DESCRIPTION

TITLE OF INVENTION: UPPER MOLD, RESIN MOLDING APPARATUS, AND METHOD FOR MANUFACTURING A RESIN MOLDED ARTICLE

Technical Field

[0001] The present invention relates to an upper mold, a resin molding apparatus, and a method for manufacturing a resin molded article.

Background Technology

[0002] Some resin molding apparatus for manufacturing a resin molded article use a release film in a cavity of a lower mold. For example, Patent Document 1 describes a resin molding apparatus that carries a release film into a molding die together with resin. In the resin molding apparatus described in Patent Document 1, the release film is suction-fixed to a suction groove formed on an outer side of the cavity of the lower mold and to a gap between blocks constituting the lower mold, and is further fixed to the lower mold by a film pressing part provided in the upper mold during mold clamping. This fixes the release film to the lower mold without wrinkles and deflections.

Related Art Literature

Patent Literature

[0003] Patent Document 1: Japanese Patent Application Laid-Open Publication No. 2013-187340

SUMMARY OF INVENTION

Problems to Be Solved by the Invention

[0004] Here, in a resin molding apparatus, a release film may be used not only in a lower mold having a cavity but also in an upper mold that holds an object to be molded. For example, the release film may be used in the upper mold in cases such as performing overmolding that seals not only a lower surface of the object to be molded, but also side faces thereof with resin, or preventing damage to the object to be molded. In the case of using a release film in the upper mold, it is

necessary to prevent wrinkles and deflections of the release film.

[0005] The present invention has been made in view of the above circumstances, and a problem to be solved is to provide an upper mold, a resin molding apparatus, and a method for manufacturing a resin molded article capable of preventing wrinkles and deflections of a release film used in the upper mold.

Means for Solving the Problems

[0006] The problem to be solved by the present invention is as described above, and to solve this problem, an upper mold according to the present invention comprises: an upper-mold main block holding an object to be molded; an upper-mold base supporting the upper-mold main block; a first film pressing part pressing, from above, a lower-mold release film arranged on a lower mold; a second film pressing part arranged above the first film pressing part and pressing, from above, an upper-mold release film arranged on the upper-mold main block; and a connecting part connecting the first film pressing part and the second film pressing part as well as holding the first film pressing part and the second film pressing part to the upper-mold base.

[0007] Also, a resin molding apparatus according to the present invention comprises: the upper mold; a lower mold having a cavity arranged to face the upper mold; a supply-side roll around which one end side of the upper-mold release film arranged below the upper mold is wound and which is capable of supplying the upper-mold release film to the upper mold; a take-up-side roll around which the other end side of the upper-mold release film is wound and which is capable of taking up the upper-mold release film; and an elevating mechanism capable of raising and lowering the supply-side roll and the take-up-side roll in a vertical direction.

[0008] Also, a method for manufacturing a resin molded article according to the present invention is a method for manufacturing a resin molded article using the resin molding apparatus, and comprises: causing the upper-mold main block to hold the object to be molded via the upper-mold release film; and performing mold clamping of the upper mold and the lower mold.

Effects of Invention

[0009] According to the present invention, wrinkles and deflections of the release film used in the upper mold can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] [FIG. 1] is a schematic plan view illustrating an overall configuration of a resin molding apparatus according to an embodiment.

[FIG. 2] is a schematic front cross-sectional view illustrating a configuration of a molding die part of a molding module.

[FIG. 3] is a bottom view illustrating the upper mold.

[FIG. 4] (a) is a bottom perspective view illustrating the upper mold, (b) is an enlarged view of part A.

[FIG. 5] is a front cross-sectional view illustrating the connecting part.

[FIG. 6] is a schematic front cross-sectional view illustrating a state in which the upper-mold release film and the substrate are suctioned to the upper mold.

[FIG. 7] is a schematic front cross-sectional view illustrating a state in which the lower mold and the upper mold are clamped.

[FIG. 8] is a schematic front cross-sectional view illustrating a state in which the lower mold and the upper mold are opened.

DESCRIPTION OF THE EMBODIMENTS

[0011] In the following, the directions indicated by arrow U, arrow D, arrow L, arrow R, arrow F, and arrow B shown in the drawings are defined as upward direction, downward direction, leftward direction, rightward direction, forward direction, and rearward direction, respectively, for the description.

[0012] <Overall Configuration of Resin molding apparatus 1>

First, the configuration of the resin molding apparatus 1 of the present embodiment is

described with reference to FIG. 1. The resin molding apparatus 1 performs resin molding by a compression molding method. The resin molding apparatus 1 resin-encapsulates electronic elements such as semiconductor chips fixed to a pre-molded substrate Wa, which is an object to be molded, and manufactures a resin molded article. As the pre-molded substrate Wa, a semiconductor substrate such as a silicon wafer, a metal substrate, a glass substrate, a ceramic substrate, or a resin substrate may be used. The pre-molded substrate Wa may or may not have wiring applied thereto. In the embodiment described below, a circular pre-molded substrate Wa is used; however, the shape of the pre-molded substrate Wa is not particularly limited. For example, a substrate formed into a rectangular shape may also be used as the pre-molded substrate Wa.

[0013] The resin molding apparatus 1 mainly comprises a molding unit 10, a substrate unit 20, a resin supply unit 30, a rail 40, a control part 50, and the like. The substrate unit 20, the molding unit 10, and the resin supply unit 30 are arranged in a line from left to right. The rail 40 is arranged to extend in the direction in which the units are arranged (the left-right direction). The molding unit 10, the substrate unit 20, and the resin supply unit 30 are detachable from adjacent units. The number of each unit may be increased or decreased as appropriate according to need.

[0014] The molding unit 10 resin-encapsulates electronic elements such as semiconductor chips fixed to the pre-molded substrate Wa within a cavity C to form a molded substrate Wb. The molding unit 10 comprises a molding die including an upper mold 120 (see FIG. 2) and a lower mold 110, and a heating means (not shown) for heating and melting a granular resin R. The pre-molded substrate Wa, with the face to which the electronic elements are fixed directed downward, may be suction-fixed to the lower surface of the upper mold 120. The lower mold 110 is provided with a cavity C capable of accommodating the granular resin R.

[0015] In addition, the molding unit 10 further comprises a film mechanism 170 for supplying an upper-mold release film F to the upper mold 120. The film mechanism 170 comprises a

supply-side roll 171 that feeds an elongated upper-mold release film F to the upper mold 120, and a take-up-side roll 172 that winds the upper-mold release film F from the upper mold 120.

[0016] The substrate unit 20 supplies the pre-molded substrate Wa to the molding unit 10 and carries out the molded substrate Wb formed by the molding unit 10. The substrate unit 20 comprises a substrate loader 21, a pre-molded substrate storage part 22, a molded substrate storage part 23, and a robot arm mechanism 24. The substrate loader 21 supplies the pre-molded substrate Wa to the molding unit 10 and carries out the molded substrate Wb formed by the molding unit 10 from the molding unit 10. The substrate loader 21 is arranged on the rail 40.

[0017] The resin supply unit 30 supplies the granular resin R in a uniform thickness onto a lower-mold release film 33, and supplies the lower-mold release film 33 on which the granular resin R is arranged into the cavity C of the molding die. The resin supply unit 30 comprises an elongated release film 33a wound in a roll shape, a grip 34 gripping and pulling out a leading end of the elongated release film 33a, a film cutting mechanism 36 cutting the elongated release film 33a to a required length and separating it, a mounting table 35 on which the elongated release film 33a is mounted, and a linear feeder 37 being a supply mechanism for the granular resin R.

[0018] In addition, the resin supply unit 30 further comprises an integrated resin loader 31 and a post-processing mechanism 32. The resin loader 31 is capable of arranging a circular frame 38 onto the lower-mold release film 33 pulled out onto the mounting table 35. The resin loader 31 is also capable of supplying the granular resin R supplied inside the circular frame 38 arranged on the lower-mold release film 33 into the cavity C of the molding die in that state. The post-processing mechanism 32 is provided with an upper-mold surface cleaner and a release film removal mechanism arranged below the upper-mold surface cleaner, integrally provided together. The resin loader 31 and the post-processing mechanism 32 are arranged on the rail 40.

[0019] The control part 50 is arranged at an arbitrary position of the resin molding apparatus 1 (in the illustrated example, at a front part of the resin molding apparatus 1). The control part 50

is capable of controlling operations of the respective parts described above in order to resin-encapsulate electronic elements fixed to the pre-molded substrate Wa and obtain the molded substrate Wb.

[0020] Next, the configuration of the molding unit 10 is described with reference to FIG. 2 to FIG. 5. Note that the cross-sectional view shown in FIG. 2 is a schematic illustration of the molding unit 10 for the purpose of description, and does not strictly illustrate the shape, arrangement, or the like of each part. In the following description, the pre-molded substrate Wa and the molded substrate Wb may be referred to as a substrate W without specific annotation.

[0021] The molding unit 10 comprises a molding die including a lower mold 110 and an upper mold 120, and mainly comprises a lower-mold base 130, an upper-mold base 160, a lower-mold main block 140, an upper-mold main block 150, a decompression mechanism 60, a film mechanism 170, a lower-mold film pressing part 180, an upper-mold film pressing part 190, and a connecting part 200, and the like.

[0022] The lower-mold base 130 shown in FIG. 2 supports the lower-mold main block 140. The lower-mold base 130 is formed into a plate shape having an appropriate width in the vertical direction. A suction path 111 is formed in the lower-mold base 130.

[0023] The suction path 111 is an air suction path for suctioning air. The suction path 111 is formed so as to connect the upper surface of the lower-mold base 130 and the outside.

[0024] The lower-mold base 130 is held by a lower-mold holder (not shown) of the molding unit 10, and a mold clamping mechanism (not shown) is provided at a lower part of the lower-mold holder. The mold clamping mechanism is capable of raising and lowering the lower-mold main block 140 via the lower-mold base 130 to perform mold clamping and mold opening. A ball screw mechanism, a hydraulic cylinder, a toggle mechanism, or the like may be used as the mold clamping mechanism.

[0025] The upper-mold base 160 is held by an upper-mold holder (not shown) of the molding

unit 10, and the upper-mold holder supports the upper-mold main block 150. The upper-mold base 160 mainly comprises an upper-side member 161, a lower-side member 162, an alignment block 163, an outer suction path 164, and an inner suction path 165, and the like.

[0026] The upper-side member 161 shown in FIG. 2, FIG. 4, and FIG. 5 constitutes an upper part of the upper-mold base 160. Note that, among FIG. 4(a) and FIG. 4(b), the upper-mold release film F is omitted in FIG. 4(a). The upper-side member 161 is formed into a plate shape having an appropriate width in the vertical direction. The upper-side member 161 is formed into a substantially rectangular shape as viewed from the vertical direction. As shown in FIG. 5, an upper-side recess 161a is formed in the upper-side member 161.

[0027] The upper-side recess 161a is formed on a lower surface of the upper-side member 161. The upper-side recess 161a has an appropriate depth in the vertical direction. The upper-side recess 161a is formed such that a cross-sectional shape as viewed from the vertical direction is circular. Multiple upper-side recesses 161a are formed at positions corresponding to connecting parts 200 described later.

[0028] The lower-side member 162 constitutes a lower part of the upper-mold base 160. The lower-side member 162 is formed into a plate shape having an appropriate width in the vertical direction. The lower-side member 162 is formed into the same shape (substantially rectangular shape) as the upper-side member 161 as viewed from the vertical direction. The lower-side member 162 is fixed to the lower surface of the upper-side member 161. A lower-side through-hole 162a is formed in the lower-side member 162.

[0029] The lower-side through-hole 162a is formed so as to penetrate the lower-side member 162 in the vertical direction. The lower-side through-hole 162a is formed such that a cross-sectional shape as viewed from the vertical direction is circular. An inner diameter of a lower part of the lower-side through-hole 162a is formed to be smaller than an inner diameter of an upper part thereof. Multiple lower-side through-holes 162a are formed at positions corresponding to

the upper-side recesses 161a. Specifically, the lower-side through-hole 162a is formed at a position facing the upper-side recess 161a in the vertical direction.

[0030] The alignment block 163 shown in FIG. 2 to FIG. 4 is for performing alignment between the substrate loader 21 (see FIG. 1) and the upper-mold main block 150. The alignment block 163 is formed into a substantially rectangular parallelepiped shape. The alignment block 163 is fixed to a lower surface of the lower-side member 162. Multiple alignment blocks 163 are arranged around the upper-mold main block 150. In the present embodiment, as shown in FIG. 3 and FIG. 4, the alignment blocks 163 are arranged at four locations around the upper-mold main block 150. The alignment blocks 163 are arranged at equal intervals with reference to a center of the upper-mold main block 150 in a bottom view. An alignment recess 163a is formed in the alignment block 163.

[0031] The alignment recess 163a is formed in a lower surface of the alignment block 163. The alignment recess 163a has an appropriate depth in the vertical direction.

[0032] The outer suction path 164 shown in FIG. 2 is an air suction path for suctioning air when suctioning the upper-mold release film F by the suction groove 151 formed in the upper-mold main block 150. The outer suction path 164 is formed so as to connect a lower surface of the upper-mold base 160 (the lower-side member 162) with the outside. Multiple outer suction paths 164 are formed at positions facing an outer peripheral end of the upper-mold main block 150 in the vertical direction. A lower part of the outer suction path 164 is connected to a connection hole 152 of the upper-mold main block 150.

[0033] The inner suction path 165 is an air suction path for suctioning air when suctioning the substrate W by an inner suction hole 153 formed in the upper-mold main block 150. The inner suction path 165 is formed so as to connect a lower surface of the upper-mold base 160 (the lower-side member 162) with the outside. The inner suction path 165 is formed further inward than the outer suction path 164 in the horizontal direction. Lower parts of the inner suction paths 165 are

connected to each other. The lower parts of the inner suction paths 165 are also connected to the inner suction hole 153 of the upper-mold main block 150.

[0034] The lower-mold main block 140 forms a lower part of the molding die as well as forming the cavity C. The lower-mold main block 140 mainly comprises a bottom surface member 141, a side surface member 142, an elastic member 143, and the like.

[0035] The bottom surface member 141 forms a bottom surface of the cavity C. The bottom surface member 141 is formed into a circular shape in a plan view. The bottom surface member 141 is formed so as to have an appropriate width in the vertical direction. The bottom surface member 141 is arranged in a state of being mounted on a central part of the lower-mold base 130. A suction path 141a is formed in the bottom surface member 141.

[0036] The suction path 141a is an air suction path for suctioning air when suctioning the lower-mold release film 33 (see FIG. 1) to the lower-mold main block 140. The suction path 141a is formed so as to connect a side face and a lower surface of the bottom surface member 141. The suction path 141a of the lower-mold main block 140 is connected to the suction path 111 of the lower-mold base 130. The suction path 141a is capable of suctioning air through a minute gap between the bottom surface member 141 and the side surface member 142, and through suction grooves (not shown) and suction paths (not shown) formed in the bottom surface member 141, which are described later.

[0037] The side surface member 142 surrounds the bottom surface member 141 from the lateral sides. The side surface member 142 is formed into a frame shape and is formed so as to have an appropriate width in the vertical direction. A hollow part that penetrates the side surface member 142 vertically through the center of the side surface member 142 is formed in the side surface member 142. The hollow part of the side surface member 142 is formed into a shape that substantially corresponds to an outer shape of the bottom surface member 141 in a plan view.

[0038] In this way, the side surface member 142 is formed into a circular frame shape in a plan

view. The bottom surface member 141 is arranged in the hollow part of the side surface member 142. The side surface member 142 is arranged in a state of being mounted on the lower-mold base 130 via the elastic member 143. An upper surface of the side surface member 142 is positioned above an upper surface of the bottom surface member 141. The cavity C for performing resin molding is defined by the side surface member 142, the bottom surface member 141, and the upper-mold main block 150. Further, suction grooves (not shown) for the lower-mold release film 33 are formed on the upper surface of the side surface member 142, and suction paths (not shown) are formed from the suction grooves to a side face of the hollow part of the side surface member 142.

[0039] The elastic member 143 is arranged between the side surface member 142 and the lower-mold base 130. The elastic member 143 is formed by, for example, a compression coil spring or the like that is extendable and contractible in the vertical direction.

[0040] The upper-mold main block 150 forms an upper part of the molding die as well as holding the object to be molded (substrate W). The upper-mold main block 150 is formed into a circular shape in a bottom view. The upper-mold main block 150 is formed so as to have an appropriate width in the vertical direction. The upper-mold main block 150 is fixed to a central part of a lower surface of the upper-mold base 160. A lower surface of the upper-mold main block 150 is a suction face capable of suctioning the object to be molded. The suction groove 151, the connection hole 152, and the inner suction hole 153 are formed in the upper-mold main block 150.

[0041] The suction groove 151 shown in FIG. 2 to FIG. 4 is for suctioning the upper-mold release film F. The suction groove 151 is formed on the lower surface of the upper-mold main block 150. The suction groove 151 is formed so as to extend along an outer periphery of the upper-mold main block 150. The suction groove 151 is formed into a substantially annular shape in a bottom view.

[0042] The connection hole 152 shown in FIG. 2 connects the outer suction path 164 of the

upper-mold base 160 and the suction groove 151. The connection hole 152 is formed so as to penetrate through the upper-mold main block 150 in the vertical direction. A lower part of the connection hole 152 is connected to the suction groove 151. An upper part of the connection hole 152 is connected to the outer suction path 164 of the upper-mold base 160. Multiple connection holes 152 are formed along the suction groove 151.

[0043] The inner suction hole 153 shown in FIG. 2 to FIG. 4 is for suctioning the substrate W. The inner suction hole 153 is formed so as to penetrate through the upper-mold main block 150 in the vertical direction. Multiple inner suction holes 153 are formed on an inner side of the suction groove 151 in a horizontal direction. An upper part of the inner suction hole 153 is connected to the inner suction path 165 of the upper-mold base 160.

[0044] The decompression mechanism 60 shown in FIG. 2 is for suctioning air to perform decompression of each part. The decompression mechanism 60 may be configured by, for example, a decompression pump or the like. The decompression mechanism 60 is connected to the lower-mold base 130 and the upper-mold base 160 via an air suction path configured by an appropriate hose or the like. Specifically, the decompression mechanism 60 is connected to the suction path 111 of the lower-mold base 130, and the outer suction path 164 and the inner suction path 165 of the upper-mold base 160, respectively. The decompression mechanism 60 is capable of independently suctioning the air in the suction path 111, the outer suction path 164, and the inner suction path 165, respectively.

[0045] The film mechanism 170 is for supplying the upper-mold release film F to the upper-mold main block 150. The film mechanism 170 mainly comprises a supply-side roll 171, a take-up-side roll 172, an elevating mechanism 173, and the like.

[0046] The supply-side roll 171 is for supplying the upper-mold release film F to the upper-mold main block 150. An unused upper-mold release film F is wound around the supply-side roll 171. The supply-side roll 171 is arranged on a front side of the upper-mold base 160 with a rotation

axis directed in a left-right direction. The supply-side roll 171 is capable of rotating by a drive mechanism (not shown). As shown in FIG. 3, the upper-mold release film F is formed in an elongated shape with a longitudinal direction directed in a front-rear direction. A width of the upper-mold release film F in a short-side direction (left-right direction) is formed so as to be substantially constant over an entire region in the longitudinal direction.

[0047] The take-up-side roll 172 is for winding up and collecting the upper-mold release film F used in the upper-mold main block 150. The take-up-side roll 172 is arranged on a rear side of the upper-mold base 160 with a rotation axis directed in a left-right direction. The take-up-side roll 172 is capable of rotating by a drive mechanism (not shown). The upper-mold release film F after being used in the upper-mold main block 150 is wound around the take-up-side roll 172.

[0048] In this manner, a single upper-mold release film F formed in an elongated shape is wound around the supply-side roll 171 and the take-up-side roll 172. As shown in FIG. 3, an intermediate part of the upper-mold release film F is arranged below the upper-mold main block 150 so as to face the upper-mold main block 150 in the vertical direction. As described later, it is necessary to suction the pre-molded substrate Wa to the upper-mold main block 150. For this reason, multiple suction through-holes Fa for enabling air suction are formed in the upper-mold release film F (see FIG. 2). In the present embodiment, the upper-mold release film F is also arranged so as to face the alignment block 163 in the vertical direction. As described later, it is necessary to fit the alignment protrusion 21a of the substrate loader 21 into the alignment recess 163a of the alignment block 163. For this reason, an alignment through-hole Fb is formed in advance in the upper-mold release film F at a position facing the alignment block 163.

[0049] Note that, in the present embodiment, an example is shown in which the upper-mold release film F is supplied in the front-rear direction by the supply-side roll 171 and the take-up-side roll 172; however, the supply direction of the upper-mold release film F is not limited to this and may be arbitrarily changed.

[0050] The elevating mechanism 173 shown in FIG. 2 is for raising and lowering the supply-side roll 171 and the take-up-side roll 172 in the vertical direction. The elevating mechanism 173 is provided on each of the supply-side roll 171 and the take-up-side roll 172. The elevating mechanism 173 is capable of raising and lowering the supply-side roll 171 and the take-up-side roll 172 by an arbitrary amount in the vertical direction by a drive mechanism (not shown).

[0051] The lower-mold film pressing part 180 shown in FIG. 2 to FIG. 5 is for pushing the lower-mold release film 33 for the lower-mold main block 140 downward. As shown in FIG. 3 and FIG. 4, the lower-mold film pressing part 180 is formed so as to be annular in a bottom view. The lower-mold film pressing part 180 is arranged so as to surround the upper-mold main block 150 from the outside in a bottom view. The lower-mold film pressing part 180 is also arranged further inward than the alignment block 163 in a bottom view.

[0052] The upper-mold film pressing part 190 shown in FIG. 2 to FIG. 5 is for pushing the upper-mold release film F downward. The upper-mold film pressing part 190 is arranged above the lower-mold film pressing part 180. As shown in FIG. 3 and FIG. 4, the upper-mold film pressing part 190 is formed so as to have substantially the same shape as the lower-mold film pressing part 180 in a bottom view. Specifically, the upper-mold film pressing part 190 is formed so as to be annular in a bottom view. The upper-mold film pressing part 190 is arranged so as to surround the upper-mold main block 150 from the outside in a bottom view. The upper-mold film pressing part 190 is also arranged further inward than the alignment block 163 in a bottom view. In this way, the upper-mold film pressing part 190 is arranged so as to be positioned between the alignment block 163 and the upper-mold main block 150 in a bottom view.

[0053] The connecting part 200 shown in FIG. 3 to FIG. 5 is for connecting the lower-mold film pressing part 180 and the upper-mold film pressing part 190 to the upper-mold main block 150 (more specifically, for connecting to the upper-mold main block 150 via the upper-mold base 160). As shown in FIG. 3, the connecting part 200 connects the vicinities of both left and right ends of

the lower-mold film pressing part 180 and the upper-mold film pressing part 190 to the upper-mold main block 150. Specifically, the connecting part 200 is arranged further outward than the upper-mold release film F in the width direction (left-right direction) of the upper-mold release film F arranged below the upper-mold main block 150. Note that the width direction of the upper-mold release film F is a direction orthogonal to the supply direction of the upper-mold release film F and the thickness direction of the upper-mold release film F. In the present embodiment, the width direction of the upper-mold release film F corresponds to the left-right direction. In the present embodiment, four connecting parts 200 are provided on each of the left and right sides of the upper-mold release film F.

[0054] As shown in FIG. 5, the connecting part 200 mainly comprises a holding part 210, a fastening part 220, a first adjustment member 230, a second adjustment member 240, an elastic member 250, and the like.

[0055] The holding part 210 is for holding the lower-mold film pressing part 180 and the upper-mold film pressing part 190 with respect to the upper-mold base 160. The holding part 210 mainly comprises a shaft part 211, a flange part 212, and the like.

[0056] The shaft part 211 is a substantially cylindrical part with its axial direction directed in the vertical direction. The flange part 212 is a circular plate-shaped part formed so as to expand in the horizontal direction from an upper end of the shaft part 211. A diameter of the flange part 212 is formed larger than an inner diameter of a lower part of the lower-side through-hole 162a formed in the lower-side member 162. The shaft part 211 of the holding part 210 is inserted into the lower-side through-hole 162a from above. Because the diameter of the flange part 212 is larger than the inner diameter of the lower part of the lower-side through-hole 162a, the holding part 210 is held by the lower-side member 162. The holding part 210 is capable of moving up and down along the lower-side through-hole 162a and the upper-side recess 161a.

[0057] The fastening part 220 is for fixing the lower-mold film pressing part 180 and the upper-

mold film pressing part 190 with respect to the holding part 210. The fastening part 220 is formed by a fastener such as a bolt that is fixable to the holding part 210. The fastening part 220 is inserted into the lower-mold film pressing part 180, the upper-mold film pressing part 190, and a first adjustment member 230 described later, from below. An upper end of the fastening part 220 is fastened to a lower part of the holding part 210. By this, the lower-mold film pressing part 180 and the upper-mold film pressing part 190 are fixed to the holding part 210.

[0058] The first adjustment member 230 is for adjusting the gap between the lower-mold film pressing part 180 and the upper-mold film pressing part 190. The first adjustment member 230 is disposed between the lower-mold film pressing part 180 and the upper-mold film pressing part 190. The first adjustment member 230 is formed in an annular shape. By disposing the first adjustment member 230 between the lower-mold film pressing part 180 and the upper-mold film pressing part 190, the lower-mold film pressing part 180 and the upper-mold film pressing part 190 may be disposed with a gap therebetween. In addition, by appropriately changing a thickness (width in the vertical direction) of the first adjustment member 230, the gap between the lower-mold film pressing part 180 and the upper-mold film pressing part 190 may be adjusted. In the present embodiment, the thickness of the first adjustment member 230 is set so that a gap through which the upper-mold release film F is capable of passing is formed between the lower-mold film pressing part 180 and the upper-mold film pressing part 190.

[0059] The second adjustment member 240 is for adjusting a position of the lower-mold film pressing part 180 and the upper-mold film pressing part 190 in the vertical direction. The second adjustment member 240 is disposed below the flange part 212 of the holding part 210 within the lower-side through-hole 162a. The second adjustment member 240 is formed in an annular shape. The shaft part 211 of the holding part 210 is inserted into the second adjustment member 240. By arranging the second adjustment member 240 below the flange part 212, the holding part 210 may be arranged in the lower-side member 162 in a state of being raised slightly upward. In addition,

by appropriately changing a thickness (width in the vertical direction) of the second adjustment member 240, a position at which the holding part 210 has moved furthest downward (lowermost position) may be adjusted. In the present embodiment, the thickness of the second adjustment member 240 is set so that, in a state in which the holding part 210 has descended furthest with respect to the lower-side member 162, a lower surface of the upper-mold film pressing part 190 is positioned slightly below a lower surface (suction face) of the upper-mold main block 150.

[0060] The elastic member 250 is for applying a downward force to the holding part 210. The elastic member 250 is formed by, for example, a compression coil spring or the like. The elastic member 250 is disposed above the flange part 212 of the holding part 210. The elastic member 250 is disposed between the upper-side recess 161a and the flange part 212 in a state of being compressed in the vertical direction. By this, the elastic member 250 is capable of applying a downward force to the holding part 210 at all times.

[0061] The following describes a method for manufacturing a resin molded article using the resin molding apparatus 1 configured as described above. The control part 50 is capable of manufacturing a resin molded article by controlling operations of each part of the resin molding apparatus 1.

[0062] First, in the molding unit 10 shown in FIG. 1 and FIG. 2, an unused upper-mold release film F fed from the supply-side roll 171 is arranged below the upper-mold main block 150. At this time, the upper-mold release film F is arranged so as to pass between the lower-mold film pressing part 180 and the upper-mold film pressing part 190, as shown in FIG. 2 to FIG. 4. In addition, in arranging the upper-mold release film F below the upper-mold main block 150, the vertical positions of the supply-side roll 171 and the take-up-side roll 172 are adjusted by the elevating mechanism 173 so that the upper-mold release film F does not interfere with the lower-mold film pressing part 180 and the upper-mold film pressing part 190.

[0063] Next, as shown in FIG. 6, the upper-mold release film F is suctioned to the suction groove

151 of the upper-mold main block 150 by the decompression mechanism 60. At this time, prior to suctioning, the supply-side roll 171 and the take-up-side roll 172 are raised slightly upward by the elevating mechanism 173. As a result, between the supply-side roll 171 and the take-up-side roll 172 and the upper-mold main block 150, the upper-mold film pressing part 190 comes to press the upper-mold release film F downward. In this manner, by pressing the upper-mold release film F with the upper-mold film pressing part 190, occurrence of wrinkles and deflections in the upper-mold release film F suctioned to the upper-mold main block 150 is suppressed.

[0064] In this embodiment in particular, because the alignment through-hole Fb is formed in the upper-mold release film F, wrinkles and deflections tend to occur starting from the alignment through-hole Fb. In the resin molding apparatus 1, by arranging the upper-mold film pressing part 190 on the upper-mold main block 150 side relative to the alignment through-hole Fb, the transmission of wrinkles and deflections to the upper-mold main block 150 side can be effectively suppressed.

[0065] Also, in the substrate unit 20 shown in FIG. 1, the control part 50 drives the robot arm mechanism 24 to take out the pre-molded substrate Wa from the pre-molded substrate storage part 22, turns the substrate over, and mounts the pre-molded substrate Wa on the substrate loader 21 with the face on which the electronic elements are fixed directed downward. The substrate loader 21 moves along the rail 40 to transfer the pre-molded substrate Wa to the molding unit 10.

[0066] As shown in FIG. 6, the substrate loader 21 has an alignment protrusion 21a formed thereon that protrudes upward. The alignment protrusion 21a is formed at a position corresponding to the alignment block 163 (alignment recess 163a) of the upper-mold base 160. The substrate loader 21 fits the alignment protrusion 21a into the alignment recess 163a of the upper-mold base 160, thereby being capable of performing alignment of the pre-molded substrate Wa with respect to the upper-mold main block 150. At this time, the alignment protrusion 21a is fitted into the alignment recess 163a via the alignment through-hole Fb of the upper-mold release

film F. In a state in which the substrate loader 21 is aligned with respect to the upper-mold main block 150, the pre-molded substrate Wa is suctioned to the inner suction hole 153 of the upper-mold main block 150 by the decompression mechanism 60. After the pre-molded substrate Wa is held by the upper-mold main block 150, the substrate loader 21 exits from the molding unit 10.

[0067] Also, in the resin supply unit 30 shown in FIG. 1, the grip 34 grips the leading end of the elongated release film 33a wound in a roll shape and pulls out the lower-mold release film 33 onto the mounting table 35. After that, the film cutting mechanism 36 cuts the lower-mold release film 33 that has been pulled out. A circular frame 38 is arranged by the resin loader 31 on top of the cut lower-mold release film 33. After that, by the lower-mold release film 33 being attached to the lower surface of the circular frame 38, a concave storage part is formed on the inner side of the circular frame 38. The granular resin R is supplied from the linear feeder 37 into the concave storage part at a uniform thickness.

[0068] The resin loader 31 holds the concave storage part into which the granular resin R has been supplied. The resin loader 31 moves along the rail 40 to transfer the concave storage part from the resin supply unit 30 to the molding unit 10, and places the concave storage part on the lower-mold main block 140.

[0069] After that, as shown in FIG. 7, air is suctioned from the suction path 141a of the lower-mold main block 140 by the decompression mechanism 60, whereby the lower-mold release film 33 is drawn into the cavity C together with the granular resin R thereon. After the circular frame 38 is removed from the lower-mold main block 140 by the resin loader 31, the granular resin R is heated and melted by the heating means.

[0070] Next, as shown in FIG. 7, the lower-mold base 130 is raised toward the upper-mold main block 150 by the mold clamping mechanism. As a result, the lower-mold film pressing part 180 provided on the upper-mold base 160 comes into contact with the lower-mold release film 33 provided on the lower-mold main block 140 from above. In a state where the lower-mold release

film 33 is pressed from above by the lower-mold film pressing part 180 in this manner, evacuation of the cavity C is performed by a decompression mechanism (not shown). At this time, as the pressure on the cavity C side decreases, the suction force of the lower-mold release film 33 via the lower-mold main block 140 decreases. However, because the lower-mold film pressing part 180 is pressing the lower-mold release film 33 from above, the lower-mold release film 33 can be prevented from floating up from the lower-mold main block 140.

[0071] In this state, the lower-mold base 130 is further elevated to perform mold clamping, whereby the electronic elements of the pre-molded substrate Wa are immersed in the melted granular resin R (molten resin). At this time, the lower-mold film pressing part 180 is pushed upward by the lower-mold main block 140, but the elastic member 250 contracts vertically, and the lower-mold film pressing part 180 and the upper-mold film pressing part 190 also move upward. For this reason, the mold clamping is not impeded by the lower-mold film pressing part 180 and the upper-mold film pressing part 190.

[0072] After a certain period of time, the molten resin solidifies, whereby resin molding is performed on the pre-molded substrate Wa, and the molded substrate Wb (a resin-sealed molded product of the electronic elements) is capable of being obtained. In the present embodiment, as shown in FIG. 8, overmolding is performed to cover the side faces of the substrate W with resin. In the case of covering the side faces of the substrate W with resin in this manner, by providing the upper-mold release film F on the upper-mold main block 150 as in the present embodiment, adhesion of resin to the upper-mold main block 150 can be prevented.

[0073] After the resin solidifies, the lower-mold base 130 is lowered to perform mold opening. As the lower-mold main block 140 is lowered, the elastic member 250 extends, whereby the lower-mold film pressing part 180 also descends together with the lower-mold main block 140 provided on the lower-mold base 130. As shown in FIG. 8, in a state where the lower-mold main block 140 has been lowered by a certain amount, air is temporarily supplied from the decompression

mechanism 60 to the suction path 141a of the lower-mold main block 140. By this, the lower-mold release film 33 is capable of being peeled from the molded substrate Wb. At this time, because the lower-mold release film 33 is pressed by the lower-mold film pressing part 180, scattering of the lower-mold release film 33 can be prevented.

[0074] Thereafter, the lower-mold base 130 is further lowered. The substrate loader 21 shown in FIG. 1 transfers the molded substrate Wb from the molding unit 10 to the substrate unit 20. The robot arm mechanism 24 takes out the molded substrate Wb from the substrate loader 21, as well as turning over the molded substrate Wb to direct the resin-sealed side upward. Thereafter, the robot arm mechanism 24 stores the molded substrate Wb in the molded substrate storage part 23.

[0075] After the molded substrate Wb is taken out from the molding unit 10, the portion of the upper-mold release film F that has been used for resin molding is wound up by the take-up-side roll 172 shown in FIG. 2. Along with this, an unused portion of the upper-mold release film F is supplied to the upper-mold main block 150. In addition, after the molded substrate Wb is taken out from the molding unit 10, the lower surface of the upper-mold main block 150 may be cleaned by an upper-mold surface cleaner of the post-processing mechanism 32. Furthermore, after the molded substrate Wb is taken out from the molding unit 10, the lower-mold release film 33 that is no longer needed is removed from the lower-mold main block 140 by a release film removal mechanism.

[0076] As described above, in the resin molding apparatus 1 according to the present embodiment, the upper-mold film pressing part 190 held on the upper-mold main block 150 side together with the lower-mold film pressing part 180 is capable of preventing wrinkles and deflections of the upper-mold release film F. By this, occurrence of molding defects can be prevented.

[0077] Although one 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 concept of the invention described in the claims.

[0078] For example, the configuration (shape, arrangement, number, etc.) of each part of the resin molding apparatus 1 described in the present embodiment is not particularly limited, and may be arbitrarily changed.

[0079] In the present embodiment, the upper-mold film pressing part 190 is formed in an annular shape; however, the present invention is not limited to this, and the upper-mold film pressing part 190 may be formed in any shape. For example, the upper-mold film pressing part 190 may be formed in a rectangular annular shape. In addition, the upper-mold film pressing part 190 is preferably formed in a shape corresponding to the shape of the pre-molded substrate Wa held by the upper-mold main block 150 (the outer shape of the upper-mold main block 150 in a bottom view).

[0080] In the present embodiment, the upper-mold film pressing part 190 is formed in an annular shape surrounding the upper-mold main block 150 in a bottom view; however, the present invention is not limited to this. For example, the upper-mold film pressing part 190 may be divided such that at least a portion thereof is interrupted. In the case where the alignment through-hole Fb is formed in the upper-mold release film F as in the present embodiment, it is preferable that the upper-mold film pressing part 190 is arranged at least between the alignment through-hole Fb and the upper-mold main block 150.

[0081] In addition, as with the upper-mold film pressing part 190, the shape of the lower-mold film pressing part 180 is not particularly limited. In addition, the shapes of the upper-mold film pressing part 190 and the lower-mold film pressing part 180 (for example, the shapes in a bottom view) do not have to be the same.

[0082] In the present embodiment, an example is shown in which the upper-mold release film F is arranged so as to face the alignment block 163 in the vertical direction; however, the present

invention is not limited to this. For example, the alignment block 163 may be arranged on the outer side of the upper-mold release film F in a width direction such that the upper-mold release film F does not face the alignment block 163. In this case, since the alignment through-hole Fb does not need to be formed in the upper-mold release film F, the occurrence of wrinkles and deflections can be reduced.

[0083] In the present embodiment, an example is shown in which the lower-mold release film 33 that has been cut in advance is arranged on the lower-mold main block 140; however, the present invention is not limited to this. For example, as with the upper-mold release film F, it is also possible to use a longitudinal elongated release film 33a wound in a roll shape without cutting it.

[0084] In the present embodiment, the resin molding apparatus 1 that performs resin molding by a compression molding method is illustrated; however, the present invention is not limited to this, and the present invention may also be applied to, for example, a resin molding apparatus that performs resin molding by a transfer molding method. In addition, in the present embodiment, granular resin is used; however, a liquid resin or a sheet resin may also be used.

[0085] <Supplementary Notes>

The upper mold 120 of a first aspect of the disclosure comprises:

an upper-mold main block 150 holding an object to be molded;

an upper-mold base 160 supporting the upper-mold main block 150;

a first film pressing part (lower-mold film pressing part 180) pressing, from above, the lower-mold release film 33 arranged on the lower mold 110;

a second film pressing part (upper-mold film pressing part 190) arranged above the first film pressing part and pressing, from above, the upper-mold release film F arranged on the upper-mold main block 150; and

a connecting part 200 connecting the first film pressing part and the second film pressing part and holding them on the upper-mold base 160.

According to the upper mold 120 of the first aspect of the disclosure, wrinkles and deflections of the release film used in the upper mold 120 can be prevented. That is, not only the release film used in the lower mold 110 but also the release film used in the upper mold 120 can be arranged without wrinkles and deflections. In addition, the connecting part 200 can hold the second film pressing part together with the first film pressing part. This enables the first film pressing part and the second film pressing part to be provided in a space-saving manner with a reduced number of components.

[0086] In the upper mold 120 of a second aspect according to the first aspect,

the connecting part 200 is arranged on an outer side in the width direction of the rectangular-shaped upper-mold release film F arranged on a part of a face of the upper-mold main block 150 on which the object to be molded is held.

According to the upper mold 120 of the second aspect of the disclosure, the connecting part 200 can be arranged so as not to interfere with the upper-mold release film F.

[0087] In the upper mold 120 of a third aspect according to the first or second aspect,

the connecting part 200 comprises:

a holding part 210 holding the first film pressing part and the second film pressing part to the upper-mold base 160; and

a first adjustment member 230 capable of adjusting the gap between the first film pressing part and the second film pressing part.

According to the upper mold 120 of the third aspect of the disclosure, the first adjustment member 230 allows the gap between the first film pressing part and the second film pressing part to be adjusted easily and appropriately. For example, by replacing the first adjustment member 230 with one having different dimensions, the gap between the first film pressing part and the second film pressing part can be easily adjusted.

[0088] In the upper mold 120 of a fourth aspect according to the first to third aspects,

the connecting part 200 is arranged so as to be movable in the vertical direction relative to the upper-mold base 160, and

a lower surface of the second film pressing part, in a state where the connecting part 200 has moved downward, is capable of being positioned below a lower surface of the upper-mold main block 150.

According to the upper mold 120 of the fourth aspect of the disclosure, the second film pressing part can be brought into appropriate contact with the upper-mold release film F. This allows wrinkles and deflections of the upper-mold release film F to be appropriately prevented.

[0089] In the upper mold 120 of a fifth aspect according to the fourth aspect,

the connecting part 200 further comprises a second adjustment member 240 capable of adjusting a lowermost position at which the connecting part 200 has moved furthest downward relative to the upper-mold main block 150.

According to the upper mold 120 of the fifth aspect of the disclosure, the second adjustment member 240 allows the position of the second film pressing part in the vertical direction to be adjusted easily and appropriately. For example, by replacing the second adjustment member 240 with one having different dimensions, the amount of protrusion of the second film pressing part from the suction face of the upper-mold main block 150 can be adjusted easily.

[0090] In the upper mold 120 of a sixth aspect according to the first to fifth aspects,

the upper mold 120 further comprises an alignment part (alignment block 163) aligning a position of the upper-mold main block 150 with a position of a transfer device (substrate loader 21) transferring the object to be molded, wherein

the second film pressing part is arranged, in a bottom view, between the alignment part and the upper-mold main block 150.

According to the upper mold 120 of the sixth aspect of the disclosure, wrinkles and deflections of the upper-mold release film F can be effectively prevented. That is, in the case

where through-holes or the like are formed in the upper-mold release film F according to the alignment part, wrinkles and deflections may occur starting from these through-holes. Transmission of wrinkles and deflections starting from the through-holes to the upper-mold main block 150 side can be effectively prevented.

[0091] In the upper mold 120 of a seventh aspect according to the first to sixth aspects,

the second film pressing part has, in a bottom view, a same shape as the first film pressing part.

According to the upper mold 120 of the seventh aspect of the disclosure, the first film pressing part and the second film pressing part can be arranged in a space-saving manner.

[0092] The resin molding apparatus 1 of an eighth aspect of the disclosure comprises:

the upper mold 120 of the first to seventh aspects,

a lower mold 110 having a cavity C, wherein the lower mold 110 is arranged to face the upper mold 120;

a supply-side roll 171, wherein one end side of the upper-mold release film F arranged below the upper mold is wound around the supply-side roll 171, and the supply-side roll 171 is capable of supplying the upper-mold release film F to the upper mold 120;

a take-up-side roll 172, wherein the other end side of the upper-mold release film F is wound around the take-up-side roll 172, and the take-up-side roll 172 is capable of taking up the upper-mold release film F; and

an elevating mechanism 173 capable of raising and lowering the supply-side roll 171 and the take-up-side roll 172 in a vertical direction.

According to the Resin molding apparatus 1 of the eighth aspect of the disclosure, by adjusting the vertical positions of the supply-side roll 171 and the take-up-side roll 172 with the elevating mechanism 173, interference between the upper-mold release film F and other members can be prevented. For example, in the case of supplying the upper-mold release film F to the

upper mold 120, and in the case of recovering the upper-mold release film F from the upper mold 120, the upper-mold release film F can avoid interference with other members. In addition, by bringing the upper-mold release film F into contact with the upper-mold film pressing part 190, wrinkles and deflections of the upper-mold release film F can be effectively prevented.

[0093] The method for manufacturing a resin molded article of the ninth aspect of the disclosure is a method for manufacturing a resin molded article using the resin molding apparatus 1 of the eighth aspect, comprising:

causing the upper-mold main block 150 to hold the object to be molded via the upper-mold release film F, and

performing mold clamping of the upper mold 120 and the lower mold 110.

According to the method for manufacturing a resin molded article of the ninth aspect of this disclosure, wrinkles and deflections of the release film used in the upper mold can be prevented.

Description of Reference Numerals

[0094]

1	resin molding apparatus
21	substrate loader
33	lower-mold release film
110	lower mold
120	upper mold
150	upper-mold main block
160	upper-mold base
163	alignment block
171	supply-side roll
172	take-up-side roll
173	elevating mechanism
180	lower-mold film pressing part

190 upper-mold film pressing part

200 connecting part

210 holding part

230 first adjustment member

240 second adjustment member

CLAIMS

[Claim 1] An upper mold, comprising:

an upper-mold main block holding an object to be molded;

an upper-mold base supporting the upper-mold main block;

a first film pressing part pressing, from above, a lower-mold release film arranged on a lower mold;

a second film pressing part arranged above the first film pressing part and pressing, from above, an upper-mold release film arranged on the upper-mold main block; and

a connecting part connecting the first film pressing part and the second film pressing part to each other and holding the first film pressing part and the second film pressing part to the upper-mold base.

[Claim 2] The upper mold according to claim 1, wherein

the connecting part is arranged on an outer side in a width direction of the rectangular-shaped upper-mold release film arranged on a portion of a surface of the upper-mold main block on which the object to be molded is held.

[Claim 3] The upper mold according to claim 1 or claim 2, wherein

the connecting part comprises:

a holding part holding the first film pressing part and the second film pressing part to the upper-mold base; and

a first adjustment member capable of adjusting a gap between the first film pressing part and the second film pressing part.

[Claim 4] The upper mold according to any one of claims 1 to 3, wherein

the connecting part is arranged so as to be movable in a vertical direction with respect to the upper-mold base, and

a lower surface of the second film pressing part, in a state where the connecting part has

moved downward, is capable of being positioned below a lower surface of the upper-mold main block.

[Claim 5] The upper mold according to claim 4, wherein,

the connecting part further comprises a second adjustment member capable of adjusting a lowermost position at which the connecting part moves furthest downward with respect to the upper-mold main block.

[Claim 6] The upper mold according to any one of claims 1 to 5, wherein

the upper mold further comprises:

an alignment part aligning a position of the upper-mold main block with a position of a transfer device transferring the object to be molded, wherein

the second film pressing part is arranged, in a bottom view, between the alignment part and the upper-mold main block.

[Claim 7] The upper mold according to any one of claims 1 to 6, wherein

the second film pressing part, in a bottom view, has a same shape as the first film pressing part.

[Claim 8] A resin molding apparatus comprising:

the upper mold according to any one of claims 1 to 7;

a lower mold having a cavity, wherein the lower mold is arranged to face the upper mold;

a supply-side roll, wherein one end side of the upper-mold release film arranged below the upper mold is wound around the supply-side roll, and the supply-side roll is capable of supplying the upper-mold release film to the upper mold;

a take-up-side roll, wherein the other end side of the upper-mold release film is wound around the take-up-side roll, and the take-up-side roll is capable of taking up the upper-mold release film; and

an elevating mechanism capable of raising and lowering the supply-side roll and the

take-up-side roll in a vertical direction.

[Claim 9] A method for manufacturing a resin molded article using the resin molding apparatus according to claim 8, wherein the method comprises:

causing the upper-mold main block to hold the object to be molded via the upper-mold release film; and

performing mold clamping of the upper mold and the lower mold.