

DESCRIPTION

TITLE OF INVENTION: RESIN MOLDING DEVICE AND METHOD FOR PRODUCING RESIN MOLDED ARTICLE

Technical Field

5 **[0001]** The present invention relates to a technology of a resin molding device and a method for producing resin molded article.

Background Technology

[0002] In a resin molding device using a mold clamping mechanism, adjustment of the interval between the movable platen and the fixed platen is required, for example, when the mold set being
10 replaced and the mold thickness changing. Patent Document 1 discloses a mold pressure adjustment device for an injection molding device. This mold pressure adjustment device can adjust the position of the fixed platen (end housing) to the left and right by rotating nuts respectively provided on four tie bars in synchronization by one driving source (hydraulic motor).

Related Art Literature

15 Patent Literature

[0003] Patent Document 1: Japanese Utility Model Publication No. 61-7060

SUMMARY OF INVENTION

Problems to Be Solved by the Invention

[0004] However, for example, in resin molding devices used for semiconductor manufacturing,
20 high-precision products are required, and therefore, there is a demand for a technology capable of more finely adjusting the interval between the movable platen and the fixed platen.

[0005] The present invention has been made in view of the above circumstances, and the technical problem to be solved is to provide a resin molding device capable of finely adjusting the interval between the lower platen and the upper platen, and a method for producing resin molded
25 article.

Means for Solving the Problems

[0006] The technical problem to be solved by the present invention is as described above. To solve this problem, a resin molding device according to the present invention comprises an upper platen, wherein an upper mold is fixed to the upper platen; a lower platen, wherein a lower mold is fixed to the lower platen; a plurality of tie bars, wherein the tie bars connect the upper platen and the lower platen; a mold clamping mechanism, wherein the mold clamping mechanism moves the lower platen vertically; and a position adjustment mechanism, wherein the position adjustment mechanism is capable of adjusting a position of the upper platen with respect to the tie bars for each of the tie bars.

[0007] Further, a method for producing resin molded article according to the present invention is a method for producing resin molded article using the resin molding device, comprising an adjustment process of adjusting the position of the upper platen with respect to the tie bar; a mold clamping process of moving the lower platen with respect to the upper platen to perform mold clamping after the adjustment process; and a resin molding process of resin molding a molding target after the mold clamping process.

Effects of Invention

[0008] According to the present invention, it is possible to finely adjust the interval between the lower platen and the upper platen.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] [FIG. 1] is a schematic plan view showing the overall configuration of a resin molding device according to one embodiment.

[FIG. 2] is a schematic front view showing the configuration of a molding mechanism.

[FIG. 3] is a schematic front cross-sectional view showing a mold set.

[FIG. 4] is a schematic front cross-sectional view showing the configuration of a position adjustment mechanism (individual adjustment mechanism).

[FIG. 5] (a) is a view showing a state where a servo motor is driven. (b) is a view showing a state

where a fixed platen moves upward.

[FIG. 6](a) is a view showing an example of strain of each tie bar when mold clamping is performed. (b) is a view showing a state where the position of a fixed platen is adjusted.

[FIG. 7](a) is a view showing an example of a clamping position when a predetermined strain
5 occurs in each tie bar. (b) is a view showing a state where the position of a fixed platen is adjusted.

[FIG. 8] is a flowchart showing a method for producing resin molded article according to one embodiment.

DESCRIPTION OF THE EMBODIMENTS

[0010] In the following, the directions indicated by arrow U, arrow D, arrow L, arrow R, arrow
10 F, and arrow B shown in the figures are defined as upward, downward, leftward, rightward, forward, and backward directions, respectively, for the description.

[0011] <Overall Configuration of Resin Molding Device 1>

First, the configuration of the resin molding device 1 will be described with reference to FIG. 1. The resin molding device 1 is for resin sealing electronic elements such as semiconductor chips
15 (hereinafter simply referred to as "chip 2a" (see FIG. 3)) and producing resin molded articles. In particular, in the present embodiment, a resin molding device 1 that performs resin molding using a transfer molding method is illustrated. Note that the chip 2a is omitted from the notation except in FIG. 3.

[0012] The resin molding device 1 includes, as components, a supply module 10, a resin molding
20 module 20, and an unloading module 30. Each component is attachable, detachable, and exchangeable with respect to other components.

[0013] <Supply Module 10>

The supply module 10 supplies a lead frame 2, which is a type of substrate on which the chip 2a is mounted, and a resin tablet T to the resin molding module 20. Note that the lead frame 2 is
25 one embodiment of a molding target according to the present invention. In the present embodiment, the lead frame 2 is illustrated as an example of a substrate to be a molding target, but

in addition to the lead frame 2, various other substrates (glass epoxy substrates, ceramic substrates, resin substrates, metal substrates, etc.) may be used. The supply module 10 mainly includes a frame feeding part 11, a frame supply part 13, a resin material supply mechanism 14, a loader 17, and a control part 18.

5 **[0014]** The frame feeding part 11 feeds the lead frame 2, which is not resin sealed and is accommodated in an in-magazine unit (not shown), to the frame supply part 13. The frame supply part 13 receives the lead frame 2 from the frame feeding part 11, appropriately aligns the received lead frame 2, and transfers it to the loader 17.

10 **[0015]** The resin material supply mechanism 14 supplies the resin tablet T to the loader 17 described later. The resin material supply mechanism 14 may align a plurality of resin tablets T and transfer them to the loader 17.

15 **[0016]** The loader 17 transports the lead frame 2 and the resin tablet T received from the frame supply part 13 and the resin material supply mechanism 14 to the resin molding module 20. The loader 17 includes a heater plate (not shown) for heating in advance (preheating) the lead frame 2. The heater plate is heated by a heating device while the loader 17 is on standby. In addition, the heater plate may heat the lead frame 2 during transport of the lead frame 2 by the loader 17.

20 **[0017]** In addition, the loader 17 is provided with a cleaning mechanism 17a for cleaning the mold set (lower mold 160 and upper mold 170) described later. As the cleaning mechanism 17a, for example, a dust collection mechanism capable of suctioning dust adhering to the surface of the mold set may be used. The cleaning mechanism 17a is provided, for example, at the front end of the loader 17.

25 **[0018]** The control part 18 controls the operation of each module of the resin molding device 1. The control part 18 controls the operations of the supply module 10, the resin molding module 20, and the unloading module 30. In addition, the control part 18 can be used to arbitrarily change (adjust) the operation of each module.

[0019] In the present embodiment, an example is shown in which the control part 18 is provided

in the supply module 10, but it is also possible to provide the control part 18 in other modules. In addition, it is also possible to provide a plurality of control parts 18. For example, it is also possible to provide the control part 18 for each module or each device, and to individually control the operations of each module while interlocking them with each other.

5 **[0020]** <Resin Molding Module 20>

The resin molding module 20 is for resin sealing the chip 2a mounted on the lead frame 2. In the present embodiment, two resin molding modules 20 are arranged side by side. The resin molding module 20 may be one, or may be three or more. By performing resin sealing of the lead frame 2 in parallel with a plurality of resin molding modules 20, the manufacturing efficiency of the resin
10 molded article can be improved. The resin molding module 20 mainly includes a molding mechanism 100.

[0021] The molding mechanism 100 mainly includes a mold set (lower mold 160 and upper mold 170) and a mold clamping mechanism 150 (see FIG. 2).

[0022] The mold set (lower mold 160 and upper mold 170) is for resin sealing the chip 2a
15 mounted on the lead frame 2 using molten resin material. The mold set includes a pair of upper and lower molds, that is, a lower mold 160 and an upper mold 170 (see FIG. 2, etc.).

[0023] The mold clamping mechanism 150 (see FIG. 2) is for mold clamping or mold opening the mold set (lower mold 160 and upper mold 170) by moving the lower mold 160 up and down. The specific configuration of the molding mechanism 100 will be described later.

20 **[0024]** <Unloading module 30>

The unloading module 30 is for receiving the resin-sealed lead frame 2 from the resin molding module 20 and unloading it. The unloading module 30 mainly includes an unloader 31 and a substrate housing part 32.

[0025] The unloader 31 is for holding the resin-sealed lead frame 2 and unloading it to the
25 substrate housing part 32. The substrate housing part 32 is for housing the resin-sealed lead frame 2.

[0026] <Molding mechanism 100>

Next, the specific configuration of the molding mechanism 100 will be described using FIG. 2 to FIG. 4.

[0027] Note that FIG. 2 is a diagram schematically showing the configuration of the molding mechanism 100. Also, FIG. 3 is a diagram schematically showing the mold set (lower mold 160 and upper mold 170) extracted from the configuration shown in FIG. 2. Also, FIG. 4 is a diagram schematically showing the configuration of the position adjustment mechanism 190 (individual adjustment mechanism 200).

[0028] As shown in FIG. 2, the molding mechanism 100 mainly includes a substrate 110, tie bars 120, a movable platen 130, a fixed platen 140, a mold clamping mechanism 150, a mold set (lower mold 160 and upper mold 170), a transfer mechanism 180, and a position adjustment mechanism 190.

[0029] The substrate 110 supports the tie bars 120 and the mold clamping mechanism 150. The substrate 110 is formed in a rectangular cuboid shape having an appropriate vertical width.

[0030] The tie bars 120 connect the movable platen 130 and the fixed platen 140. The tie bars 120 are formed in an elongated shape with the longitudinal direction oriented in the vertical direction. In the present embodiment, the tie bars 120 are formed in a cylindrical shape. The lower part of the tie bars 120 is fixed to the substrate 110. A plurality of tie bars 120 are provided. In the present embodiment, four tie bars 120 are provided, and one is arranged at each of the four corners of the substrate 110. Note that the number of tie bars 120 is not limited to four, and the number and arrangement of the tie bars 120 may be changed arbitrarily.

[0031] The movable platen 130 is a component to which the lower mold 160 is fixed and which moves the lower mold 160 up and down. Note that the movable platen 130 is one embodiment of the lower platen according to the present invention. The movable platen 130 is formed in a rectangular cuboid shape having an appropriate vertical width. The vertical middle part of the tie bars 120 is inserted so as to penetrate the four corners of the movable platen 130 vertically.

This allows the movable platen 130 to move up and down along the tie bars 120. A lower mold chase holder 131 for holding the lower mold 160 is provided on the upper part of the movable platen 130.

[0032] The fixed platen 140 is a component to which the upper mold 170 is fixed. Note that the fixed platen 140 is one embodiment of the upper platen according to the present invention. The fixed platen 140 is formed in a rectangular cuboid shape having an appropriate vertical width. The fixed platen 140 is arranged above the movable platen 130. The upper part of the tie bars 120 is inserted into through holes 140a (see FIG. 4) formed at the four corners of the fixed platen 140 so as to penetrate the fixed platen 140 vertically. The fixed platen 140 is fixed to the tie bars 120 via the position adjustment mechanism 190. An upper mold chase holder 141 for holding the upper mold 170 is provided at the lower part of the fixed platen 140. A pressure regulating plate 142 for adjusting the vertical position of the upper mold chase holder 141 is arranged between the fixed platen 140 and the upper mold chase holder 141. By appropriately changing the thickness (width in the vertical direction) of the pressure regulating plate 142, the vertical position of the upper mold chase holder 141 relative to the fixed platen 140 may be adjusted. By adjusting the vertical position of the upper mold chase holder 141 using the pressure regulating plate 142, the mold contact and clamping force during mold clamping may be adjusted.

[0033] The mold clamping mechanism 150 clamps or opens the mold set (the lower mold 160 and the upper mold 170) by moving the movable platen 130 up and down. The mold clamping mechanism 150 mainly includes a toggle link 151, a lifting member 152, and a ball screw 153.

[0034] The toggle link 151 is a link mechanism that connects the substrate 110 and the movable platen 130. The toggle link 151 is configured to be extendable and retractable vertically by combining multiple link members. The vertical middle part of the toggle link 151 is connected to the lifting member 152. The lifting member 152 is engaged with the ball screw 153. The ball screw 153 is arranged with its longitudinal direction oriented in the vertical direction. By rotating the ball screw 153 with a driving source (not shown) such as a servo motor, the lifting

member 152 can be raised and lowered vertically. As the lifting member 152 moves up and down, the toggle link 151 may be operated to move the movable platen 130 up and down relative to the substrate 110.

[0035] The lower mold 160 shown in FIG. 2 and FIG. 3 forms the lower part of the mold set.

5 The lower mold 160 is fixed to the upper part of the movable platen 130. The lower mold 160 mainly includes a pot 161 and a lower mold heater 162.

[0036] The pot 161 shown in FIG. 3 is a part that accommodates the resin tablet T. The pot 161 is formed to penetrate the lower mold 160 vertically. The pot 161 is formed at the left-right center of the lower mold 160. A plurality of pots 161 are formed to be arranged in a row in the
10 front-rear direction (not shown). In the present embodiment, a so-called two-piece configuration is adopted in which the lead frames 2 are arranged on the left and right sides of the pot 161 of the lower mold 160, but a configuration in which only one lead frame 2 is arranged on the lower mold 160 may be adopted, or a configuration in which three or more lead frames 2 are arranged on the lower mold 160 may be adopted.

15 **[0037]** The lower mold heater 162 is for heating the lower mold 160 when performing resin molding. The lower mold heater 162 is provided inside the lower mold 160.

[0038] The upper mold 170 shown in FIG. 2 and FIG. 3 forms the upper part of the mold set. The upper mold 170 mainly includes a recess part 171, a resin flow path 172, and an upper mold heater 173.

20 **[0039]** The recess part 171 shown in FIG. 3 is a part that forms a cavity, which is a space for resin sealing, between the lead frame 2 and the upper mold 170 in a state where the lead frame 2 is placed on the lower mold 160 and the lower mold 160 and the upper mold 170 are closed. The chip 2a fixed to the lead frame 2 is accommodated in the cavity, and the chip 2a is resin-sealed by the resin material supplied to the cavity. The recess part 171 is formed by recessing the lower
25 surface of the upper mold 170 upward. The recess part 171 is formed at a position and in a shape corresponding to the shape and the like of the product (resin molded article).

[0040] The resin flow path 172 is a part that guides the melted resin tablet T (resin material) to the recess part 171 (cavity) in a state where the lead frame 2 is placed on the lower mold 160 and the lower mold 160 and the upper mold 170 are closed. The resin flow path 172 is formed by recessing the lower surface of the upper mold 170 upward. The resin flow path 172 is formed so as to connect the pot 161 and the recess part 171 (cavity) in a state where the lower mold 160 and the upper mold 170 are closed.

[0041] The upper mold heater 173 is for heating the upper mold 170 when performing resin molding. The upper mold heater 173 is provided inside the upper mold 170.

[0042] Note that the shapes and the like of the lower mold 160 and the upper mold 170 described in the present embodiment are an example, and may be arbitrarily changed according to the shape, number, and the like of products.

[0043] The transfer mechanism 180 shown in FIG. 2 and FIG. 3 supplies the resin material to the cavity. The transfer mechanism 180 mainly includes a plunger 181 and a transfer driving part (not shown).

[0044] The plunger 181 shown in FIG. 3 injects the resin tablet T (resin material) accommodated in the pot 161 and supplies it to the cavity. The plunger 181 is arranged so as to be movable (liftable) up and down within the pot 161.

[0045] The transfer driving part (not shown) moves the plunger 181 in the vertical direction (driving source). The transfer driving part (not shown) may be configured by, for example, a servo motor, an air cylinder, or the like.

[0046] <Position Adjustment Mechanism 190>

The position adjustment mechanism 190 shown in FIG. 2 and FIG. 4 is for adjusting the position of the fixed platen 140 relative to the tie bar 120 for each tie bar 120. The position adjustment mechanism 190 mainly includes a plurality of individual adjustment mechanisms 200, a strain gauge 260, and an adjustment control part 270.

[0047] The individual adjustment mechanism 200 is provided on each of the plurality of tie bars

120, and adjusts the position of the fixed platen 140 relative to the tie bar 120 on which it is provided. In the present embodiment, four individual adjustment mechanisms 200 are provided to correspond to the four tie bars 120.

[0048] In the following, the configuration of the individual adjustment mechanism 200 will be described using FIG. 4. Since the configurations of the four individual adjustment mechanisms 200 are identical, the following description will focus on one of them. The individual adjustment mechanism 200 mainly includes a support member 210, a connecting member 220, a spring 230, an adjusting nut 240, and a change mechanism 250.

[0049] The support member 210 is for supporting the fixed platen 140 via the spring 230. The support member 210 mainly includes a pair of upper and lower plates (a lower plate 211 and an upper plate 212), and a column part 213.

[0050] The lower plate 211 is formed, for example, in a rectangular plate shape. The lower plate 211 is arranged with its plate surface oriented substantially horizontally. The central part of the lower surface of the lower plate 211 is fixed to the upper end of the tie bar 120. A plurality of through holes 211a are formed in the lower plate 211. The through holes 211a are formed, for example, one at each of the four corners of the lower plate 211.

[0051] The upper plate 212 is formed, for example, in substantially the same shape (rectangular plate shape) as the lower plate 211. The upper plate 212 is arranged above the lower plate 211 so as to be parallel to the lower plate 211. The upper plate 212 is arranged so as to be positioned above the connecting member 220. By this, the upper plate 212 can regulate the connecting member 220 from rising excessively by contacting the upper end of the connecting member 220.

[0052] The column part 213 is formed in a columnar shape with its longitudinal direction oriented in the vertical direction. The lower part of the column part 213 is fixed to the lower plate 211. The upper part of the column part 213 is fixed to the upper plate 212. A plurality of column parts 213 are provided, for example. The lower plate 211 and the upper plate 212 are connected by the column parts 213.

[0053] The connecting member 220 is for connecting the fixed platen 140 and the support member 210. The connecting member 220 is formed in a columnar shape (for example, cylindrical shape) with its longitudinal direction oriented in the vertical direction. A plurality of connecting members 220 (four in the present embodiment) are provided at positions corresponding to the through holes 211a of the lower plate 211. The connecting member 220 is arranged so as to pass vertically through the through hole 211a of the lower plate 211. The lower end of the connecting member 220 is fixed to the fixed platen 140. A circular flat plate-shaped flange part 221 is formed at the upper end of the connecting member 220. The flange part 221 is arranged between the lower plate 211 and the upper plate 212.

[0054] The spring 230 is for applying a force directed upward to the fixed platen 140. The spring 230 is one embodiment of the imparting member according to the present invention. The spring 230 is formed by a compression coil spring. The spring 230 is arranged between the lower plate 211 and the flange part 221 of the connecting member 220. By this, the spring 230 can apply a force to the flange part 221 (connecting member 220) that pushes the flange part 221 upward.

[0055] The adjusting nut 240 is for regulating the upward movement of the fixed platen 140. The adjusting nut 240 is one embodiment of the regulating member according to the present invention. The diameter of the adjusting nut 240 is formed larger than the inner diameter of through hole 140a of the fixed platen 140. The adjusting nut 240 is engaged with a male screw (not shown) formed on the upper part of the tie bar 120. By rotating the adjusting nut 240, the adjusting nut 240 can be moved in the vertical direction relative to the tie bar 120.

[0056] The change mechanism 250 is for changing the vertical position of the adjusting nut 240. The change mechanism 250 mainly includes a servo motor 251 and a transmission part (decelerating mechanism 252, drive gear 253, and driven gear 254) that transmits the power of the servo motor 251.

[0057] The servo motor 251 serves as a driving source for moving the adjusting nut 240. The rotational position and rotational speed of the servo motor 251 are controlled based on control

signals from outside. The servo motor 251 is arranged on the side of the support member 210.

[0058] The decelerating mechanism 252 is for reducing the rotational speed of the servo motor 251. The decelerating mechanism 252 is configured by, for example, a plurality of gears and a housing that accommodates the gears. The decelerating mechanism 252 is provided at the lower
5 part of the servo motor 251.

[0059] The drive gear 253 rotates by the power output from the decelerating mechanism 252. The drive gear 253 is provided at the lower part of the decelerating mechanism 252. The drive gear 253 is connected to an output shaft (not shown) of the decelerating mechanism 252 and rotates by the power transmitted from the servo motor 251 through the decelerating mechanism 252. The
10 servo motor 251, the decelerating mechanism 252, and the drive gear 253 are supported on the upper surface of the fixed platen 140.

[0060] The driven gear 254 is for transmitting the rotation of the drive gear 253 to the adjusting nut 240. The driven gear 254 is formed on the outer peripheral surface of the adjusting nut 240. The driven gear 254 may be formed integrally with the adjusting nut 240 or may be formed as a
15 separate member from the adjusting nut 240. The driven gear 254 is arranged to engage with the drive gear 253.

[0061] The strain gauge 260 shown in FIG. 2 is for measuring the strain occurring in the tie bar 120. The strain gauge 260 is provided on each of the plurality of tie bars 120. It is desirable that the strain gauge 260 is provided at a position that is less susceptible to the influence of heat during
20 resin molding. In the present embodiment, an example is shown in which the strain gauge 260 is provided at the lower part of the tie bar 120 (near the substrate 110). The strain in the vertical direction of the tie bar 120 can be measured by the strain gauge 260.

[0062] The adjustment control part 270 is for controlling the operation of the servo motor 251. The adjustment control part 270 is mainly composed of an arithmetic processing device such as a
25 CPU, a storage device such as RAM or ROM, and the like. The storage device of the adjustment control part 270 stores information and various programs necessary for controlling the operation

of the servo motor 251. In the present embodiment, the control part 18 (see FIG. 1) and the adjustment control part 270 are illustrated separately, but it is also possible to configure the adjustment control part 270 integrally with the control part 18 (see FIG. 1).

[0063] The adjustment control part 270 is provided with various input devices (not shown) such as a touch panel, a keyboard, and switches. By using the input devices, various information related to the operation of the servo motor 251 can be input to the adjustment control part 270. The adjustment control part 270 is also provided with various display devices (not shown) such as a liquid crystal panel, a touch panel, and lamps. By using the display devices, various information related to the operation of the servo motor 251 can be displayed.

[0064] The adjustment control part 270 is connected to each strain gauge 260 and may acquire the measurement result of each strain gauge 260. The adjustment control part 270 is also connected to the servo motor 251 and may transmit a control signal to the servo motor 251 to control the operation of the servo motor 251.

[0065] The adjustment of the position of the fixed platen 140 using the position adjustment mechanism 190 (individual adjustment mechanism 200) as described later may be performed manually by an operator or automatically by the adjustment control part 270. In the case of the operator manually adjusting the position of the fixed platen 140, the operator can confirm the measurement result of the strain gauge 260 and the like on the display device and operate the servo motor 251 according to the measurement result. In the case of the adjustment control part 270 automatically adjusting the position of the fixed platen 140, the adjustment control part 270 may control the operation of the servo motor 251 based on the measured various information (for example, the measurement result of the strain gauge 260 and the like) and various programs.

[0066] <Operation of Individual Adjustment Mechanism 200>

The operation mode of the individual adjustment mechanism 200 will be described below.

[0067] As shown in FIG. 4, the connecting member 220 is pushed upward by the spring 230. Therefore, the fixed platen 140 is pushed upward along the tie bar 120 via the connecting member

220. The upward movement of the fixed platen 140 is regulated by the upper surface of the fixed platen 140 contacting the adjusting nut 240. In this way, the vertical position of the fixed platen 140 relative to the tie bar 120 may be determined by the vertical position of the adjusting nut 240.

[0068] For example, when moving the fixed platen 140 upward relative to the tie bar 120, as shown in FIG. 5(a), the servo motor 251 is driven to move the adjusting nut 240 upward relative to the tie bar 120. By moving the adjusting nut 240 upward, a gap is created between the adjusting nut 240 and the fixed platen 140.

[0069] When a gap is created between the adjusting nut 240 and the fixed platen 140, the fixed platen 140 is pushed upward by the spring 230, as shown in FIG. 5(b). The upward movement of the fixed platen 140 is regulated by contacting the adjusting nut 240. By moving the adjusting nut 240 upward in this way, the fixed platen 140 may be moved upward relative to the tie bar 120.

[0070] In FIG. 5(a), a state in which a gap is created between the adjusting nut 240 and the fixed platen 140 is illustrated in order to describe the operation of the individual adjustment mechanism 200 in stages. However, in practice, the fixed platen 140 also moves upward following the upward movement of the adjusting nut 240. Therefore, almost no gap is created between the adjusting nut 240 and the fixed platen 140.

[0071] On the other hand, when moving the fixed platen 140 downward relative to the tie bar 120, although not illustrated, the servo motor 251 is driven to move the adjusting nut 240 downward relative to the tie bar 120. By this, the fixed platen 140 may be pushed downward via the adjusting nut 240, thereby moving the fixed platen 140 downward.

[0072] <Adjustment Method by Position Adjustment Mechanism 190>

Hereinafter, an example of a position adjustment method for the fixed platen 140 using the position adjustment mechanism 190 will be described.

[0073] First, an example of a method for adjusting the clamping force by adjusting the overall position of the fixed platen 140 using the position adjustment mechanism 190 will be described.

[0074] Generally, a molding mechanism 100 using a toggle link 151 as in the present

embodiment is designed so that mold clamping is performed near the top dead center of the toggle link 151 (a state in which the toggle link 151 is fully extended), and a clamping force necessary for resin molding is obtained. However, in the case of the thickness of the mold set or the lead frame 2 is changed, or in the case of changes in dimensions of various parts (for example, the top dead center of the toggle link 151, etc.) occur due to change over time of component assemblies, the mold clamping position (clamping position) may change, and the necessary clamping force may not be obtained. Therefore, in the present embodiment, by adjusting the position of the fixed platen 140 by the position adjustment mechanism 190, the position of the fixed platen 140 can be adjusted so that the necessary clamping force is obtained.

[0075] Specifically, with the lead frame 2 placed on the lower mold 160, the mold clamping mechanism 150 is operated to perform mold clamping in the same manner as in the case of actual resin molding. In this state, at least one of the clamping force and the clamping position is measured. The clamping force may be measured using a measuring device such as a load cell. The clamping position may be measured using the rotational position of the servo motor of the mold clamping mechanism 150 or various measuring devices.

[0076] Next, the operation of the servo motor 251 of each individual adjustment mechanism 200 is controlled based on the measurement result of the clamping force or the clamping position. Specifically, the position of the fixed platen 140 is adjusted vertically so that a position where the necessary clamping force is obtained or an appropriate clamping position is achieved. At this time, the servo motors 251 of each individual adjustment mechanism 200 are all controlled to rotate by the same amount. This allows the fixed platen 140 to be moved in parallel without tilting its posture. In this way, by adjusting the overall position of the fixed platen 140, the mold clamping position (clamping position) and the clamping force can be adjusted. In addition, by adjusting the position of the fixed platen 140, mold clamping can be performed near the top dead center of the toggle link 151, so that the capacity of the driving source (servo motor, etc.) of the mold clamping mechanism 150 can be optimized, and reduction of component costs and

miniaturization of components can be achieved.

[0077] Next, an example of a method for adjusting mold contact by adjusting the position of the fixed platen 140 for each tie bar 120 using the position adjustment mechanism 190 will be described. In the following, two types of methods (a first adjustment method and a second adjustment method) will be described as methods for adjusting mold contact.

[0078] In the following, as shown in FIG. 6 and FIG. 7, in order to distinguish the four tie bars 120, symbols A to D are added to the reference numerals in counterclockwise order in plan view starting from the left front tie bar 120. Similarly, symbols A to D are added to the reference numerals of the individual adjustment mechanisms 200 corresponding to each tie bar 120A to 120D. In addition, although specific numerical values such as strain are exemplified below, these numerical values are provisional values for explanation purposes, and the present invention does not limit various numerical values.

[0079] First, the first adjustment method will be described using FIG. 6. The first adjustment method is a method for adjusting mold contact based on the strain of each tie bar 120 when mold clamping is performed with a constant clamping force. Specifically, as shown in FIG. 6(a), the strain (ϵ) of each tie bar 120 is measured in a state where mold clamping is performed with an appropriate clamping force. In FIG. 6, the strain of each tie bar 120A to 120D is indicated as $\epsilon(A)$ to $\epsilon(D)$, respectively.

[0080] In the example shown in FIG. 6(a), it can be understood that the strain of the tie bar 120B on the right front side is relatively large. From this, it is inferred that the mold contact on the right front side of the mold set is strong. In addition, in the example shown in FIG. 6(a), it can be understood that the strain of the tie bar 120D on the left rear side is relatively small. From this, it is inferred that the mold contact on the left rear side of the mold set is weak. Therefore, by adjusting the position of the fixed platen 140 with respect to each tie bar 120 so that the strain of each tie bar 120 becomes constant, uniformity of the mold contact of the mold set can be achieved.

[0081] Specifically, as shown in FIG. 6(b), the individual adjustment mechanism 200B corresponding to the tie bar 120B, which had relatively large strain, is controlled to move the fixed platen 140 upward with respect to the tie bar 120B. This can weaken the mold contact on the right front side of the mold set. In addition, the individual adjustment mechanism 200D
5 corresponding to the tie bar 120D, which had relatively small strain, is controlled to move the fixed platen 140 downward with respect to the tie bar 120D. This can strengthen the mold contact on the left rear side of the mold set.

[0082] In this manner, the measurement of the strain of each tie bar 120 and the control of the individual adjustment mechanism 200 are repeated several times, and as shown in FIG. 6(b), the
10 position of the fixed platen 140 is adjusted so that the strain of each tie bar 120 becomes constant. This allows adjustment so that the mold contact of the mold set becomes uniform.

[0083] Next, the second adjustment method will be described using FIG. 7. The second adjustment method is a method of adjusting the mold contact based on the clamping position when the same strain occurs in each tie bar 120. Specifically, as shown in FIG. 7(a), the clamping
15 position when the strain (ϵ) of each tie bar 120 becomes 100 is measured. In FIG. 7, the clamping positions when the strain of each tie bar 120A to 120D becomes 100 are indicated as CL POS(A) to CL POS(D), respectively. The clamping position is expressed as the amount of movement by which the lower mold 160 has risen, with an appropriate position as a reference.

[0084] Describing using the specific example shown in FIG. 7(a), when the lower mold 160 is
20 raised using the mold clamping mechanism 150 and the lower mold 160 is pressed against the upper mold 170, a load is applied to each tie bar 120 and strain occurs in each tie bar 120. When the clamping position is gradually increased (the lower mold 160 is raised), first, when the clamping position becomes 99.8 (mm), the strain of the tie bar 120B becomes 100. When the clamping position is further increased, when the clamping position becomes 100 (mm), the strain
25 of the tie bar 120A and the tie bar 120C becomes 100. When the clamping position is further increased, when the clamping position becomes 100.1 (mm), the strain of the tie bar 120D becomes

100.

[0085] In the example shown in FIG. 7(a), it can be understood that the strain of the tie bar 120B on the right front side reached 100 at a relatively early stage (when the clamping position is small). From this, it is inferred that the mold contact on the right front side of the mold set is strong. Also, in the example shown in FIG. 7(a), it can be understood that the strain of the tie bar 120D on the left rear side reached 100 at a relatively late stage (when the clamping position is large). From this, it is inferred that the mold contact on the left rear side of the mold set is weak. Therefore, by adjusting the position of the fixed platen 140 with respect to each tie bar 120 so that the same strain occurs in each tie bar 120 at the same timing (same clamping position), uniformity of the mold contact of the mold set can be achieved.

[0086] Specifically, as shown in FIG. 7(b), the individual adjustment mechanism 200B corresponding to the tie bar 120B whose strain reached 100 at a relatively early stage is controlled to move the fixed platen 140 upward with respect to the tie bar 120B. This can weaken the mold contact on the right front side of the mold set. Also, the individual adjustment mechanism 200D corresponding to the tie bar 120D whose strain reached 100 at a relatively late stage is controlled to move the fixed platen 140 downward with respect to the tie bar 120D. This can strengthen the mold contact on the left rear side of the mold set.

[0087] In this way, by repeating the measurement of the clamping position when the strain reaches 100 and the control of the individual adjustment mechanism 200 several times, the position of the fixed platen 140 is adjusted so that the strain of each tie bar 120 reaches 100 at the same timing (clamping position), as shown in FIG. 7(b). This allows adjustment so that the mold contact of the mold set becomes uniform.

[0088] As described above, in the present embodiment, since the position of the fixed platen 140 with respect to the tie bar 120 can be adjusted for each tie bar 120, the position of the fixed platen 140 (the interval between the fixed platen 140 and the movable platen 130) can be finely adjusted. Also, since the position of the fixed platen 140 can be adjusted using the position adjustment

mechanism 190, the position adjustment of the fixed platen 140 using the pressure regulating plate 142 can be omitted or simplified. This can reduce the workload of the operator required for the position adjustment work of the fixed platen 140.

[0089] <Overview of Operation of Resin Molding Device 1>

5 Next, an overview of the operation of the resin molding device 1 configured as described above (a method for producing resin molded article using the resin molding device 1) will be described with reference to FIG. 1 and FIG. 8.

[0090] First, the position of the fixed platen 140 is adjusted as necessary (step S11 in FIG. 8). Specifically, adjustment of the clamping force using the position adjustment mechanism 190 and
10 adjustment of the mold contact are performed as described above. Note that the position adjustment of the fixed platen 140 in step S11 is performed at necessary timing, such as in the case of the mold set being replaced, in the case of starting resin molding of a different type of lead frame 2 or lead frames 2 with different lot numbers, or in the case of adjustment becoming necessary due to dimensional changes in each part caused by change over time of the component
15 assembly. In other words, in the case of adjustment being unnecessary, the adjustment in step S11 can be omitted.

[0091] Next, the lead frame 2 and the resin tablet T are transferred to the loader 17 (step S12 in FIG. 8). Specifically, in the supply module 10 shown in FIG. 1, the frame feeding part 11 feeds the lead frame 2 accommodated in the in-magazine unit (not shown) to the frame supply part 13. The
20 frame supply part 13 appropriately aligns the received lead frame 2 and transfers it to the loader 17.

[0092] Also, the resin material supply mechanism 14 transfers the number of resin tablets T required for one resin molding in the resin molding module 20 to the loader 17.

[0093] Next, the loader 17 is moved into the mold set (step S13 in FIG. 8). Specifically, after
25 receiving the lead frame 2 and the resin tablet T, the loader 17 moves to the resin molding module 20 while preheating the lead frame 2. Then, the loader 17 moves from the rear to the mold set of

the molding mechanism 100. After that, the loader 17 places the lead frame 2 on the upper surface of the lower mold 160 and accommodates (sets) the resin tablet T in the pot 161 of the lower mold 160 (step S14 in FIG. 8).

[0094] After placing the lead frame 2 on the lower mold 160 and housing the resin tablet T in the pot 161, the loader 17 retreats rearward from the mold set (step S15 in FIG. 8).

[0095] Next, mold clamping of the mold set is performed by the mold clamping mechanism 150 (step S16 in FIG. 4). Specifically, the mold clamping mechanism 150 is driven to raise the lower mold 160 toward the upper mold 170. When the lower mold 160 approaches the upper mold 170, the lead frame 2 is sandwiched between the lower mold 160 and the upper mold 170.

[0096] Next, injection of the resin material into the cavity is performed by the transfer mechanism 180 (step S17 in FIG. 8). Specifically, the resin tablet T accommodated in the pot 161 is heated and melted by heaters (the lower mold heater 114 and the upper mold heater 123) provided in the mold set. The transfer mechanism 180 can inject the melted resin tablet T (resin material) into the cavity by raising the plunger 181.

[0097] After the resin material is injected by the transfer mechanism 180, by waiting until a predetermined time elapses, the resin material is cured, and the chip 2a of the lead frame 2 may be resin sealed.

[0098] Next, mold opening of the mold set is performed by the mold clamping mechanism 150 (step S18 in FIG. 8). Specifically, the mold clamping mechanism 150 is driven to lower the lower mold 160 away from the upper mold 170. By this, the resin sealed lead frame 2 can be released from the upper mold 170. Thereafter, the lead frame 2 is unloaded from the mold set (step S19 in FIG. 8). Specifically, the lead frame 2 is unloaded from the mold set by the unloader 31 shown in FIG. 1 and housed in the substrate housing part 32 of the unloading module 30. In this manner, the resin sealed lead frame 2 (resin molded article) is manufactured.

[0099] Although the embodiment of the present invention has been described above, the present invention is not limited to the above embodiment, and appropriate modifications are possible

within the scope of the technical idea of the invention described in the claims.

[0100] For example, in the above embodiment, an example was shown in which mold contact and the like are adjusted by controlling the position adjustment mechanism 190 based on the strain generated in the tie bar 120, but the present invention is not limited to this. For example, the distance between the movable platen 130 and the fixed platen 140 (for example, the distance at each of the four corners) is measured using various measuring devices such as dial gauges and displacement meters, and the position adjustment mechanism 190 is controlled so that both become parallel, thereby making it possible to perform mold contact adjustment. Note that the position adjustment mechanism 190 can be controlled based on various information serving as a reference for mold contact, not limited to the strain of the tie bar 120 and the distance between the platens.

[0101] Also, in the present embodiment, a toggle link type mold clamping mechanism 150 that raises the lower mold 160 toward the upper mold 170 using the toggle link 151 is exemplified, but the present invention is not limited to this. For example, the present invention may also be applied to a linear axis system mold clamping mechanism that raises the lower mold 160 linearly toward the upper mold 170 using a ball screw, hydraulic (oil pressure) cylinder, or the like. Also, the driving source of the mold clamping mechanism 150 is not limited to a servo motor, and various driving sources such as hydraulic (oil pressure), pneumatic pressure, and the like may also be used.

[0102] Also, in the present embodiment, a spring 230 formed by a compression coil spring is exemplified as an example of an imparting member that applies force to the fixed platen 140, but the present invention is not limited to this. For example, as the imparting member, various members capable of applying force, such as a tension coil spring, a leaf spring, a cylinder, and the like, may be used.

[0103] Also, in the present embodiment, an adjusting nut 240 is exemplified as an example of a regulating member that restricts upward movement of the fixed platen 140, but the present invention is not limited to this. As the regulating member, various members capable of changing the vertical position may be used.

[0104] Also, in the present embodiment, a molding mechanism 100 including a pressure regulating plate 142 is exemplified, but the present invention is not limited to this. For example, it is also possible to omit the pressure regulating plate 142 and adjust the mold contact, clamping force, and the like using only the position adjustment mechanism 190.

5 **[0105]** Also, the configuration of the position adjustment mechanism 190 (individual adjustment mechanism 200) described in the present embodiment is an example, and the configuration may be arbitrarily changed as long as the position of the fixed platen 140 may be adjusted for each tie bar 120. For example, in the present embodiment, an example in which a driving source (servo motor 251) is provided for each individual adjustment mechanism 200 is shown, but a
10 configuration in which each individual adjustment mechanism 200 is operated using a common (single) driving source is also possible. In this case, for example, by providing a mechanism that switches whether or not power is transmitted from the driving source to each individual adjustment mechanism 200, the individual adjustment mechanisms 200 may be operated independently of each other.

15 **[0106]** Also, although not particularly described in the above embodiment, resin molding may be performed in a state where a release film is provided on the surface of the mold set (for example, the lower surface of the upper mold 170).

[0107] Also, in the above embodiment, a mold set composed of the lower mold 160 and the upper mold 170 has been described as an example, but it is also possible to use a mold set including
20 an intermediate mold, for example.

[0108] Also, in the above embodiment, the resin molding device 1 using the transfer molding method has been described as an example, but the present invention is not limited to this, and may also be applied to a resin molding device using a compression molding method.

[0109] <Supplementary Notes>

25 A resin molding device 1 according to a first aspect of the present invention comprises:
a fixed platen 140 (upper platen) to which an upper mold 170 is fixed;

a movable platen 130 to which a lower mold 160 is fixed;
a plurality of tie bars 120 connecting the fixed platen 140 and the movable platen 130;
a mold clamping mechanism 150 that moves the movable platen 130 up and down; and
a position adjustment mechanism 190 capable of adjusting the position of the fixed platen 140 with
5 respect to the tie bars 120 for each of the tie bars 120.

According to the resin molding device 1 of the first aspect of the present invention, the interval
between the fixed platen 140 and the movable platen 130 may be finely adjusted. This allows
fine adjustment of the clamping force, mold contact, and the like.

[0110] The position adjustment mechanism 190 of the second aspect according to the first aspect
10 comprises:

a plurality of individual adjustment mechanisms 200 respectively provided on the plurality of tie
bars 120 and capable of adjusting the position of the fixed platen 140 with respect to the tie bars
120.

According to the resin molding device 1 of the second aspect of the present invention, the interval
15 between the fixed platen 140 and the movable platen 130 can be finely adjusted.

[0111] The individual adjustment mechanism 200 of the third aspect according to the second
aspect comprises:

a spring 230 (imparting member) that applies an upward force to the fixed platen 140;
an adjusting nut 240 (regulating member) that regulates the upward movement of the fixed platen
20 140; and
a change mechanism 250 that changes the vertical position of the adjusting nut 240.

According to the resin molding device 1 of the third aspect of the present invention, the position
of the fixed platen 140 can be adjusted with a simple configuration.

[0112] The change mechanism 250 of the fourth aspect according to the third aspect comprises:
25 a servo motor 251 (driving source); and

a transmission part (decelerating mechanism 252, drive gear 253, and driven gear 254) that

transmits the power of the servo motor 251 to the adjusting nut 240.

According to the resin molding device 1 of the fourth aspect of the present invention, the position of the fixed platen 140 can be adjusted with a simple configuration.

[0113] The driving source of the fifth aspect according to the fourth aspect is

5 configured by a servo motor 251.

According to the resin molding device 1 of the fifth aspect of the present invention, the position of the fixed platen 140 can be finely adjusted.

[0114] The transmission part of the sixth aspect according to the fourth or fifth aspect is

provided with a decelerating mechanism 252 capable of decelerating and transmitting the power
10 of the servo motor 251.

According to the resin molding device 1 of the sixth aspect of the present invention, the torque of the servo motor 251 can be increased. This allows the fixed platen 140 to be moved more reliably.

[0115] The mold clamping mechanism 150 of the seventh aspect according to any one of the first to sixth aspects is

15 configured by a toggle link system or a linear axis system.

According to the resin molding device 1 of the seventh aspect of the present invention, the interval between the fixed platen 140 and the movable platen 130 can be finely adjusted regardless of which system is used. In addition, particularly in the toggle link system, by adjusting the position of the fixed platen 140, adjustment can be made so that mold clamping is performed near the top
20 dead center of the toggle link 151, thereby enabling optimization of the capacity of the driving source of the mold clamping mechanism 150.

[0116] The resin molding device 1 of the eighth aspect according to any one of the first to seventh aspects comprises strain gauges 260 that are respectively provided on the plurality of tie bars 120 and are capable of detecting strain of the tie bars 120.

25 According to the resin molding device 1 of the eighth aspect of the present invention, the interval between the fixed platen 140 and the movable platen 130 (the state of mold contact, etc.) can be

easily inferred. This enables easy adjustment of the position of the fixed platen 140.

[0117] A method for producing resin molded article of the ninth aspect of the present invention is

a method for producing resin molded article using the resin molding device 1 according to any one
5 of the first to eighth aspects, the method comprises:

an adjustment process (step S11) of adjusting the position of the fixed platen 140 with respect to the tie bars 120;

after the adjustment process, a mold clamping process (step S16) of moving the movable platen 130 with respect to the fixed platen 140 to perform mold clamping; and

10 after the mold clamping process, a resin molding process (step S17) of resin molding the lead frame 2 (molding target).

According to the method for producing resin molded article of the ninth aspect of the present invention, the interval between the fixed platen 140 and the movable platen 130 can be finely adjusted. This allows fine adjustment of the clamping force, mold contact, and the like.

15 **Description of Reference Numerals**

[0118]

1 resin molding device

100 molding mechanism

120 tie bar

20 130 movable platen

140 fixed platen

160 lower mold

170 upper mold

190 position adjustment mechanism

25 200 individual adjustment mechanism

230 spring

	240 adjusting nut
	250 change mechanism
	251 servo motor
	252 decelerating mechanism
5	253 drive gear
	254 driven gear
	260 strain gauge

CLAIMS

[Claim 1] A resin molding device comprising:

an upper platen, wherein an upper mold is fixed to the upper platen;

a lower platen, wherein a lower mold is fixed to the lower platen;

5 a plurality of tie bars, wherein the plurality of tie bars connect the upper platen and the lower platen;

a mold clamping mechanism, wherein the mold clamping mechanism moves the lower platen vertically; and

a position adjustment mechanism, wherein the position adjustment mechanism is
10 capable of adjusting a position of the upper platen with respect to the tie bars for each of the tie bars.

[Claim 2] The resin molding device according to claim 1, wherein

the position adjustment mechanism comprises:

a plurality of individual adjustment mechanisms, wherein the plurality of individual
15 adjustment mechanisms are respectively provided on the plurality of tie bars, and are capable of adjusting the position of the upper platen with respect to the tie bars.

[Claim 3] The resin molding device according to claim 2, wherein

the individual adjustment mechanism comprises:

an imparting member, wherein the imparting member applies an upward force to the
20 upper platen;

a regulating member, wherein the regulating member restricts an upward movement of the upper platen; and

a change mechanism, wherein the change mechanism changes a vertical position of the regulating member.

25 [Claim 4] The resin molding device according to claim 3, wherein

the change mechanism comprises:

a driving source; and

a transmission part, wherein the transmission part transmits a power of the driving source to the regulating member.

[Claim 5] The resin molding device according to claim 4, wherein

5 the driving source is constituted by
 a servo motor.

[Claim 6] The resin molding device according to claim 4 or claim 5, wherein

the transmission part comprises:

10 a decelerating mechanism capable of decelerating and transmitting the power of the
driving source.

[Claim 7] The resin molding device according to any one of claim 1 to claim 6, wherein

the mold clamping mechanism is constituted by
a toggle link system or a linear axis system.

[Claim 8] The resin molding device according to any one of claim 1 to claim 7, comprising

15 strain gauges, wherein the strain gauges are respectively provided on the plurality of tie
bars and are capable of detecting strains of the tie bars.

[Claim 9] A method for producing resin molded article using the resin molding device according
to any one of claim 1 to claim 8, comprising:

20 an adjustment process of adjusting the position of the upper platen with respect to the
tie bars;

a mold clamping process of moving the lower platen with respect to the upper platen to
perform mold clamping after the adjustment process; and

a resin molding process of resin molding a molding target after the mold clamping
process.

25