

TITLE OF THE INVENTION

Resin Molded Product Manufacturing Apparatus, Resin Molding System, and
Resin Molded Product Manufacturing Method

BACKGROUND OF THE INVENTION

5 Field of the Invention

The present invention relates to a resin molded product manufacturing
apparatus, a resin molding system, and a resin molded product manufacturing method.

Description of the Background Art

10 For example, Japanese Patent Laying-Open No. 2014-233882 discloses a resin
molding apparatus comprising a ball screw mechanism linked with a movable platen to
close a mold with a fixed platen to a first mold clamping force, and a toggle link
mechanism linked with the movable platen to close the mold to a second mold
clamping force larger than the first mold clamping force to maintain a final resin
pressure.

15 SUMMARY OF THE INVENTION

However, the resin molding apparatus described in Japanese Patent
Laying-Open No. 2014-233882 needs to incorporate the two mechanisms of the ball
screw mechanism and the toggle link mechanism, and accordingly has a complicated
configuration.

20 Further, in the toggle link mechanism of the resin molding apparatus described
in Japanese Patent Laying-Open No. 2014-233882, when a plurality of coupled link
members in a state bent at a link becomes closer to a straight state, a force applied to an
object to be molded with resin rapidly increases, and accordingly, an applicable
pressure application range is narrowed and the thickness of a lead frame or the like
25 included in the object to be molded with resin is accordingly limited.

According to an embodiment disclosed herein, there can be provided a resin
molded product manufacturing apparatus comprising: a first platen; a pair of press
frames fixed to the first platen so as to extend vertically below the first platen and be
spaced in a horizontal direction; a second platen spaced from and facing the first platen

in a vertical direction; an intermediate plate between the first platen and the second platen; an ascending and descending mechanism configured to move the second platen in the vertical direction; and an arm extending in one direction and having one end coupled to the second platen, the arm having attached thereto from the one toward the other ends thereof a first bearing member followed by a second bearing member followed by a third bearing member, the arm having the one end with a first block attached thereto via the first bearing member, the first bearing member being disposed movably within a first opening of the first block, the first block being coupled to the second platen and allowing the one end of the arm to move to draw an arc between a top dead center and a bottom dead center with a center of the third bearing member of the other end of the arm serving as a fulcrum as the second platen moves in the vertical direction, a second block being attached between the one end of the arm and the other end of the arm via the second bearing member, the second bearing member being disposed movably within a second opening of the second block, a ganging mechanism being coupled between the intermediate plate and the second block so as to cause the intermediate plate to gang with the second block, the intermediate plate being movable in the vertical direction via the ganging mechanism along with an operation of the arm.

According to an embodiment disclosed herein, there can be provided a resin molding system comprising the above resin molded product manufacturing apparatus.

According to an embodiment disclosed herein, there can be provided a resin molded product manufacturing method using the above resin molded product manufacturing apparatus.

The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic elevation of a main portion of a resin molded product manufacturing apparatus according to an embodiment.

Fig. 2 is a schematic side perspective view of a main part of the resin molded

product manufacturing apparatus of the embodiment shown in Fig. 1.

Fig. 3 is a schematic perspective view of a main part of the resin molded product manufacturing apparatus of the embodiment shown in Fig. 1.

Fig. 4 is an enlarged schematic perspective view of a main part of the resin molded product manufacturing apparatus of the embodiment shown in Fig. 3.

Fig. 5 is a schematic enlarged cross section taken along a line V-V of Fig. 4.

Fig. 6 is a schematic side perspective view of a main part of the resin molded product manufacturing apparatus of the embodiment shown in Figs. 2 to 4.

Fig. 7 is a schematic perspective view for illustrating a part of a manufacturing process of a resin molded product manufacturing method of an embodiment.

Fig. 8 is a schematic side perspective view for illustrating a part of the manufacturing process of the resin molded product manufacturing method of the embodiment.

Fig. 9 is a schematic perspective view of a first mold chase holder and a second mold chase holder shown in Figs. 7 and 8.

Fig. 10 is a schematic cross section for illustrating a part of a manufacturing process of a resin molded product manufacturing method of an embodiment.

Fig. 11 is a schematic cross section for illustrating a part of the manufacturing process of the resin molded product manufacturing method of the embodiment.

Fig. 12 is a schematic cross section for illustrating a part of the manufacturing process of the resin molded product manufacturing method of the embodiment.

Fig. 13 is a schematic plan view of a resin molding system of an embodiment.

Fig. 14 is a schematic cross section for illustrating a part of a manufacturing process of a resin molded product manufacturing method of an embodiment.

Fig. 15 is a schematic cross section for illustrating a part of the manufacturing process of the resin molded product manufacturing method of the embodiment.

Fig. 16 is a schematic perspective view for illustrating a part of the manufacturing process of the resin molded product manufacturing method of the embodiment.

Fig. 17 is a schematic side perspective view for illustrating a part of the manufacturing process of the resin molded product manufacturing method of the embodiment.

Fig. 18 is an enlarged schematic perspective view of a main part of the resin molded product manufacturing apparatus according to the embodiment shown in Fig. 17.

Fig. 19 is a schematic perspective view for illustrating a part of a manufacturing process of a resin molded product manufacturing method of an embodiment.

Fig. 20 is a schematic side perspective view for illustrating a part of the manufacturing process of the resin molded product manufacturing method of the embodiment.

Fig. 21 is an enlarged schematic perspective view of a main part of the resin molded product manufacturing apparatus according to the embodiment shown in Fig. 20.

Fig. 22 is a schematic cross section for illustrating a part of a manufacturing process of a resin molded product manufacturing method of an embodiment.

Fig. 23 is a schematic side view for illustrating a distance of a movement of a first bearing member in a first opening when an arm has one end, or a point where force is applied, moved between a top dead center and a bottom dead center.

Fig. 24 is a schematic side view for illustrating a distance of a movement of a second bearing member in a second opening when the arm has one end, or the point where force is applied, moved between the top dead center and the bottom dead center.

Fig. 25 is a schematic cross section for illustrating a part of a manufacturing process of a resin molded product manufacturing method of an embodiment.

Fig. 26 is a schematic plan view for illustrating an example of a positional relationship between a ball screw and a servomotor of a resin molded product manufacturing apparatus of an embodiment.

Fig. 27 is a schematic plan view for illustrating an example of a positional relationship between the ball screw and the servomotor of the resin molded product

manufacturing apparatus of the embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, an embodiment will be described. In the drawings used for describing the embodiment, the same reference characters denote the same parts or
 5 corresponding parts.

Fig. 1 is a schematic elevation of a main portion of a resin molded product manufacturing apparatus according to an embodiment. As shown in Fig. 1, a resin molded product manufacturing apparatus 1 according to the embodiment includes a
 10 first platen 11, a second platen 12, and a third platen 13. Paired press frames 17 each have one end fixed to first platen 11 so as to extend vertically below first platen 11 and be spaced from each other in the horizontal direction. Paired press frames 17 each have the other end fixed to a respective one of opposite ends of third platen 13. It should be noted that first platen 11, third platen 13 and press frame 17 may be integrally formed as, for example, a casting.

15 In a region between first platen 11 and third platen 13 in a direction in which pressed frame 17 extends (i.e., a vertical direction), second platen 12 is disposed such that it is spaced from and faces each of first platen 11 and third platen 13.

In a region between first platen 11 and second platen 12 in the direction in which pressed frame 17 extends, an intermediate plate 91 is disposed such that it is
 20 spaced from and faces each of first platen 11 and second platen 12.

In a region between second platen 12 and third platen 13 in the direction in which pressed frame 17 extends, paired ball screws 100 are disposed each with one end fixed to second platen 12 and the other end fixed to third platen 13. In the present embodiment, ball screw 100 functions as an ascending and descending mechanism that
 25 allows second platen 12 to move in the vertical direction. Ball screws 100 are spaced apart from each other in the horizontal direction.

To intermediate plate 91 is fixed an inner surface of one end of a plate-shaped lifter plate 103, for example, so as to extend vertically below intermediate plate 91. On an outer surface of lifter plate 103, a linear motion rail 102, which is, for example,

an elongate member and extends vertically below lifter plate 103, is fixed. To each of the pair of press frames 17, a plurality of linear motion blocks 101 are attached such that they are spaced in the vertical direction. The plurality of linear motion blocks 101 are each fixed to a side wall portion of press frame 17.

5 Linear motion rail 102 is attached to each of the plurality of linear motion blocks 101 so as to be movable in the vertical direction. Accordingly, intermediate plate 91 can move vertically upward or downward as lifter plate 103 fixed to intermediate plate 91 moves vertically upward or downward. A linear motion guide 150 is composed of linear motion rail 102 and linear motion block 101. It is also
10 possible to attach linear motion rail 102 to press frame 17 and attach linear motion block 101 to lifter plate 103.

Fig. 2 is a schematic side perspective view of a main part of resin molded product manufacturing apparatus 1 of the embodiment shown in Fig. 1. Fig. 3 is a schematic perspective view of a main part of resin molded product manufacturing apparatus 1 of the embodiment shown in Fig. 1. Fig. 4 is an enlarged schematic perspective view of a main part of resin molded product manufacturing apparatus 1 of the embodiment shown in Fig. 3.

As shown in Fig. 2, resin molded product manufacturing apparatus 1 according to the embodiment includes an inner plate 116 and an outer plate 118. On each of
20 opposite sides of inner plate 116, outer plate 118 extending in the vertical direction is disposed. A first recess 118a, which is a relatively large, local, horizontal recess, is provided in upper and lower parts of each outer plate 118, and a second recess 118b, which is a relatively small, local, horizontal recess, is provided in a center part of outer plate 118 between two vertical recesses 118a. A resilient member 113 such as a
25 spring capable of expanding and contracting in the vertical direction is disposed in first recess 118a. A protrusion 116a is fitted in second recess 118b via a spacer 117.

As shown in Figs. 3 and 4, resin molded product manufacturing apparatus 1 according to the embodiment includes a lower linear motion guide 120. As shown in Figs. 3 and 4, lower linear motion guide 120 includes a lower linear motion rail 123,

and a plurality of lower linear motion blocks 124 attached to allow lower linear motion rail 123 to move in the vertical direction. Each of the plurality of lower linear motion blocks 124 is fixed to inner plate 116 extending in the vertical direction. Lower linear motion rail 123 is fixed to lifter plate 103.

5 As shown in Figs. 2 to 4, resin molded product manufacturing apparatus 1 according to the embodiment also includes an arm 104 vertically below inner plate 116 and outer plate 118. Arm 104 has a shape extending in one direction, and has attached thereto from one toward the other ends thereof a first bearing member 105, a second bearing member 106, and a third bearing member 121 spaced apart from one another in
10 the stated order.

In the present embodiment, two first bearing members 105 are disposed such that they are spaced from each other in the direction of a normal to the plane of the sheet of Fig. 2. Arm 104 is sandwiched between the two first bearing members 105, and the two first bearing members 105 are attached to a first shaft 109 rotatably about
15 first shaft 109 with respect to arm 104. First shaft 109 is attached to arm 104 so as to extend in a direction traversing a direction in which arm 104 extends.

The two first bearing members 105 are each disposed in a first opening 107 of each of two, mutually spaced side walls of a first block 114. Each of the two first bearing members 105 is attached so as to be movable in first opening 107 with respect
20 to first block 114 in the horizontal direction. Thus, arm 104 will have one end with first block 114 attached thereto via first bearing member 105.

As first bearing member 105, for example, a roller follower which is a roller bearing using needle rollers can be used. This allows first bearing member 105 to have an inner race fixed to first shaft 109 serving as a point of arm 104 where force is
25 applied, and have an outer race with an outer surface brought into contact with an inner surface of first opening 107 of first block 114. Furthermore, in that case, it is preferable to set the size of first opening 107 such that when second platen 12 is moved vertically upward, the lower surface of the inner surface of first opening 107 of first block 114 contacts the outer surface of the outer race of first bearing member 105, and

the upper surface of the inner surface of first opening 107 of first block 114 does not contact the outer surface of the outer race of first bearing member 105. Furthermore, when first bearing member 105 is a roller follower, it can reduce more a frequency of supplying a lubricant than a rack and pinion mechanism.

5 In the present embodiment, two second bearing members 106 are also spaced from each other in the direction of the normal to the plane of the sheet of Fig. 2. Arm 104 is sandwiched between the two second bearing members 106, and the two second bearing members 106 are attached to a second shaft 110 rotatably about second shaft 110 with respect to arm 104. Second shaft 110 is attached to arm 104 so as to extend
10 in a direction traversing the direction in which arm 104 extends.

 The two second bearing members 106 are each disposed in a second opening 108 of each of two, mutually spaced side walls of a second block 115. Each of the two second bearing members 106 is attached so as to be movable in second opening 108 with respect to second block 115 in the horizontal direction. Thus, second block
15 115 is attached to a center portion of arm 104 via second bearing member 106.

 As second bearing member 106, for example, a roller follower which is a roller bearing using needle rollers can be used. This allows second bearing member 106 to have an inner race fixed to second shaft 110 serving as a point of action of arm 104, and an outer race with an outer surface brought into contact with an inner surface of
20 second opening 108 of second block 115. Furthermore, in that case, it is preferable to set the size of second opening 108 such that when second platen 12 is moved vertically upward, the upper surface of the inner surface of second opening 108 of second block 115 contacts the outer surface of the outer race of second bearing member 106, and the lower surface of the inner surface of second opening 108 of second block 115 does not
25 contact the outer surface of the outer race of second bearing member 106. Furthermore, when second bearing member 106 is a roller follower, it can reduce more a frequency of supplying the lubricant than a rack and pinion mechanism.

 In the present embodiment, two third bearing members 121 are also spaced from each other in the direction of the normal to the plane of the sheet of Fig. 2. Arm

104 is sandwiched between the two third bearing members 121, and the two third bearing members 121 are attached to a third shaft 111 rotatably about third shaft 111 with respect to arm 104. Third shaft 111 is attached to arm 104 so as to extend in a direction traversing the direction in which arm 104 extends.

5 In contrast to first bearing member 105 and second bearing member 106, third bearing member 121 is not movable in the horizontal direction with respect to third block 119. Third block 119 is fixed to resin molded product manufacturing apparatus 1 of the embodiment, and is not movable with respect to press frame 17, for example.

10 As third bearing member 121, for example, a deep groove ball bearing can be used. In that case, the inner ring of third bearing member 121 can be fixed to third shaft 111 of arm 104, and the outer ring of third bearing member 121 can be fixed to third block 119.

In Fig. 2, lower linear motion rail 123 and lower linear motion block 124 above inner plate 116 are not shown for convenience of explanation.

15 In resin molded product manufacturing apparatus 1 of the embodiment, as shown in Fig. 3, first block 114 is fixed to second platen 12 by a linking member 122 such as a plate. Accordingly, first block 114 also moves in the vertical direction as second platen 12 is moved by ball screw 100 in the vertical direction. As first block 114 moves in the vertical direction, one end of arm 104 to which first bearing member 105 is attached can move so as to draw an arc between the top dead center and the bottom dead center such that a portion of arm 104 to which first shaft 109 is attached serves as a point where force is applied and the other end of arm 104 to which third shaft 111 is attached serves as a fulcrum.

20 Fig. 5 is a schematic enlarged cross section taken along a line V-V of Fig. 4. As shown in Fig. 5, lifter plate 103 has an inner surface facing an outer surface of inner plate 116 and an outer surface of outer plate 118 in parallel. As has been described above, lower linear motion block 124 and second block 115 are fixed to inner plate 116. Lower linear motion rail 123 and outer plate 118 are fixed to lifter plate 103. Further, lower linear motion rail 123 is attached to lower linear motion block 124 so as to be

movable in the vertical direction.

Lifter plate 103, lower linear motion rail 123, and lower linear motion block 124 act as a ganging mechanism 160 that links between intermediate plate 91 and second block 115 so as to cause intermediate plate 91 to gang with second block 115.

5 It is also possible to attach lower linear motion rail 123 to inner plate 116 and lower linear motion block 124 to lifter plate 103.

Thus, as shown in the plan view of Fig. 6, as second platen 12 is moved by ball screw 100 in the vertical direction, with arm 104's other end (or third shaft 111) serving as a fulcrum, arm 104's one end serving as a point where force is applied (or first shaft 109) makes an arcuate movement, and thereby a portion of arm 104 serving as a point of action, or second shaft 110, also makes an arcuate movement. At the time, first bearing member 105 moves in the horizontal direction within first opening 107 of first block 114, and second bearing member 106 moves in the horizontal direction within second opening 108 of second block 115. Further, first block 114 and second block 115 move in the vertical direction. Note that third block 119 and third bearing member 121 do not move.

For example, as shown in Fig. 6, when a linear distance between first shaft 109 and third shaft 111 is represented as L and a linear distance between second shaft 110 and third shaft 111 is represented as a half thereof, i.e., $L/2$, first block 114 will move a distance H in the vertical direction and second block 115 will move a half thereof, i.e., $H/2$, in the vertical direction.

Fig. 6 also does not show lower linear motion rail 123 and lower linear motion block 124 over inner plate 116 for convenience of explanation.

Hereinafter, with reference to Figs. 7 to 25, a resin molded product manufacturing method according to an embodiment, which is an example of a resin molded product manufacturing method by using resin molded product manufacturing apparatus 1 according to an embodiment, will be described. First, as shown in the schematic perspective view of Fig. 7 and the schematic side perspective view of Fig. 8, a first mold chase holder 14 is installed on the side of a lower surface of first platen 11

and on the side of a lower surface of intermediate plate 91, and a second mold chase holder 15 is installed on the side of an upper surface of second platen 12 and on the side of a upper surface of intermediate plate 91. At the time, arm 104's one end, or the point where force is applied (or first shaft 109), is located at a bottommost point in the vertical direction, or the bottom dead center. When arm 104's one end, or the point where force is applied (or first shaft 109), is located at the bottom dead center, arm 104's point where force is applied (or first shaft 109) is located vertically below arm 104's point of action (or second shaft 110), and arm 104's point of action (or second shaft 110) is located vertically below arm 104's fulcrum (or third shaft 111).

Further, as shown in Figs. 7 and 8, arm 104 is provided on each of opposite side surfaces of resin molded product manufacturing apparatus 1 according to the embodiment. When arm 104's one end, or the point where force is applied (or first shaft 109), is located at the bottom dead center, in a plan view of a side surface of manufacturing apparatus 1, a direction in which a first arm 104 provided on one side surface of manufacturing apparatus 1 extends traverses a direction in which a second arm 104 provided on the other side surface of manufacturing apparatus 1 extends.

Fig. 9 is a schematic perspective view of first mold chase holder 14 and second mold chase holder 15 shown in Figs. 7 and 8. First mold chase holder 14 comprises a first heat insulating member 22 on a side closer to first platen 11 and also comprises in a first heater plate 23 provided on a side closer to second platen 12 a first mold chase holder heater 25 configured to heat a first mold chase (not shown). Further, first mold chase holder 14 further comprises a first plate 21 on a side closer to first platen 11 than first heat insulating member 22, and also comprises a first side wall 24 extending vertically downward from a peripheral edge of first heater plate 23. In the present embodiment, first heater plate 23 incorporates four first mold chase holder heaters 25 spaced from one another and extending in the horizontal direction.

Second mold chase holder 15 comprises a second heat insulating member 32 on a side closer to second platen 12 and also comprises in a second heater plate 33 provided on a side closer to first platen 11 a second mold chase holder heater 35

configured to heat a second mold chase (not shown). Further, second mold chase holder 15 further comprises a second plate 31 on a side closer to second platen 12 than second heat insulating member 32, and also comprises a second side wall 34 extending vertically upward from a peripheral edge of second heat insulating member 32. In the present embodiment, second heater plate 33 incorporates four second mold chase holder heaters 35 spaced from one another and extending in the horizontal direction.

Then, as shown in the schematic cross section shown in Fig. 10, a first mold chase 41 is fixed on first heater plate 23 of first mold chase holder 14 and a second mold chase 42 is fixed on second heater plate 33 of second mold chase holder 15. A cavity 43 is provided on a side of second mold chase 42 closer to first mold chase 41. Thus, first mold chase 41 is attached to a lower surface of first platen 11 and a lower surface intermediate plate 91, and second mold chase 42 is attached to an upper surface of second platen 12 and an upper surface of intermediate plate 91.

Subsequently, as shown in the schematic cross section shown in Fig. 11, a mold release film 52 is placed so as to cover cavity 43 of second mold chase 42.

Subsequently, by vacuuming a space inside cavity 43 covered with mold release film 52, as shown in the schematic cross section shown in Fig. 12, mold release film 52 is brought into close contact with a surface of second mold chase 42 defining cavity 43.

Subsequently, from a support member supply device 201 of a supply module 1001 of a resin molding system 1000 of the embodiment shown in a schematic plan view shown in Fig. 13, a support member 51, which is an object to be molded by resin molding, is supplied on an upper side of a transport mechanism 301.

Support member 51 can include, for example, a lead frame, a substrate, an interposer, a semiconductor substrate (such as a silicon wafer), a metal substrate, a glass substrate, a ceramic substrate, a resin substrate, a wired substrate, and the like that can support a semiconductor chip, a chip-shaped electronic component, or a film (including a conductive film, an insulating film, and a semiconductor film). Further, support member 51 is not particularly limited in shape, and support member 51 may have, for example, a circular or quadrangular surface. In addition, support member 51

may or may not include wiring. In addition, support member 51 may include a carrier of a plate-shaped member used for FO-WLP (fan out wafer level package) or FO-PLP (fan out panel level package).

Subsequently, transport mechanism 301 supplied with support member 51
 5 moves along a rail 401 provided in supply module 1001 for movement in a first direction, in which the rail extends, and thus reaches a resin material supply device 202.

Subsequently, resin material supply device 202 supplies a resin material 61 to a lower side of transport mechanism 301 so that transport mechanism 301 holds a solid matter of resin material 61 under transport mechanism 301. Accordingly, at this stage,
 10 transport mechanism 301 holds support member 51 on the upper side and holds resin material 61 on the lower side.

Subsequently, with support member 51 held on the upper side and resin material 61 held on the lower side, transport mechanism 301 moves in a second direction, which is a direction perpendicular to the first direction, along a rail 402 provided for
 15 movement in the second direction, and reaches a resin sealing module 1002 of resin molding system 1000. Transport mechanism 301 that has reached resin sealing module 1002 moves in the first direction along a rail 403 provided for movement in the first direction and thus reaches resin molded product manufacturing apparatus 1 of the embodiment. While Fig. 13 shows four resin sealing modules 1002, this is not a
 20 limitation, and the number of resin sealing modules 1002 can be increased or decreased.

Subsequently, as shown in the schematic cross section shown in Fig. 14, support member 51 is moved from transport mechanism 301 to first mold chase 41, and resin material 61 is supplied from transport mechanism 301 onto mold release film 52
 25 closely attached to second mold chase 42. In the present embodiment, support member 51 including a semiconductor substrate 51a and a semiconductor chip 51b on semiconductor substrate 51a is used.

Subsequently, first mold chase 41 is heated by first mold chase holder heater 25 of first heater plate 23 and second mold chase 42 is heated by second mold chase

holder heater 35 of second heater plate 33. At the time, first platen 11 is heated by first platen heater 18. Note that as second mold chase holder heater 35 heats second mold chase 42, resin material 61 is melted, and, as shown in the schematic cross section shown in Fig. 15, a flowable resin 71 is produced.

5 Then, as shown in the schematic perspective view of Fig. 16, the schematic side perspective view of Fig. 17, and the enlarged schematic perspective view of a main part shown in Fig. 18, by driving ball screw 100, second platen 12 is moved vertically upward.

10 In the configuration shown in Figs. 16 to 18, arm 104's one end, or the point where force is applied (or first shaft 109), is located at the midpoint between the top dead center and the bottom dead center. When arm 104's one end, or the point where force is applied (or first shaft 109), is located at the midpoint, arm 104's point where force is applied (or first shaft 109), point of action (or second shaft 110) and fulcrum (or third shaft 111) extend in the horizontal direction, and are equal in level in the vertical direction. Accordingly, when arm 104's one end, or the point where force is applied (or first shaft 109), is located at the midpoint, in a plan view of a side surface of manufacturing apparatus 1, a direction in which first arm 104 provided on one side surface of manufacturing apparatus 1 extends is parallel to a direction in which second arm 104 provided on the other side surface of manufacturing apparatus 1 extends.

20 Further, while arm 104's one end, or the point where force is applied (or first shaft 109), moves between the top dead center and the bottom dead center, the movement of first bearing member 105 in first opening 107 is reversed. For example, when first bearing member 105 moves from the Fig. 8 state (or the bottom dead center) to the Fig. 17 state, first bearing member 105 moves within first opening 107 to a right side on the plane of the sheet of each figure, whereas when first bearing member 105 moves from the Fig. 17 state to the Fig. 20 state, which will be described hereinafter, (or the top dead center), first bearing member 105 moves within first opening 107 to a left side on the plane of the sheet of each figure. At the time, second bearing member 106 also moves within second opening 108 in the same direction and is similarly reversed. With such a

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configuration, it is possible to reduce the horizontal length of first opening 107 of first block 114 and the horizontal length of second opening 108 of second block 115, and hence prevent resin molded product manufacturing apparatus 1 according to the embodiment from having an increased size.

5 Subsequently, as shown in the schematic perspective view of Fig. 19, the schematic side perspective view of Fig. 20 and the enlarged schematic perspective view of a main part shown in Fig. 21, by further driving ball screw 100, second platen 12 is further moved vertically upward. As a result, as shown in the schematic cross section of Fig. 22, first mold chase 41 and second mold chase 42 are clamped together. This
10 brings flowable resin 71 into contact with a surface of support member 51, as shown in Fig. 22.

At the time, arm 104's one end, or the point where force is applied (or first shaft 109), is located at a topmost point in the vertical direction, or the top dead center. When arm 104's one end, or the point where force is applied (or first shaft 109), is
15 located at the top dead center, arm 104's point where force is applied (or first shaft 109) is located vertically above arm 104's point of action (or second shaft 110), and arm 104's point of action (or second shaft 110) is located vertically above arm 104's fulcrum (or third shaft 111).

Further, when arm 104's one end, or the point where force is applied (or first
20 shaft 109), is located at the top dead center, in a plan view of a side surface of manufacturing apparatus 1, a direction in which first arm 104 provided on one side surface of manufacturing apparatus 1 extends traverses a direction in which second arm 104 provided on the other side surface of the manufacturing apparatus 1 extends.

Note that, as described above, when arm 104's one end, or the point where force
25 is applied (or first shaft 109) moves from the bottom dead center to the top dead center through the midpoint, second platen 12 is moved vertically upward as ball screw 100 is driven, and intermediate plate 91 moves vertically upward as lifter plate 103 moves vertically upward.

At that time, as shown in Fig. 6, first block 114 moves a distance in the vertical

direction which is larger than second block 115 does, and accordingly, second platen 12 coupled to first block 114 also moves a distance in the vertical direction which is larger than intermediate plate 91 coupled to second block 115 does. That is, when arm 104's one end, or the point where force is applied (or first shaft 109) moves between the top dead center and the bottom dead center, lifter plate 103 moves a distance and second platen 12 moves a different distance. As a result, second mold chase 42 installed at second mold chase holder 15 attached to second platen 12 moves a distance in the vertical direction upward larger than first mold chase 41 installed at first mold chase holder 14 attached to intermediate plate 91 does, and first mold chase 41 and second mold chase 42 can thus be clamped together.

Furthermore, as first platen 11 is fixed and does not move in the vertical direction, second mold chase 42 installed at second mold chase holder 15 attached to intermediate plate 91 moves a distance in the vertical direction upward larger than first mold chase 41 installed at first mold chase holder 14 attached to first platen 11 does, and first mold chase 41 and second mold chase 42 can thus be clamped together.

First opening 107 of first block 114 and second opening 108 of second block 115 each extend in the horizontal direction. While arm 104's one end, or the point where force is applied (or first shaft 109), moves between the top dead center and the bottom dead center, first bearing member 105 moves within first opening 107 in the horizontal direction and second bearing member 106 moves within second opening 108 in the horizontal direction. When arm 104's one end, or the point where force is applied (or first shaft 109), moves between the top dead center and the bottom dead center, first bearing member 105 moves within first opening 107 in the horizontal direction a distance L1 as indicated in the schematic side view of Fig. 23 and second bearing member 106 moves within second opening 108 in the horizontal direction a distance L2 as indicated in the schematic side view of Fig. 24, and a relationship of $L1 > L2$ is established.

Furthermore, as has been described above, resilient member 113 is disposed in first recess 118a of outer plate 118 and protrusion 116a of inner plate 116 and second

recess 118b of outer plate 118 are mated with spacer 117 posed therebetween to couple inner plate 116 and outer plate 118 together. With such a configuration, second block 115 and intermediate plate 91 can be ganged together via resilient member 113.

Accordingly, in that case, if support member 51 is placed on each of first mold chase 41 and second mold chase 42 with support member 51 on first mold chase 41 and support member 51 on second mold chase 42 having a difference in thickness, the difference in thickness can be adjusted by resilient member 113 expanding and contracting in the vertical direction.

Subsequently, after flowable resin 71 is set, second platen 12 is moved vertically downward. As a result, as shown in the schematic cross section shown in Fig. 25, support member 51 has a surface sealed with a set resin 81, that is, a resin molded product 82 is manufactured.

Resin molded product 82 manufactured as described above is transported from resin molded product manufacturing apparatus 1 by transport mechanism 301 shown in Fig. 13. Then, transport mechanism 301 holding resin molded product 82 moves to rail 402 along rail 403 provided in resin sealing module 1002. Then, transport mechanism 301 moves along rail 402 in the second direction to a storage module 1003 of resin molding system 1000 of the embodiment. Transport mechanism 301 that has reached storage module 1003 moves to a resin molded product storage device 203 along a rail 404 provided in storage module 1003 for movement in the first direction. Thereafter, resin molded product 82 is stored from transport mechanism 301 to resin molded product storage device 203.

Furthermore, as shown in the schematic plan views of Figs. 26 and 27, resin molded product manufacturing apparatus 1 according to the embodiment may comprise a first ball screw 100a and a second ball screw 100b configured to move second platen 12 in the vertical direction, and a first servomotor 141a configured to drive first ball screw 100a and a second servomotor 141b configured to drive second ball screw 100b. Note that if a belt is stretched between and over first ball screw 100a and first servomotor 141a and a belt is stretched between and over second ball screw 100b and

second servomotor 141b in order to drive first ball screw 100a and second ball screw 100b, then, in view of preventing resin molded product manufacturing apparatus 1 from having an increased size, for example, as shown in Fig. 26, it is preferable that a direction 1100 in which first ball screw 100a and second ball screw 100b are aligned
 5 traverse a direction 1200 in which arm 104 extends and that first servomotor 141a and second servomotor 141b be positioned on the same side with respect to second platen 12.

Further, as an exemplary variation of the resin molding system of the embodiment shown in Fig. 13, an embodiment can be indicated as an example in which
 10 storage module 1003 is not employed and resin molded product storage device 203 is provided in supply module 1001. In that case, a single transport mechanism can supply support member 51 from supply module 1001 to resin sealing module 1002, and store resin molded product 82 manufactured by resin molded product manufacturing apparatus 1 to resin molded product storage device 203 in supply module 1001.

15 Further, as an exemplary variation of the resin molding system of the embodiment shown in Fig. 13, an embodiment can also be indicated as an example in which resin material supply device 202 is provided in storage module 1003. In that case, a transport mechanism (not shown) can collectively supply mold release film 52 previously cut and resin material 61 from storage module 1003 to resin molded product
 20 manufacturing apparatus 1 installed in resin sealing module 1002, and recover mold release film 52 after resin molded product 82 is manufactured by resin molded product manufacturing apparatus 1.

Resin molded product manufacturing apparatus 1 of the embodiment described above can dispense with a toggle link mechanism, and when it is compared with the
 25 resin molding apparatus described in Japanese Patent Laying-Open No. 2014-233882, the former can have a simplified configuration and allows pressure to be applied in a wider range.

while embodiments have thus been described, it is also initially planned to combine the configuration of each embodiment described above with another, as

appropriate.

While embodiments of the present invention have been described, it should be understood that the embodiments disclosed herein have been described for the purpose of illustration only and in a non-restrictive manner in any respect. The scope
5 of the present invention is defined by the terms of the claims, rather than the description above, and is intended to include any modifications within the meaning and scope equivalent to the terms of the claims.

INDUSTRIAL APPLICABILITY

An embodiment disclosed herein can provide a resin molded product
10 manufacturing apparatus, a resin molding system, and a resin molded product manufacturing method.

CLAIMS

1. A resin molded product manufacturing apparatus comprising:
 - a first platen;
 - a pair of press frames fixed to the first platen so as to extend vertically below the first platen and be spaced in a horizontal direction;
 - 5 a second platen spaced from and facing the first platen in a vertical direction;
 - an intermediate plate between the first platen and the second platen;
 - an ascending and descending mechanism configured to move the second platen in the vertical direction;
 - a first mold chase provided on the intermediate plate and a second mold chase
 - 10 provided on the second platen; and
 - an arm extending in one direction and having one end coupled to the second platen,
 - the arm having attached thereto from the one toward the other ends thereof a first bearing member followed by a second bearing member followed by a third bearing
 - 15 member,
 - the arm having the one end with a first block attached thereto via the first bearing member,
 - the first bearing member being disposed movably within a first opening of the first block,
 - 20 the first block being coupled to the second platen and allowing the one end of the arm to move to draw an arc between a top dead center and a bottom dead center with a center of the third bearing member of the other end of the arm serving as a fulcrum as the second platen moves in the vertical direction,
 - a second block being attached between the one end of the arm and the other end
 - 25 of the arm via the second bearing member,
 - the second bearing member being disposed movably within a second opening of the second block,
 - a ganging mechanism being coupled between the intermediate plate and the

second block so as to cause the intermediate plate to gang with the second block,
30 the intermediate plate being movable in the vertical direction via the ganging
mechanism along with an operation of the arm.

2. The resin molded product manufacturing apparatus according to claim 1,
wherein

the ganging mechanism includes a lifter plate fixed to the intermediate plate so
as to extend vertically below the intermediate plate, and a linear motion guide attached
5 between the lifter plate and the press frame and including a linear motion rail extending
in the vertical direction and a linear motion block movable in the vertical direction with
respect to the linear motion rail,

the second block is coupled to the lifter plate, and

the intermediate plate is movable in the vertical direction via the lifter plate
10 along with an operation of the arm.

3. The resin molded product manufacturing apparatus according to claim 2,
wherein when the one end of the arm moves between the top dead center and the
bottom dead center, the lifter plate moves a distance and the second platen moves a
different distance.

4. The resin molded product manufacturing apparatus according to any one of
claims 1 to 3, further comprising a coupling member configured to couple the first
block and the second platen.

5. The resin molded product manufacturing apparatus according to any one of
claims 1 to 4, wherein

the ascending and descending mechanism includes a first ball screw and a
second ball screw configured to move the second platen in the vertical direction, and a
5 first servomotor configured to drive the first ball screw and a second servomotor
configured to drive the second ball screw,

a direction in which the first ball screw and the second ball screw are aligned traverses the direction in which the arm extends, and

10 the first servomotor and the second servomotor are positioned on a same side with respect to the second platen.

6. The resin molded product manufacturing apparatus according to any one of claims 1 to 5, wherein the arm extends in the horizontal direction at a midpoint between the top dead center and the bottom dead center.

7. The resin molded product manufacturing apparatus according to any one of claims 1 to 6, wherein

5 the first opening and the second opening extend in the horizontal direction, and while the one end of the arm moves between the top dead center and the bottom dead center, the first bearing member moves within the first opening in the horizontal direction and the second bearing member moves within the second opening in the horizontal direction.

8. The resin molded product manufacturing apparatus according to claim 7, wherein when the one end of the arm moves between the top dead center and the bottom dead center, the first bearing member moves a larger distance within the first opening in the horizontal direction than a distance that the second bearing member moves within the second opening in the horizontal direction.

9. The resin molded product manufacturing apparatus according to any one of claims 1 to 8, wherein while the one end of the arm moves between the top dead center and the bottom dead center, a movement of the first bearing member within the first opening is reversed.

10. A resin molding system comprising a resin molded product manufacturing apparatus according to any one of claims 1 to 9.

11. A resin molded product manufacturing method using a resin molded product manufacturing apparatus according to any one of claims 1 to 9, comprising:

attaching the first mold chase to the intermediate plate;

attaching the second mold chase to the second platen; and

5 clamping the first mold chase and the second mold chase together.