cavity, in which the lower mold cavity piece 34 is connected to a driving source and movable relative to the lower mold base 46 of the mold set 30 and in which the lower mold clamber 35 is fixed to the lower mold base 46, may be employed.

Further, another mechanism for changing the height of the cavity, which has a wedge section including a plurality of thickness adjusting blocks (tapered blocks) being stacked and having boundary faces formed into tapered faces (slope faces) and which is provided between the lower mold cavity piece 34 and the lower mold base 46, may be employed, and one of the thickness adjusting blocks is slidably moved by a driving source, e.g., air cylinder, motor.

In the first embodiment, air is sucked from the holding face 64 of the film loader 57, which is connected to the sucking section 67 (see Fig. 3). The sucking structure is not limited to this structure, the film loader

57a may have the recessed parts 66 in which air can be sucked, and the recessed parts 66 may be filled with air and pressurized. Concretely, the film loader 57a shown in Figs. 30-32 can be used. Note that, in Figs. 30-32, the upper mold 31 (see Fig. 3) is omitted.

By using the film loader 57a, when the release film F on which the resin R is conveyed as shown in Fig. 30, air is sucked and pressurized through an air path 65b, which is included in a system separated from the system including an air path 65a whose function is the same as that of the air path 65 shown in Fig. 3 and which connects a sucking/pressurizing section 67b to the recessed parts 66. Concretely, the release film F is prevented from being bent by the weight of the resin R by balancing pressure generated by the weight of the resin and applied to the release film F with a sucking force (negative pressure) applied by the sucking section 67a.

By using the film loader 57a, when the release film F is disposed to the cavity 33 as shown in Figs. 31 and 32, air is supplied, from the sucking/pressurizing section 67b, to fill the cavity 33 with air, so that wrinkles of the release film F can be stretched. Therefore, wrinkles of the release film F can be squashed with being outwardly pushed toward an end face of the cavity piece 34, and the release film F can be disposed with conforming to the shape of the cavity 33 by sucking air from the parts corresponding to the corners of the cavity 33, so that forming wrinkles can be more securely prevented. Note that, in this step, air being supplied into the recessed parts 66 may be hot air so as to prevent forming wrinkles without decreasing the temperature of the mold. In this case, the release film F is also heated, so that the release film F can securely conform to the shape of the cavity 33.

Note that, in the first embodiment, the film loader 57 disposes the

release film F, on which the resin R is loaded, onto the lower mold 32, but the present invention is not limited to this manner, so the release film may be disposed on the upper mold 31. In this case, the lower mold 32 and the upper mold 31 of the mold set 30 of the resin molding apparatus 100 are inverted, and the work W is molded with the resin filling the cavity in the state where the lower mold (a first mold of the present invention) and the upper mold (a second mold of the present invention), in which the cavity is formed, are closed. The upper mold may comprises: a cavity piece for configuring the bottom of the cavity; a clamper for configuring the sides of the cavity; a movable section for moving the cavity piece relative to the clamper; and a sucking section for sucking the release film F covering the end faces of the cavity piece and the clamper, as well as the lower mold 32 of the first embodiment. The film loader conveys the release film F in the flat state and disposes the release film F on the end faces of the cavity piece and the clamper in the flat state with holding the end face of the cavity piece level with that of the clamper, as well as the film loader 57 of the first embodiment. In the resin molding apparatus 100, the release film can be disposed without forming wrinkles even if the release film is not conveyed to the press section 130 together with the resin R.

Further, the granular resins R are supplied by the resin supply sections 120. The resin supply sections 120 may supply liquid resin as the resin R. In this case, each of the resin supply sections 120 supplies the liquid resins R onto the work W, and then the robot mechanism section 180 may convey the work W on which the resins have been supplied to the press section 130. Further, the resin supply sections 120 may supply sheet-shaped resins as the resins R. In this case, the robot mechanism section 180 may convey the sheet-shaped resins R supplied by the resin supply section 120 to the press section 130 in a state of

stacking on the release film F or the work W or a state of being alone.

Further, if the work W has a surface to be protected, the work may be a mere plate-shaped work, e.g., wafer, on which no chip parts 11 or no bumps 11A are mounted. The surfaces of such work may be uneven surfaces or flat surfaces.

CLAIMS

[Claim 1]

A resin molding apparatus, in which a work is resin-molded by closing an upper mold and a lower mold having a cavity and filling the cavity with a resin, the resin molding apparatus being characterized in,

that the lower mold comprises: a lower mold cavity piece for configuring a bottom of the cavity; a lower mold clamper for configuring sides of the cavity; a film loader capable of holding and conveying a film on which the resin has been loaded; and a sucking section for sucking the film, which is disposed so as to cover an end face of the lower mold cavity piece and an end face of the lower mold clamper,

that the lower mold cavity piece is capable of moving relative to the lower mold clamper,

that the film loader disposes the film on the lower mold, in which the end face of the lower mold cavity piece is held level with the end face of the lower mold clamper, so that the resin is located above the lower mold cavity piece, and

that the sucking section sucks and holds the film so as to conform to an inner face of the cavity and supplies the resin to the cavity.

[Claim 2]

The resin molding apparatus according to claim 1,

wherein the film loader has a hand section including: a holding face for holding the film; a recessed part being formed in the holding face so as to act as a clearance of the resin loaded on the film; and an air path being communicated to a part of the holding face, which is located around the recessed part, so as to suck the film.

[Claim 3]

The resin molding apparatus according to claim 2,
wherein the loader has a rolled shutter section for opening and closing the holding face, the film is held and conveyed by the shutter section in a state where the shutter section is closed, and the film is disposed onto the lower mold in a state where the shutter section is opened.

[Claim 4]

The resin molding apparatus according to any one of claims 1-3,
wherein the loader has a heating section and a cooling section.

[Claim 5]

The resin molding apparatus according to claim 1,
wherein an upper part of the lower mold cavity piece is separable,
an upper part of the lower mold clamper are separable,
the upper part of the lower mold cavity piece and the upper part of the lower mold clamper are connected by a connecting member, and
the loader conveys the film, which covers the end face of the upper part of the lower mold cavity piece and the upper end face of the upper part of the lower mold clamper in a state where the end face of the upper part of the lower mold cavity piece and the upper end face of the upper part of the lower mold clamper are level with each other.

[Claim 6]

The resin molding apparatus according to claim 1,
further comprising a ring-shaped upper plate and a ring-shaped lower plate,
wherein the lower plate has a step-shaped part, which is formed in

an outer edge part, recessed from an upper plate-side face and extended in a circumferential direction,

a film plate section is constituted by the upper plate and the lower plate, the film is pinched between the plates, the step-shaped part of the lower plate is fitted to an inner part of the upper plate, and

the lower mold clamber has a step-shaped part, which is formed in an outer edge part, recessed from the end face and extended in a circumferential direction, the film plate section is fitted by fitting the step-shaped part of the lower mold clamber to an inner part of the lower plate.

[Claim 7]

The resin molding apparatus according to claim 1,

wherein an upper part of the lower mold cavity piece is separable, and

the upper part of the lower mold cavity piece is floating-supported so as to make the end face of the upper part of the lower mold cavity piece level with the end face of the lower mold clamber while opening the molds.

[Claim 8]

The resin molding apparatus according to any one of claims 1-7,

wherein the lower mold clamber has a plurality of pins, which are floating-supported and capable of projecting from the end face of the lower mold clamber, and

the plurality of pins are projected from the end face of the lower mold clamber so as to support the work and retracted in the lower mold clamber while clamping the work.

[Claim 9]

A resin molding apparatus, in which a work is resin-molded by closing a first mold and a second mold having a cavity and filling the cavity with a resin, the resin molding apparatus being characterized in,

that the second mold comprises: a cavity piece for configuring a bottom of the cavity; a clamper for configuring sides of the cavity; a movable section for moving the cavity piece relative to the clamper; a sucking section for sucking a film, which is disposed so as to cover the end face of the cavity piece and the end face of the clamper, and

that a film loader conveys the film in a flat state and disposes the film on the end face of the cavity piece and the end face of the clamper, in the flat state, with maintaining the end face of the cavity piece level with the end face of the clamper.

[Claim 10]

A resin molding method being performed in a resin molding apparatus, in which a work is resin-molded by closing an upper mold and a lower mold having a cavity and filling the cavity with a resin, the resin molding method being characterized in,

that the lower mold comprises: a lower mold cavity piece for configuring a bottom of the cavity; a lower mold clamper for configuring sides of the cavity; a film loader capable of holding and conveying a film on which the resin has been loaded; and a sucking section for sucking the film, which is disposed so as to cover an end face of the lower mold cavity piece and an end face of the lower mold clamper, and

that the resin molding method comprises:

(a) a step of disposing the film, by the film loader, to the lower mold, in which the end face of the lower mold cavity piece and the end face of the lower mold clamper are held level with each other, so as to

dispose the resin above the lower mold cavity piece; and

(b) a step of relatively moving the lower mold cavity piece with respect to the lower mold clasper, with sucking the film by the sucking section, so as to form the cavity, thereby the film is sucked and held with conforming to an inner face of the cavity and the resin is supplied to the cavity in a state where the resin is loaded on the film

[Claim 11]

A resin molding apparatus comprising a clamping mechanism for opening and closing molds, the resin molding apparatus being characterized in,

that the clamping mechanism comprises:

a movable platen for supporting at least one mold of a mold set;

a fixed platen for supporting the other mold thereof;

a first open/close mechanism cooperating with the movable platen and closing the mold set, with the fixed platen, until reaching a first clamping force;

a second open/close mechanism cooperating with the movable platen, closing the mold set until reaching a second clamping force greater than the first clamping force and maintaining a final resin pressure; and

a control section for controlling open-close actions of the first open/close mechanism and the second open/close mechanism, and

that the control section synchronously actuates the first open/close mechanism and the second open/close mechanism when starting the mold-closing action, the control section controls clamping the work supplied to the mold by: clamping the work with the first clamping force applied by the first open/close mechanism via the movable platen;

making the second open/close mechanism take over a pressurizing state of the first open/close mechanism; and clamping the work with the second clamping force, which is greater than the first clamping force and applied by the second open/close mechanism via the movable platen.

[Claim 12]

The resin molding apparatus according to claim 11,

wherein a plurality of the first open/close mechanisms are disposed, along an outer periphery of the movable platen, at regular intervals, and the second open/close mechanism is disposed in a center part of the movable platen.

[Claim 13]

A resin molding apparatus comprising: a fixed platen supporting one of molds of a mold set; a movable platen capable of moving upward and downward, the movable platen supporting the other mold of the mold set; and a clamping mechanism for opening and closing the mold set, the resin molding apparatus being characterized in,

that the clamping mechanism comprises:

a toggle link mechanism being linked with the center of the movable platen; and

at least three ball screw mechanisms being disposed, along the outer periphery of the movable platen, at regular intervals, the ball screw mechanisms being connected to the movable platen at the disposed positions.

[Claim 14]

A resin molding method being performed in a resin molding apparatus, comprising: a movable platen for supporting one of molds of

a mold set; a fixed platen for supporting the other mold thereof; and a clamping mechanism for opening and closing the molds for resin-molding, the resin molding method comprising:

- a step of supplying a work and a resin to the opened mold set;

- a step of synchronously actuating a first open/close mechanism and a second open/close mechanism, which are cooperated with the movable platen, and closing the mold set, by the first open/close mechanism, until the work is clamped with a first clamping force;

- a step of making the second open/close mechanism take over the pressurizing state of the first open/close mechanism, and moving the movable platen until the mold set is clamped with a second clamping force greater than the first clamping force; and

- a step of thermally curing the resin, with maintaining a final resin pressure generated by clamping the mold set with the second clamping force.