

TITLE OF THE INVENTION

Resin Molding Apparatus and Resin Molded Product Manufacturing Method

BACKGROUND OF THE INVENTION

5 Field of the Invention

The present disclosure relates to a resin molding apparatus and a resin molded product manufacturing method.

Description of the Background Art

10 For example, Japanese Patent Laying-Open No. 11-260844 (Patent Literature 1) describes a semiconductor resin-sealing apparatus that automatically properly controls the apparatus by determining whether incomplete filling or a hole defect has been caused by abnormality of characteristics of a resin or abnormality of the apparatus by monitoring force applied to a plunger with the force being distinguished between injection resistance force and sliding resistance force.

15 SUMMARY OF THE INVENTION

The semiconductor resin-sealing apparatus described in Patent Literature 1 determines whether or not abnormality of the resin has occurred based on comparison between injection resistance force during molding and a threshold value (a slide threshold value) obtained from a load cell below the plunger when the plunger is
20 moved up under the control by an apparatus drive controller.

A resin molded product may be manufactured by aligning plungers of the semiconductor resin-sealing apparatus along one direction to form a plunger row and providing a single-row plunger row or a multiple-row plunger row. When the same threshold value is used for both of a case of the single-row plunger row and a case of
25 the multiple-row plunger row, however, appropriate transfer output may not be applied to the plunger.

An embodiment disclosed herein provides a resin molding apparatus including a molding die, a plunger row configured to be capable of transferring a resin to the molding die, a detector configured to be capable of detecting a detection value relating

to transfer output of the plunger row, and a controller configured to be capable of controlling the transfer output. The resin molding apparatus is adapted to a single-row plunger row or a multiple-row plunger row. The controller can change a calibration value for calibration of the detection value detected by the detector so as to generate the transfer output in accordance with the number of rows in the plunger row.

The embodiment disclosed herein provides a resin molded product manufacturing method of manufacturing a resin molded product with the resin molding apparatus, and the resin molded product manufacturing method includes setting an object to be molded (an object) in the molding die, clamping the molding die, resin molding the object, and opening the molding die.

The embodiment disclosed herein can provide a resin molding apparatus and a resin molded product manufacturing method that can more accurately grasp transfer output.

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 plan view of an apparatus for manufacturing a resin molded product in an embodiment.

Fig. 2 is a schematic perspective view of a resin molding apparatus in the embodiment.

Fig. 3 is a partial schematic cross-sectional view of the resin molding apparatus in the embodiment.

Fig. 4 is a schematic side view of an exemplary transfer drive mechanism included in the resin molding apparatus in the embodiment.

Fig. 5 is a schematic plan view of the transfer drive mechanism shown in Fig. 4.

Fig. 6 is a schematic side view of another exemplary transfer drive mechanism included in the resin molding apparatus in the embodiment.

Fig. 7 is a schematic plan view of the transfer drive mechanism shown in Fig. 6.

Fig. 8 is a flowchart of a method of manufacturing a resin molded product in the embodiment.

Fig. 9 is a partial schematic cross-sectional view illustrating an exemplary step of determining a calibration value.

5 Fig. 10 is a block diagram of a main part of the resin molding apparatus in the embodiment.

Fig. 11 is a partial schematic cross-sectional view illustrating an exemplary step of setting an object.

10 Fig. 12 is a schematic plan view of an exemplary second die used in the resin molding apparatus in the embodiment.

Fig. 13 is a partial schematic cross-sectional view illustrating an exemplary step of setting an object.

Fig. 14 is a partial schematic cross-sectional view illustrating a clamping step in the method of manufacturing a resin molded product in the embodiment.

15 Figs. 15 and 16 are partially enlarged schematic cross-sectional views illustrating transfer of a resin into a cavity by movement of a plunger.

Fig. 17 is a schematic plan view of another exemplary second die used in the resin molding apparatus in the embodiment.

20 Fig. 18 is a flowchart of an exemplary operation for control of transfer output of a plunger row by a controller of the resin molding apparatus in the embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment will be described below. The same or corresponding elements in the drawings referred to in the description of the embodiment have the same reference characters allotted.

25 Fig. 1 shows a schematic plan view of an apparatus for manufacturing a resin molded product in an embodiment. As shown in Fig. 1, the apparatus for manufacturing a resin molded product in a first embodiment includes a molding module A, a loader module B, and an unloader module C.

Molding module A includes a mold mechanism portion 1000 that can

resin-mold an object such as a semiconductor chip mounted on a leadframe. Loader module B includes a loader 2000 that can supply an object and a resin to molding module A. Unloader module C includes an unloader 3000 that can take out a resin molded product from molding module A. Loader 2000 and unloader 3000 are
5 movable in a direction shown with an arrow in Fig. 1.

Molding module A and loader module B are removably coupled to each other by such a coupling mechanism as a bolt or a pin. Molding module A and unloader module C are also removably coupled to each other by such a coupling mechanism as a bolt or a pin.

10 Though the apparatus for manufacturing a resin molded product in the embodiment shown in Fig. 1 includes two molding modules A, the number of molding modules A can be adjusted to increase or decrease in accordance with a production volume. The apparatus for manufacturing a resin molded product in the embodiment may include, for example, one molding module A or molding modules A increased in
15 number to four. The apparatus for manufacturing a resin molded product in the embodiment can be configured such that the number of molding modules A can be increased or decreased.

In the apparatus for manufacturing a resin molded product in the embodiment shown in Fig. 1, molding module A, loader module B, and unloader module C are
20 arranged in the order shown in Fig. 1. The apparatus for manufacturing a resin molded product may be constituted, for example, of one parent unit in which molding module A, loader module B, and unloader module C are integrated and a single child unit or a plurality of child units each including molding module A alone. Single molding module A can also be regarded as the apparatus for manufacturing a resin
25 molded product in the embodiment.

Fig. 2 shows a schematic perspective view of a resin molding apparatus in the embodiment. The resin molding apparatus in the embodiment shown in Fig. 2 is arranged in mold mechanism portion 1000 of the apparatus for manufacturing a resin molded product in the embodiment shown in Fig. 1.

As shown in Fig. 2, the resin molding apparatus in the embodiment includes a first platen 200, a second platen 400, a movable platen 300, and a tie bar 500. Second platen 400 is opposed to first platen 200 at a distance therefrom.

5 Movable platen 300 is located between first platen 200 and second platen 400 and movable between first platen 200 and second platen 400 with respect to first platen 200 along tie bar 500.

Tie bar 500 is a rod-shaped member that extends between first platen 200 and second platen 400. Tie bar 500 has one end fixed to first platen 200 and the other end fixed to second platen 400.

10 The resin molding apparatus in the embodiment shown in Fig. 2 includes a first die holder 30 attached to first platen 200, a second die holder attachment block 50 attached to movable platen 300, a second die holder 40 attached to second die holder attachment block 50, a transfer drive mechanism 60 within second die holder attachment block 50, and a clamping mechanism 600 between movable platen 300 and
15 second platen 400. Second die holder 40 is attached to movable platen 300 with second die holder attachment block 50 being interposed.

Fig. 3 shows a partial schematic cross-sectional view of the resin molding apparatus in the embodiment. As shown in Fig. 3, the resin molding apparatus in the embodiment includes a first die 10 as a molding die held by first die holder 30 and a
20 second die 20 as a molding die held by second die holder 40.

Clamping mechanism 600 can clamp first die 10 and second die 20 by moving movable platen 300 with respect to first platen 200 and pressing first die 10 and second die 20.

First die holder 30 includes a first plate 31 and a first assistance block 32.
25 First plate 31 is attachable to first platen 200 and includes a heat insulating plate and a heater plate in this order from a side of first platen 200. First assistance block 32 can fix first die 10 under first plate 31.

Second die holder 40 includes a second assistance block 41 and a second plate 42. Second plate 42 is attachable to second die holder attachment block 50 and

includes a heat insulating plate and a heater plate in this order from a side of second die holder attachment block 50. Second assistance block 41 can fix second die 20 onto second plate 42.

5 First die 10 includes a first recess 11, a cull 12, and a first die plate 13. First recess 11 may be in a shape in conformity with a shape of a resin-molded object. Cull 12 serves as a reservoir of a resin before transfer of the resin to the object. First die plate 13 can be fixed to first plate 31 of first die holder 30.

10 Second die 20 includes a second recess 21, a pot 22, and a second die plate 23. Second recess 21 may be in a shape in conformity with a shape of a resin-molded object. Pot 22 serves as a portion where a resin used for resin molding of an object is set. Second die plate 23 can be fixed to second plate 42 of second die holder 40.

15 Fig. 4 shows a schematic side view of an exemplary transfer drive mechanism included in the resin molding apparatus in the embodiment. As shown in Fig. 4, transfer drive mechanism 60 in the embodiment includes a first transfer drive shaft 63a and a first detector 66a such as a load cell on first transfer drive shaft 63a. Transfer drive mechanism 60 in the embodiment includes a third transfer drive shaft 63c and a third detector 66c such as a load cell on third transfer drive shaft 63c.

20 Transfer drive mechanism 60 in the embodiment includes a plunger unit support plate 62 on first detector 66a and third detector 66c and a plunger unit 61 on plunger unit support plate 62.

25 Plunger unit 61 includes a plunger 64 for injection of a resin into a molding die and a plunger unit main body 65. Plunger 64 is a rod-shaped member that linearly extends in a Z-axis direction. In the example shown in Fig. 4, plunger 64 has a tip end 740 located outside plunger unit main body 65 and the other tip end 740 (not shown) located inside plunger unit main body 65.

Fig. 5 shows a schematic plan view of transfer drive mechanism 60 in the embodiment. Fig. 5 is a schematic plan view when transfer drive mechanism 60 shown in Fig. 4 is viewed from tip end 740 of plunger 64.

As shown in the plan view in Fig. 5, plungers 64 as being aligned in an X-axis

direction constitute a single-row plunger row 641. As shown in the plan view in Fig. 5, single-row plunger row 641 is constructed such that tip ends 740 of plungers 64 are located on an arbitrary straight line 741.

5 As shown in the plan view in Fig. 5, plunger row 641 is located in one region R1 of two regions R1 and R2 delimited by a centerline C-C that extends in the X-axis direction and equally divides a width in a Y-axis direction of plunger unit main body 65. Straight line 741 that passes through tip ends 740 of plungers 64 that constitute plunger row 641 and extends in the X-axis direction is located in region R1.

10 Single-row plunger row 641 or straight line 741 may be located in the other region R2 of two regions R1 and R2 delimited by centerline C-C of plunger unit main body 65. Such a construction that single-row plunger row 641 or straight line 741 is located in any one of region R1 and region R2 is demanded for various reasons such as low-volume high-variety production.

15 As shown in the plan view in Fig. 5, transfer drive mechanism 60 includes first transfer drive shaft 63a, a second transfer drive shaft 63b, and third transfer drive shaft 63c. As shown in the plan view in Fig. 5, first transfer drive shaft 63a, third transfer drive shaft 63c, and second transfer drive shaft 63b are located in this order in the X-axis direction.

20 As shown in the plan view in Fig. 5, in transfer drive mechanism 60 in the embodiment, a center 631c of third transfer drive shaft 63c is located in a portion other than a straight line 632 that passes through a center 631a of first transfer drive shaft 63a and a center 631b of second transfer drive shaft 63b.

25 As shown in the plan view in Fig. 5, transfer drive mechanism 60 includes first detector 66a between first transfer drive shaft 63a and plunger unit support plate 62, a second detector 66b between second transfer drive shaft 63b and plunger unit support plate 62, and third detector 66c between third transfer drive shaft 63c and plunger unit support plate 62.

Transfer drive mechanism 60 can move up and down plunger unit main body 65, that is, plunger row 641, by means of first transfer drive shaft 63a, second transfer drive

shaft 63b, and third transfer drive shaft 63c each including, for example, a ball screw.

Plunger row 641 of transfer drive mechanism 60 can transfer a resin arranged above plunger row 641 to the molding die as plunger row 641 is moved up. Force applied by transfer drive mechanism 60 for moving up plunger row 641 is referred to as transfer output of plunger row 641. First detector 66a, second detector 66b, and third detector 66c can detect a detection value relating to transfer output of plunger row 641.

Fig. 6 shows a schematic side view of another exemplary transfer drive mechanism 60 included in the resin molding apparatus in the embodiment. Transfer drive mechanism 60 shown in Fig. 6 is characterized by including a multiple-row plunger row. Thus, the resin molding apparatus in the embodiment is constructed to replaceably include transfer drive mechanism 60 containing a single-row plunger row and transfer drive mechanism 60 containing a multiple-row plunger row. The resin molding apparatus in the embodiment is adapted to any of a single-row plunger row and a multiple-row plunger row.

Plunger unit 61 of transfer drive mechanism 60 in the embodiment shown in Fig. 6 includes plungers 64a and 64b for injection of a resin into a molding die. Plungers 64a and 64b are each also a rod-shaped member that linearly extends in the Z-axis direction. In the example shown in Fig. 6, plunger 64a has a tip end 740a located outside plunger unit main body 65 and the other tip end 740a (not shown) located inside plunger unit main body 65. Plunger 64b has a tip end 740b located outside plunger unit main body 65 and the other tip end 740b (not shown) located inside plunger unit main body 65.

Fig. 7 shows a schematic plan view of transfer drive mechanism 60 in the embodiment. Fig. 7 is a schematic plan view when transfer drive mechanism 60 shown in Fig. 6 is viewed from tip ends 740a and 740b of plungers 64a and 64b.

As shown in the plan view in Fig. 7, transfer drive mechanism 60 includes a multiple-row plunger row 643. Multiple-row plunger row 643 is constructed such that single-row plunger row 641 and a single-row plunger row 642 are aligned in the Y-axis direction at a distance from each other. Single-row plunger row 641 is constituted of

a plurality of plungers 64a and single-row plunger row 642 is constituted of a plurality of plungers 64b. Single-row plunger row 641 and single-row plunger row 642 each extend in the X-axis direction.

As shown in the plan view in Fig. 7, single-row plunger row 641 is located in one region R1 of two regions R1 and R2 delimited by centerline C-C of plunger unit main body 65 and single-row plunger row 642 is located in the other region R2. A straight line 741a that passes through tip ends 740a of the plurality of plungers 64a that constitute single-row plunger row 641 and extends in the X-axis direction is located in region R1 and a straight line 741b that passes through tip ends 740b of the plurality of plungers 64b that constitute single-row plunger row 642 and extends in the X-axis direction is located in region R2.

The construction of multiple-row plunger row 643 is naturally not limited to the construction shown in the plan view in Fig. 7, and multiple-row plunger row 643 may be constructed, for example, by three or more single-row plunger rows aligned at a distance in the Y-axis direction.

A method of manufacturing a resin molded product in the embodiment that represents one of methods of manufacturing a resin molded product with the resin molding apparatus in the embodiment will be described below with reference to Figs. 8 to 18. Fig. 8 shows a flowchart of the method of manufacturing a resin molded product in the embodiment. As shown in Fig. 8, the method of manufacturing a resin molded product in the embodiment includes a step of determining a calibration value (S10), a step of setting an object (S20), a step of clamping a die (S30), a resin forming step (S40), and a step of opening the die (S50). Each step will be described in further detail below.

As shown in Fig. 8, the method of manufacturing a resin molded product in the embodiment starts from the step of determining a calibration value (S10). The step of determining a calibration value (S10) can be performed, for example, as below. Initially, plunger unit 61 of transfer drive mechanism 60 shown in Fig. 4 or 6 is replaced with a test jig 900 shown in a partial schematic cross-sectional view in Fig. 9.

Test jig 900 includes a dummy plunger unit main body 65c and a dummy plunger 64c on dummy plunger unit main body 65c. Second die 20 is removed from the resin molding apparatus in the embodiment shown in Fig. 3.

Then, in the resin molding apparatus in the embodiment shown in Fig. 3, test jig 900 shown in Fig. 9 is set instead of transfer drive mechanism 60. Then, as shown in Fig. 9, a reference detector 800 such as an externally calibrated load cell is set on second plate 42. Then, for example, with the use of a ball screw, first transfer drive shaft 63a, second transfer drive shaft 63b, and third transfer drive shaft 63c are driven to move up test jig 900. Dummy plunger 64c of test jig 900 thus applies force to reference detector 800, and reference detector 800 detects a measurement value of force applied to dummy plunger 64c. At the same time, first detector 66a, second detector 66b, and third detector 66c also detect measurement values of force. Reference detector 800 contains an amplifier, and the measurement value output from reference detector 800 is amplified by the amplifier.

Since reference detector 800 has externally been calibrated, the measurement value of force detected by reference detector 800 is more accurate than measurement values of force based on detection values detected by first detector 66a, second detector 66b, and third detector 66c. Thus, with the measurement value of force detected by reference detector 800 being defined as the reference, the measurement values of force based on the detection values from first detector 66a, second detector 66b, and third detector 66c are calibrated. In the resin molding apparatus in the embodiment, a more accurate value of transfer output of the plunger row can be detected by using the calibration value. A value corresponding to the number of rows in a plunger row is determined as the calibration value.

When single-row plunger row 641 shown, for example, in Fig. 5 is employed, reference detector 800 is set at a point 751 in the middle of a line segment where straight line 741 extending in the X-axis direction is cut in plunger unit main body 65 in the plan view in Fig. 5 and the step of determining a calibration value is performed. When multiple-row plunger row 643 shown in Fig. 7 is employed, reference detector

800 is set at a point 752 in the middle of a line segment where plunger unit main body 65 is cut by centerline C-C extending in the X-axis direction in the plan view in Fig. 7 and the step of determining a calibration value is performed.

Fig. 10 shows a block diagram of a main part of the resin molding apparatus in the embodiment. As shown in Fig. 10, the resin molding apparatus in the embodiment includes an input and output portion 67 such as a touch panel, a controller 68 connected to input and output portion 67, transfer drive mechanism 60 connected to controller 68, an amplifier 69 connected to controller 68, and detector 66 (first detector 66a, second detector 66b, and third detector 66c) connected to amplifier 69.

In the step of determining a calibration value, the resin molding apparatus in the embodiment operates, for example, as below. Initially, input and output portion 67 outputs a command to controller 68 to perform the step of determining a calibration value. Controller 68 thus outputs a command to the transfer drive shaft (first transfer drive shaft 63a, second transfer drive shaft 63b, and third transfer drive shaft 63c) to drive. Upon receiving an instruction from controller 68, the transfer drive shaft moves up test jig 900.

Detector 66 (first detector 66a, second detector 66b, and third detector 66c) carries out detection simultaneously with measurement of force applied to dummy plunger 64c by reference detector 800. Then, first detector 66a, second detector 66b, and third detector 66c output detection values to controller 68, the detections values being amplified by amplifier 69.

Thereafter, with a value of force output from reference detector 800 being defined as the reference, the calibration value is determined based on the values output from first detector 66a, second detector 66b, and third detector 66c through the amplifier. The calibration value can be determined by controller 68. Controller 68 includes a storage. The storage of controller 68 stores calibration values corresponding to the number of rows in the plunger row in a case of a single-row plunger row and a case of a multiple-row plunger row (including two or more rows). Controller 68 may include, for example, a programmable logic controller (PLC) or a

human machine interface (HMI) other than the storage.

Then, as shown in Fig. 8, after the step of determining a calibration value (S10), the step of setting an object (S20) is performed. The step of setting an object (S20) can be performed, for example, as below. Initially, as shown in the partial schematic cross-sectional view in Fig. 11, an object 1 is set between first die 10 and second die 20. In the example shown in Fig. 11, object 1 is set in recess 21 in second die 20. For example, a semiconductor chip mounted on a leadframe can be employed as object 1.

Fig. 12 shows a schematic plan view of exemplary second die 20 used in the embodiment. As shown in Fig. 12, second recess 21 in second die 20 is provided only on one side of pot 22 that also serves as a passage through which plunger 64 moves. Though second recess 21 is in a rectangular shape and pot 22 is in an annular shape in the example shown in Fig. 12, the shapes are not limited as such.

Then, the step of clamping a die (S30) is performed. The step of clamping a die (S30) is performed, for example, as below. Initially, clamping mechanism 600 moves up movable platen 300, moves second die 20 with respect to fixed first die 10, and presses first die 10 and second die 20 as shown in the partial schematic cross-sectional view in Fig. 13. First die 10 and second die 20 may be clamped by moving first die 10 with respect to fixed second die 20 or by moving both of first die 10 and second die 20.

Then, the resin molding step (S40) is performed. The resin molding step (S40) can be performed, for example, as below. Initially, transfer drive mechanism 60 shown in Fig. 4 moves up plunger unit 61 with plunger unit support plate 62 being interposed. Plunger 64 is thus moved up, and as shown in the partial schematic cross-sectional view in Fig. 14, the resin supplied into pot 22 is extruded out of pot 22.

Then, the resin extruded out of pot 22 is molten and built up in cull 12. Then, the molten resin is transferred into a cavity 90 defined by recess 11 in first die 10 and recess 21 in second die 20. Thereafter, object 1 is molded with the resin as the resin is solidified to seal object 1.

Figs. 15 and 16 show partially enlarged schematic cross-sectional views

illustrating transfer of a resin 70 into cavity 90 by movement of plunger 64 in the resin molding apparatus in the embodiment. As shown in Fig. 15, after the step of setting an object (S20) and before the step of clamping a die (S30), a solid resin 70a is set in pot 22 and plunger 64 is located under solid resin 70a.

5 In the subsequent step of resin molding object 1 (S40), as shown in Fig. 16, plunger 64 extrudes solid resin 70a in pot 22 toward cull 12 in first die 10, solid resin 70a is molten by a not-shown heater plate in first die 10, and molten resin 70 is built up in cull 12. Thereafter, molten resin 70 is transferred to object 1 within cavity 90 through a resin passage 14 by a pressure produced by movement of plunger 64.

10 Thereafter, molten resin 70 is solidified to complete resin molding of object 1.

Though a method of manufacturing a resin molded product in the embodiment in an example where the resin molding apparatus in the embodiment includes transfer drive mechanism 60 including single-row plunger row 641 constituted of a plurality of plungers 64 shown in Fig. 5 is described above, the resin molding apparatus in the
15 embodiment can also manufacture a resin molded product, for example, by using second die 20 as shown in the schematic plan view in Fig. 17 and switching to transfer drive mechanism 60 including a multiple-row plunger row as shown, for example, in Figs. 6 and 7.

Controller 68 can control transfer output of the plunger row. Fig. 18 shows a
20 flowchart of an exemplary operation for control of transfer output of a plunger row by controller 68 of the resin molding apparatus in the embodiment. Controller 68 initially obtains an operation condition from input and output portion 67. The operation condition includes the number of rows in a plunger row and a transfer output value (a set value for transfer output) set in advance in correspondence with the number
25 of rows in the plunger row.

Then, controller 68 outputs a command value (a calibration value) to amplifier 69 based on the operation condition. Controller 68 outputs a calibration value stored in the storage of controller 68 in accordance with the number of rows in the plunger row. When transfer drive mechanism 60 including a single-row plunger row is

employed, controller 68 outputs a calibration value in the case of a single-row plunger row. When transfer drive mechanism 60 including a single-row plunger row is replaced with transfer drive mechanism 60 including a multiple-row plunger row, controller 68 changes the calibration value to a calibration value in accordance with the number of rows in the plunger row and outputs the calibration value to amplifier 69.

Then, controller 68 outputs a command value (a set value for transfer output) to transfer drive mechanism 60 based on the operation condition. Controller 68 outputs the set value for transfer output stored in the storage of controller 68 in accordance with the number of rows in the plunger row. For example, when a single-row plunger row is provided, controller 68 outputs a set value for transfer output for the single-row plunger row. Alternatively, when a multiple-row plunger row is provided, controller 68 outputs a set value for transfer output corresponding to the number of rows in that plunger row.

Then, controller 68 checks whether or not the transfer output of the plunger row of transfer drive mechanism 60 has attained to the set value for the transfer output. Controller 68 obtains a transfer output value of the plunger row based on detection by detector 66 (first detector 66a, second detector 66b, and third detector 66c) through amplifier 69. The transfer output value from amplifier 69 is a value calibrated based on the calibration value, of the transfer output value of the plunger row based on detection by detector 66. Then, controller 68 determines whether or not the obtained transfer output value has attained to the set value for the transfer output based on comparison between these values. Calibration in generation of transfer output may be carried out by controller 68 or detector 66 (first detector 66a, second detector 66b, and third detector 66c). A calibrator may be provided between controller 68 and amplifier 69 and the calibrator may carry out calibration in generation of transfer output.

When controller 68 determines that the calibrated value of the transfer output of the plunger row has attained to the set value for the transfer output, it does not output a command to change the transfer output of the plunger row to transfer drive mechanism 60. Controller 68 maintains the transfer output value at a constant value so as to stop

an operation to move up the plunger row.

When controller 68 determines that the calibrated value of the transfer output has not attained to the set value for the transfer output, it outputs a command to increase the transfer output of the plunger row to transfer drive mechanism 60.

5 Controller 68 outputs a command to increase the transfer output of the plunger row to transfer drive mechanism 60 until it determines that the transfer output value of the plunger row has attained to the set value for the transfer output.

10 The left field in Table 1 shows a transfer output value of the plunger row actually applied to test jig 900 shown in Fig. 9 instead of transfer drive mechanism 60 and detected by the reference detector. The field in the middle in Table 1 shows a transfer output value of the plunger row that is actually applied in the resin molding apparatus in the embodiment including transfer drive mechanism 60 containing single-row plunger row 641 shown in Figs. 4 and 5 and is based on detector 66 (first detector 66a, second detector 66b, and third detector 66c). The right field in Table 1
15 shows a difference between the output values.

The left field in each of Tables 2 and 3 shows a transfer output value of the plunger row actually applied to test jig 900 shown in Fig. 9 instead of transfer drive mechanism 60 and detected by the reference detector. The field in the middle in each of Tables 2 and 3 shows a transfer output value of the plunger row that is actually
20 applied in the resin molding apparatus in the embodiment including transfer drive mechanism 60 including two-row plunger row 643 shown in Figs. 6 and 7 and is based on detector 66 (first detector 66a, second detector 66b, and third detector 66c). The right field in each of Tables 2 and 3 shows a difference between the output values.

A numeric value in the field of "Output Value from Reference Detector [kN]" in
25 Tables 1 to 3 represents a transfer output value of the plunger row actually applied by reference detector 800, and a numeric value in the field of "Output Value from Detector [kN]" represents a transfer output value of the plunger row based on a detection value actually detected by detector 66 (first detector 66a, second detector 66b, and third detector 66c) of the resin molding apparatus in the embodiment. A numeric value in

the field of "Difference [kN]" in Table 1 to 3 represents a difference between the numeric value in the field of "Output Value from Reference Detector [kN]" and the numeric value in the field of "Output Value from Detector [kN]." A smaller numeric value in the field of "Difference [kN]" in Tables 1 to 3 indicates that an actual value of the transfer output of the plunger row can more accurately be grasped.

"Output Value from Detector [kN]" in Tables 1 and 2 represents a value calibrated with the calibration value when a single-row plunger row is provided, whereas a numeric value in the field of "Output Value from Detector [kN]" in Table 3 represents an output value calibrated with the calibration value when a two-row plunger row is provided.

Table 1

Output Value from Reference Detector [kN]	Output Value from Detector [kN]	Difference [kN]
0.00	0.040	0.04
3.90	3.930	0.03
9.80	9.830	0.03
20.0	19.98	-0.02
29.4	29.41	0.01
39.2	39.17	-0.03
49.1	49.04	-0.06

Table 2

Output Value from Reference Detector [kN]	Output Value from Detector [kN]	Difference [kN]
0.00	0.040	0.04
3.90	3.910	0.01
9.80	9.710	-0.09
20.0	19.76	-0.24
30.1	29.74	-0.36
39.4	39.02	-0.38
49.2	48.73	-0.47
58.8	58.20	-0.60
69.3	68.63	-0.67

Table 3

Output Value from Reference Detector [kN]	Output Value from Detector [kN]	Difference [kN]
0.00	0.040	0.04
4.10	4.120	0.02
9.80	9.760	-0.04
19.6	19.52	-0.08
29.4	29.31	-0.09
39.2	39.11	-0.09
49.2	49.07	-0.13
59.2	59.07	-0.13
68.5	68.34	-0.16
78.3	78.15	-0.15
88.2	88.02	-0.18
98.0	97.95	-0.05

5

As is clear from comparison between the numeric value in the field of "Difference [kN]" in Table 2 and the numeric value in the field of "Difference [kN]" in

Table 3, it was confirmed that, when the transfer drive mechanism including the two-row plunger row was employed, calculation based on the calibration value in accordance with the two-row plunger row more accurately grasped the actual value of the transfer output of the plunger row than calculation based on the calibration value in accordance with the single-row plunger row.

The resin molding apparatus in the embodiment is thus configured such that the controller can change the calibration value for calibration of the transfer output value detected by the detector in accordance with the number of rows in a plunger row and hence transfer output of the plunger row can more accurately be controlled.

Though the embodiment is described above, combination of features in the embodiment described above as appropriate is also originally intended.

Though an embodiment of the present invention has been described, it should be understood that the embodiment disclosed herein is illustrative and non-restrictive in every respect. The scope of the present invention is defined by the terms of the claims and is intended to include any modifications within the scope and meaning equivalent to the terms of the claims.

CLAIMS

1. A resin molding apparatus comprising:
 - a molding die;
 - a plunger row configured to be capable of transferring a resin to the molding die;
 - 5 a detector configured to be capable of detecting a detection value relating to transfer output of the plunger row; and
 - a controller configured to be capable of controlling the transfer output, the resin molding apparatus being adapted to a single-row plunger row or a multiple-row plunger row,
 - 10 the controller being configured to be capable of changing a calibration value for calibration of the detection value detected by the detector so as to generate the transfer output using the calibration value in accordance with the number of rows in the plunger row, the calibration value determined before resin molding,
 - the transfer output being force applied to the plunger row to move up the
 - 15 plunger row,
 - the resin molding apparatus configured to be capable of replaceably including a single-row plunger row or a multiple-row plunger row.
2. The resin molding apparatus according to claim 1, further comprising an amplifier connected to the controller and the detector.
3. The resin molding apparatus according to claim 1 or 2, wherein the controller includes a storage configured to store the calibration value.
4. The resin molding apparatus according to any one of claims 1 to 3, further comprising a transfer drive mechanism configured to be capable of moving up and down the plunger row.

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

5 determining the calibration value, wherein after determining the calibration value the method further comprising:

- setting an object in the molding die;
- clamping the molding die;
- resin molding the object; and
- opening the molding die.

6. The resin molded product manufacturing method according to claim 5, wherein

the resin molding the object includes controlling, by the controller, the transfer output with the calibration value.