RESIN MOLDING APPARATUS AND RESIN SUPPLY APPARATUS

FIELD OF TECHNOLOGY

The present invention relates to a resin molding apparatus (resin sealing apparatus) and a resin supply apparatus, especially relates to an efficient technology applied to a resin molding apparatus for resin-molding with granular resin including powder resin (hereinafter referred to as “granular resin”).

BACKGROUND TECHNOLOGY

Japanese Laid-open Patent Publication No. 2009-234000 (Patent Document 1) discloses a technology for supplying granular resin to a supply target. In this technology, the granular resin is supplied by using a shooter, which is extended in the vertical direction, and a diffusing member, which is provided in the shooter so as to diffuse the resin (a diffusing method).

PRIOR ART DOCUMENT

PATENT DOCUMENT

Patent Document 1: Japanese Laid-open Patent Publication No. 2009-234000

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

In one of resin molding apparatuses having a resin supply section, the resin supply section drops and supplies granular resin onto a surface of a workpiece (supply target), the workpiece is conveyed to the press section, and then the

granular resin is thermal-cured in the press section so as to form a resin-sealed part on the workpiece.

In one of methods for supplying the resin, the granular resin is stored in a cylindrical holder whose bottom is closed by a shutter, and the granular resin is dropped and supplied onto the workpiece by opening the shutter (an opening method). In another method for supplying the resin, the granular resin is dropped and supplied onto the workpiece by a resin dropping part, and a table on which the resin dropping part or the workpiece is mounted is moved in X- and Y-directions so as to supply the granular resin on a surface of the workpiece like traversable writing (a writing method). Further, the granular resin may be manually supplied onto the workpiece.

In case of performing the opening method, writing method or diffusing method, even if granular resin is dropped to be evenly supplied onto a surface of a workpiece, the deposited resin forms convexoconcaves on the surface. For example, in case of evenly supplying granular resin onto a workpiece on which electronic parts have been matrically mounted, convexoconcaves which correspond to the electronic parts must be formed on the surface of the supplied resin. If the workpiece on which the resin has been supplied in such a state is compression-molded, air pockets will be formed between molding dies and the workpiece and air cannot be sufficiently discharged, so mold defects, e.g., incomplete filling (voids), will be caused in a molded product (resin-sealed part).

An object of the present invention is to provide a technology capable of reducing mold defects such as incomplete filling. Said object, other objects and

characteristics of the present invention will be clarified from the description of the present specification and the attached drawings.

MEANS FOR SOLVING THE PROBLEMS

Typical structures of the present invention will be briefly described.

An example of the resin molding apparatus of the present invention comprises: a resin supply section for dropping granular resin onto a supply target; a conveying hand for conveying the supply target; and a press section including a pair of dies, in which a recessed cavity will be formed, the resin supply section includes: a trough for dropping the granular resin onto the supply target; a supply target mounting part, on which the supply target will be mounted, being located immediately under the trough; a driving mechanism for moving the trough; a first storing part storing the granular resin; a second storing part being smaller than the first storing part, the granular resin being supplied to the second storing part when the second storing part is moved to a prescribed position close to the first storing part thereby the second storing part temporarily stores the granular resin sent from the first storing part and supplies the granular resin to the trough; and a weight scale, which measures a supply amount of the dropped granular resin in a state where the supply target is mounted on the supply target mounting section, being provided to the supply target mounting part, the first storing part is fixed, the trough is moved, by the driving mechanism, together with the second storing part, the supply target mounting part is fixed, the trough is moved to supply the granular resin onto the supply target and form the same in a desired pattern thereon, the conveying hand conveys the supply target, on which the granular resin has been supplied, into the pair of dies and sets therein, and the press section clamps the supply target, on which the granular resin has been supplied, by the pair of dies and thermal-cures the

granular resin in the cavity for resin molding.

With the above described structure, the movable section including the trough and the second storing part can be made lighter and downsized, so that the trough can be moved smoothly. Further, an error between an actual supply amount of the dropped resin weighed by the weight scale and a predetermined supply amount thereof can be corrected. With this effect, mold defects such as incomplete filling can be reduced.

In the resin molding apparatus, a base resin part can be formed by a writing method, which is performed by continuously dropping the granular resin onto the supply target from the trough, with relatively moving the supply target mounting part with respect to the trough by the driving mechanism, and a convex resin part, which is higher than the base resin part, can be formed on a center part of the base resin part by supplying the granular resin.

With this structure, even if concavities and convexities are formed on the surface of the base resin part, the melted resin which has flowed from the convex resin part can fill the uneven surface of the base resin part. Therefore, mold defects such as incomplete filling can be reduced.

In the resin molding apparatus, the granular resin is supplied onto the entire surface of the supply target by repeating an action for supplying the granular resin onto the supply target in the form of a belt when the trough is reciprocally moved in the longitudinal direction of the trough.

Here, measuring the actual supply amount of the former dropping action by the weight scale and adjusting the supply amount for the next dropping action to correct an error between the measured supply amount and the predetermined amount are repeated.

With the above described structure, the granular resin can be dropped in one belt-like area by performing one dropping action, so the granular resin can be evenly supplied in the arranged belt-like areas by repeating this action. Further, an error of the total supply amount can be highly reduced.

The resin molding apparatus may further comprise a preheating section being provided on a workpiece conveying route between the resin supply section and the press section, the preheating section preheating the workpiece, on which the granular resin has been supplied, at a temperature lower than a molding temperature.

With this structure, the melted resin can reduce air between grains of the granular resin. Namely, involving air in a resin-sealed part can be prevented. Therefore, mold defects such as incomplete filling can be reduced.

The resin molding apparatus may further comprise a cooling section being provided on the workpiece conveying route between the preheating section and the press section, the cooling section cooling the preheated workpiece.

With this structure, even if the granular resin is heated by the preheating section, shortening a gel time until molding can be restrained. Namely, fluidity of the resin can be ensured while the resin molding is performed. Therefore, even if the surface of the base resin part includes convexoconcaves, the melted resin from the convex resin part flows on the surface of the base resin part and fills the convexoconcaves. Therefore, mold defects such as incomplete filling can be reduced.

EFFECTS OF THE INVENTION

The effect of the typical structure of the present invention will be explained. In the typical resin molding apparatus of the present invention, mold defects such as incomplete filling can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[Fig. 1] shows a layout of a resin molding apparatus relating to Embodiment 1 of the present invention.

[Fig. 2] is a sectional view of a resin supply section of the resin molding apparatus shown in Fig. 1, which is in operation.

[Fig. 3] is a plan view of a workpiece for explaining operation of the resin supply section shown in Fig. 2.

[Fig. 4] is a sectional view of the workpiece to which resin has been supplied by the resin supply section shown in Fig. 2.

[Fig. 5] is a sectional view in which a step of the resin supply operation following the step shown in Fig. 2 is performed.

[Fig. 6] is a plan view of the workpiece for explaining the operation of the resin supply section shown in Fig. 5.

[Fig. 7] is a sectional view of the workpiece to which the resin has been supplied by the resin supply section shown in Fig. 5.

[Fig. 8] is a sectional view of a preheating section of the resin molding apparatus shown in Fig. 1, which is in operation.

[Fig. 9] is a sectional view of a cooling section of the resin molding apparatus shown in Fig. 1, which is in operation.

[Fig. 10] is a sectional view of a press section of the resin molding apparatus shown in Fig. 1, which is in operation.

[Fig. 11] is a sectional view of the press section, in which a step of the press operation following the step shown in Fig. 10 is performed.

[Fig. 12] is a sectional view of the press section, in

which a step of the press operation following the step shown in Fig. 11 is performed.

[Fig. 13] is a sectional view of the press section, in which a step of the press operation following the step shown in Fig. 12 is performed.

[Fig. 14] is a sectional view of the press section, in which a step of the press operation following the step shown in Fig. 13 is performed.

[Fig. 15] is a sectional view of a resin supply section of the resin molding apparatus relating to Embodiment 2 of the present invention, which is in operation.

[Fig. 16] is a sectional view in which a step of the resin supply operation following the step shown in Fig. 15 is performed.

[Fig. 17] is a sectional view in which a step of the resin supply operation following the step shown in Fig. 16 is performed.

[Fig. 18] is a sectional view in which a step of the resin supply operation following the step shown in Fig. 17 is performed.

[Fig. 19] is a side view of one of blades provided in a resin supply section of the resin molding apparatus relating to Embodiment 3 of the present invention.

[Fig. 20] is a side view of anther blade provided in the resin supply section of the resin molding apparatus relating to Embodiment 3 of the present invention.

[Fig. 21] is a sectional view of a preheating section of the resin molding apparatus relating to Embodiment 4 of the present invention, which is in operation.

[Fig. 22] is a sectional view of a cooling section of the resin molding apparatus relating to Embodiment 4 of the present invention, which is in operation.

[Fig. 23] Figs. 23A-23F show modified examples of the operation of the resin supply section.

[Fig. 24] Figs. 24A-24G show other examples of the workpiece.

[Fig. 25] shows another example of a control system of the resin supply section.

[Fig. 26] shows a modified example of the resin supply section.

EMBODIMENTS OF THE INVENTION

In the following embodiments, the apparatus will be explained separately divided into a plurality of sections, etc. as necessary, but they are basically related to each other and have relationships that, for example, one section is a modified example, a detail, etc. of a whole or a part of another section. Thus, in all of the drawings, structural elements having a same function are assigned a same reference symbol and repetitive explanation will be omitted. All structural elements shown in the embodiments are not essential elements in the present invention. Numbers of the structural elements (including figure, amount, numerical value, range, etc.) are not limited except as specified in the following description or clearly specified in principle, and they are not limited to specific numbers and may be greater or smaller than the specific numbers. Further, as to shapes of the structural elements, the shapes include substantially same shapes and similar shapes except as

specified in the following description or clearly differ in principle.

(Embodiment 1)

Firstly, a schematic structure of a resin molding apparatus 1 will be explained with reference to Fig. 1. The resin molding apparatus 1 has a workpiece/resin supply section A, a workpiece accommodating section B, molding sections C and a pretreating section D. In the resin molding apparatus 1, a plurality of the molding sections C (e.g., two molding sections shown in Fig. 1) and one pretreating section D are placed between the workpiece/resin supply section A and the workpiece accommodating section B. In the resin molding apparatus 1, workpieces W are conveyed, by conveying hands 4 and 5 (loader and unloader) which are moved along a conveying rail 2 connecting said sections to each other, to the workpiece/resin supply section A, the pretreating section D, the molding sections C and the workpiece accommodating section B in this order. Note that, the pretreating section D is provided in the present embodiment; in case of providing no pretreating section, the molding section C may be provided instead of the pretreating section D. Number of the molding sections C may be optionally increased or reduced according to processing powers of other sections.

In each of the workpieces W, an electronic parts (e.g., semiconductor chips) are mounted on a rectangular substrate (e.g., circuit board). By resin-molding the workpiece W, the electronic parts are sealed by a resin-sealed part. The resin for forming the resin-sealed part is thermosetting resin (e.g., epoxy resin, silicone resin) including prescribed content rates

of resin compositions (e.g., filler such as silica and alumina, mold release agent, coloring agent). The resin is granular or powder resin (hereinafter referred to as “granular resin”).

The workpiece/resin supply section A includes: a supply magazine 6; a setting part 7; a supply table 8; a thickness measuring section 11; and a resin supply section 12. In the workpiece/resin supply section A, the workpieces W are conveyed to the supply magazine 6, the setting part 7, the supply table 8, the thickness measuring section 11 and the resin supply section 12 in this order.

Concretely, the workpieces W stored in the supply magazine 6 are arranged, in a prescribed direction, in the setting part 7 by a conveying mechanism not shown, and then further conveyed from the setting part 7 to the supply table 8. The workpieces W which have been put on the supply table 8 are conveyed to the thickness measuring section 11 by the conveying hand 4 (the loader) which is moved on the conveying rail 2.

The thickness measuring section 11 measures a thickness of the workpiece W to be molded so as to adjust a supply amount of the granular resin to be supplied (dropped) onto the workpiece W. The thickness measuring section 11 includes: a table 13 to which the workpiece W is conveyed from the supply table 8; a conveying rail 14 being extended from the rail 2 side to the resin supply section 12 side; and a measuring unit 15.

The measuring unit 15 includes an optical distance measuring unit, e.g., laser displacement meter, so as to detect defects (e.g., lack) of the workpieces W and measure heights thereof, thicknesses of the substrates, etc. Each of the

workpieces W is mounted on the table 13 and moved along the conveying rail 14, then its thickness is measured by the measuring unit 15 and further conveyed to a position short of the resin supply section 12. For example, the amount of the resin to be supplied can be adjusted by the resin supply section 12 according to number and thicknesses of the electronic parts measured by the measuring unit 15.

The resin supply section (dispenser) 12 supplies (drops) the granular resin onto the workpieces W. The resin supply section 12 supplies a prescribed amount of the granular resin, which has been determined on the basis of the data measured by the thickness measuring section 11, to deposit on the workpieces W. Details of the resin supply section 12 will be described later.

The workpieces W on which the granular resin has been deposited by the workpiece/resin supply section A are conveyed to the pretreating section D by the conveying mechanism, not shown. The pretreating section D includes: a preheating section 16; a cooling section 17; and a table 18. In the pretreating section D, the workpieces W on which the granular resin has been supplied by the resin supply section 12 are conveyed to the preheating section 16, the cooling section 17 and the table 18 in this order.

The preheating section 16 preheats the workpieces W at a temperature lower than a molding temperature of heaters of the molding sections C. The preheating section 16 is provided on the conveying route of the workpieces W between the resin supply section 12 and the molding section C. Details of the preheating section 16 will be described later. The preheated

workpieces W are conveyed to the cooling section 17 by the conveying mechanism, not shown.

The cooling section 17 cools the workpieces W preheated by the preheating section 16. The cooling section 17 is provided on the conveying route of the workpieces W between the preheating section 16 and the molding section C. Details of the cooling section 17 will be described later. The workpieces W which have been cooled are conveyed to the table 18 by the conveying mechanism, not shown.

The workpieces W which have been pretreated in the pretreating section D are conveyed, by the conveying hand 4, to one of the molding sections C. Each of the molding sections C includes a press section (molding die mechanism) 21. In each of the molding sections C, the conveying hands 4 and 5 are extended from the conveying rail 2 side to inside of the press section 21 and retracted threrefrom. The conveying hand 4 (the loader) is used to convey the workpieces W into the press section 21, and the conveying hand 5 (the unloader) is used to convey the workpieces W from the inside of the press section 21.

In each of the press sections 21, the workpieces W on which the granular resin has been supplied are clamped by a pair of dies, and the granular resin are thermally cured in a cavity for resin-sealing. Details of the press section 21 will be described later.

The workpieces W which have been resin-sealed in the molding sections C are conveyed, by the conveying hand 5, to the workpiece accommodating section B. The workpiece accommodating section B includes: a thickness measuring

section 22; and an accommodating magazine 23. In the workpiece accommodating section B, the workpieces W (molded products) are conveyed to the measuring section 22 and the accommodating magazine 23 in this order.

The thickness measuring section 22 includes: a table 24; a conveying rail 25; and a measuring unit 26, as well as the thickness measuring section 11, and measures a thicknesses of the molded workpiece W so as to adjust the amount of the granular resin to be supplied (dropped) onto the workpiece W.

Note that, the resin supply section 12 supplies the prescribed amount of the granular resin, which has been determined on the basis of the data measured by the thickness measuring section 22 too, to deposit it on the workpieces W. For example, the amount of the granular resin to be dropped by the workpiece/resin supply section A is increased or reduced, according to difference between the thickness of the resin-sealed part measured by the measuring unit 26 and the predetermined thickness, so as to perform feedback control.

The workpieces W mounted on the table 24 are moved along the conveying rail 25, their thicknesses are measured by the measuring unit 26, and they are conveyed to the accommodating magazine 23 and accommodated therein. As described above, the resin-sealed parts of the workpieces W (molded products) are formed by the resin molding apparatus 1.

Next, the resin supply section 12 (dispenser) will be explained in detail with reference to Figs. 2-7. The resin supply section 12 performs a first supply step, in which granular resin 27 is flatly deposited on the workpiece W, and a second supply step, in which granular resin 27 is deposited on

the workpiece W as dot. By performing the first supply step and the second supply step, the resin supply section 12 supplies the prescribed amount of granular resin 27 for resin-molding one workpiece W. Each of the workpieces W has a planar square-shaped (rectangular) substrate 28 on which a plurality of electronic parts 29 are matrically mounted. Note that, a structure for resin-molding a carrier (workpiece W), on which a plurality of electronic parts 29 are matrically fixed, may be employed.

Further, the resin supply section 12 includes a resin dropping part 32 (e.g., trough) for dropping granular resin 27 onto the workpiece W from an end part. In case that the resin dropping part 32 is the trough, the granular resin 27 supplied from a hopper is received by the trough, the trough is vibrated, by an electromagnetic feeder, so as to send the granular resin 27 forward, and then the granular resin 27 is dropped onto the workpiece W from the end part of the trough.

Further, the resin supply section 12 includes: an X-Y driven stage 31 (workpiece mounting part) being moved in X- and Y-directions in a state where the workpiece W is fixed thereon; and an X-Y driving mechanism 33 (scanning mechanism) for moving the stage 31 in the X- and Y-directions. In the X-Y driving mechanism 33, a slider 35 is slid, in the X-direction, on an X-axis rail 34, and a slider 36 is slid, in the Y-direction, on the slider 35 which acts as a Y-axis rail, by a driving unit not shown. Note that, in the resin supply section 12, the stage 31 can be moved in the X- and Y-directions, but the resin dropping part 32 is fixed.

The resin supply section 12 has an antiscattering frame

37, which has an opening part 37a and which prevents the granular resin 27 from scattering when the resin is dropped onto the workpiece W from the end part of the resin dropping part 32. The antiscattering frame 37 faces the stage 31 and moved in the X- and Y-directions together with the stage 31. The granular resin 27 is dropped in the antiscattering frame 37, i.e., in the opening part 37 (see Figs. 2 and 5). Even if the granular resin 27 is dropped onto the workpiece W from the resin dropping part 32, scattering the granular resin 27 can be prevented by inner walls of the opening part 37a of the antiscattering frame 37.

In the resin supply section 12 having the above described structure, a large part of total supply amount of the granular resin 27 (e.g., 90% or more) is firstly dropped as the first supply step. In the first supply step, the stage 31 is moved, in the X- and Y-directions, in the horizontal surface of the workpiece W (see Fig. 3) with dropping the granular resin 27 from the end part of the resin dropping part 32 (see Fig. 2) so as to perform the writing method and form a base resin part 27a on the workpiece W (see Fig. 4). Namely, the granular resin 27 is evenly spread in a prescribed area of the workpiece W.

An example of dropping the granular resin 27 by the resin dropping part 32 will be explained. The resin dropping part 32 is moved, in the rectangular opening part 37a, from a corner A to a corner B along an edge of the opening part 37a (X-direction) as shown by an arrow of Fig. 3. Next, the resin dropping part 32 is moved a prescribed distance from the corner B toward a corner C along an edge of the opening part 37a (Y-direction), and then moved in the X-direction until

reaching a side AD. Next, the resin dropping part 32 is moved a prescribed distance toward a corner D along an edge of the opening part 37a (Y-direction), and then moved in the X-direction until reaching a side BC. By repeating the above described actions, the granular resin 27 can be wholly supplied. Namely, the resin dropping part 32 drops and supplies the granular resin 27, onto the workpiece W, from the corner A to the diagonal corner C like traversable writing by the writing method.

The resin dropping part 32 drops a prescribed amount of the granular resin 27 onto the workpiece W per unit time, and the stage 31 on which the workpiece W is mounted is moved, a prescribed distance, in the X- and Y-directions per unit time, so that the granular resin 27 can be evenly deposited on the surface of the workpiece W. Note that, a thickness of the granular resin 27 layer can be controlled by adjusting a moving speed of the stage 31.

In the present embodiment, the antiscattering frame 37 is provided as shown in Fig. 2, so the outermost electronic parts 29 of the electronic parts 29 matrically mounted on the substrate 28 are partially covered with the granular resin 27, the electronic parts 29 located in the inner part are entirely covered with the granular resin 27 (the base resin part 27a). Namely, the outer part of a mounting area, in which the electronic parts 29 are mounted, is not covered with the granular resin 27. By supplying no granular resin 27 to the outside of the outermost electronic parts 29, spreading the granular resin 27 is limited to the outermost electronic parts, so that falling the granular resin 27 while conveying and biting

the granular resin 27 with the dies while molding can be prevented. Note that, the opening part 37a of the antiscattering frame 37 has an optimum planar shape, so that no granular resin 27 spreads to the outer part of the area and no granular resin 27 covers the same.

In the resin supply section 12, the second supply amount of the granular resin 27, which is obtained by subtracting the first supply amount from the total supply amount, (e.g., 10% or less) is dropped as the second supply step. In the second supply step, the stage 31 is not moved, the granular resin 27 is dropped onto a center part of the workpiece W from the end part of the resin dropping part 32 (see Figs. 5 and 6) so as to form a convex resin part 27b (see Fig. 7).

As described above, the resin dropping part 32 is relatively moved, by the X-Y driving mechanism 33 (scanning mechanism), to scan the stage 31 (workpiece mounting part) so as to continuously drop the granular resin 27 onto the workpiece W from the resin dropping part 32 as the writing method, so that the base resin part 27a is formed. Further, the convex resin part 27b whose height is higher than that of the base resin part 27a is formed, in the center part of the base resin part 27a, by supplying the resin.

By the above described structure, the prescribed amount of granular resin 27 can be correctly and easily supplied to the prescribed part of the horizontal surface of the workpiece W. It is difficult to precisely control the supply amount of the resin for evenly forming the base resin part 27a on the entire surface, but the base resin part 27a can be formed by supplying the resin with a prescribed accuracy and the rest resin ~~cab~~ can be

supplied to the center part, so that the supply amount of the resin can be easily controlled and the total supply amount can be precisely controlled.

Next, the preheating section 16 will be explained in detail with reference to Fig. 8. The preheating section 16 includes: a table 38 on which the workpiece W can be mounted; a heater 39; and a housing which accommodates the table 38 and the heater 39 so as to increase heat efficiency and prevent heat loss to the environment. The heater 39 is, for example, an infrared heater. To increase heat efficiency, the table 38 may have a built-in heater so as to heat from the table 38 side. In this case, the table 38 may have a built-in sucking mechanism so as to easily conduct heat from the table 38.

In the preheating section 16, the workpiece W, on which the base resin part 27a and the convex resin part 27b have been formed, is mounted on the table 38, and the workpiece W is preheated, by the heater 39, at the temperature lower than the molding temperature. By preheating, the granular resin 27 is melted and resin grains of the resin in the surface are connected to each other, so that scattering grains of the granular resin 27 can be prevented. By melting the granular resin 27, density of the grains is increased and thicknesses of the base resin part 27a and the convex resin part 27b are reduced, so that they can be easily heated.

Next, the cooling section 17 will be explained in detail with reference to Fig. 9. The cooling section 17 includes: a table 41 on which the workpiece W can be mounted; an air blower 42; and a housing which accommodates the table 41 and the air blower 42 so as to increase cooling efficiency. To

increase the cooling efficiency, the table 41 may have a built-in cooler so as to cool from the table 41 side. In this case, the table 41 may have a built-in sucking mechanism so as to easily conduct heat from the table 41. Further, in case of naturally cooling the workpiece W preheated by the preheating section 16, the workpiece W may be directly conveyed from the preheating section 16 to the table 18 (see Fig. 1).

By the cooling section 17, even if the granular resin 27 is heated by the preheating section 16, handling ability and moldability in the press sections can be improved and shortening a gel time until molding can be restrained. Namely, fluidity of the resin can be ensured while molding.

Further, in case that the granular resin 27 is heated by the preheating section 16, influence of time lag caused by conveying the workpiece W from the pretreating section D to any one of the press sections 21 (molding sections C) can be restrained. Namely, in each of the press sections 21, the resin supplied to the workpieces W can be evenly cured.

Next, the press section 21 will be explained in detail with reference to Figs. 10-14. The press section 21 includes the pair of dies (molding die mechanism), which clamps the workpiece W on which the granular resin has been supplied, and thermal-cures the granular resin 27 in a cavity recess (or mere “cavity”) 45 to form a resin-sealed part 27c (see Fig. 14). The pair of dies are an upper die 43 and a lower die 44, which face each other and have built-in heaters (not shown), and the dies are relatively moved close to and away from each other by a known vertical driving mechanism (e.g., toggle mechanism). In the present embodiment, the upper die 43 is a fixed die, and

the lower die 44 is a movable die.

The upper die 43 includes: a cavity block 46 being fixed to an upper base (not shown); and an upper clamper 47 enclosing the cavity block 46 and being attached to the upper base with, for example, springs. The cavity block 46 is a block having a planar shape (e.g., square shape) corresponding to the shape of the resin-sealed part 27c to be formed on the workpiece W. The upper clamper 47 is a hollow block having a through-hole for enclosing the cavity block 46. Note that, air vents not shown are formed in a clamping face 43a of the upper clamper 47.

In the upper die 43, a bottom face of the cavity recess 45 is constituted by a flat face (bottom face) of the cavity block 46, and side faces of the cavity recess 45 are constituted by inner faces of the through-hole of the upper clamper 47. Namely, the cavity recess (cavity) 45 is formed in the upper die 43. Note that, the clamping face 43a of the upper die 43 is covered with a release film 48.

The lower die 44 includes a lower clamper 51, which is fixed to a lower base (not shown). The lower clamper 51 is a block having a flat face on which the workpiece W can be mounted.

Sucking holes 52 for sucking the mounted workpiece W are formed in the lower clamper 51. The sucking holes 52 are communicated with, for example, a sucking mechanism including a compressor. When the workpiece W is mounted on the lower die 44, the sucking mechanism sucks the workpiece W, so that heating efficiency from the lower die 44 can be improved.

Further, a decompression hole 53, which is used to reduce inner pressure of the cavity 45 when the clamping action is performed, is formed in the lower clamper 51. The decompression hole 53 is communicated with, for example, a decompression mechanism including a vacuum pump. Since the resin flows in the decompressed cavity 45, involving air in the resin-sealed part can be prevented while molding. Note that, a sealing member 54 (e.g., O-ring), which is used to form a closed space (airtight space), is provided to an outer part of the lower clamper 51 (a part capable of contacting the upper clamper 47).

Next, actions of the press section 12 will be explained in detail. As shown in Fig. 10, the workpiece W is supplied to the opened dies. In this state, no resin-sealed part is formed on the workpiece W. The workpiece W is conveyed, by the loader 4, from the table 18 of the pretreating section D to inside of the pair of dies, and then sucked through the sucking holes 52 and mounted on the lower die 44

The surface of the workpiece W (substrate 28), on which the electronic parts 29 are mounted and the granular resin 27 is supplied, faces the upper die 43, and the opposite surface contacts a clamping face 44a of the lower die 44, namely the workpiece is mounted on the lower die 44. The workpiece W is mounted on the lower die 44 in a state where the supplied granular resin 27 corresponds to the cavity recess 45 of the upper die 43.

As shown in Fig. 10, the release film 48 is sucked and held on the clamping face 43a of the upper die 43. In the drawing, the cavity block 46, which constitutes the bottom of

the cavity recess 45, is located at a standby position, at which the bottom of the cavity is relatively separated away from a position for curing the resin (a molding position). As shown in Fig. 10, the release film 48 has been sucked on the upper die 43 along a surface configuration of the cavity recess 45.

Next, as shown in Figs. 11 and 12, the upper die 43 and the lower die 44 are moved close to each other after the conveying hand 4 is moved away from the pair of dies. The pair of dies have been heated, by the heaters not shown, until reaching a melting point of the granular resin 27 (molding temperature). Thus, the upper die 43 is brought into contact with the convex resin part 27b formed on the workpiece W so as to melt the granular resin 27 of the convex resin part 27b. Note that, when the sealing member 54 provided to the clamping face 44a of the lower die 44 begins to contact the clamping face 43a of the upper die 43 through the release film 48, the closed space is formed by shielding an inner space of the dies including the cavity recess 45 and discharging air therefrom.

Next, as shown in Figs. 13 and 14, the melted resin of the convex resin part 27b is pressed and spread on the base resin part 27a so as to fill the inside of the cavity 45 with the resin. Concretely, the upper die 43 and the lower die 44 are further moved close to each other and the upper clamper 47 is pushed back against the springs, so that the bottom face of the cavity block 46 is moved from the standby position to the molding position and the depth of the cavity 45 is reduced. Then, the bottom face of the cavity block 46 presses and spreads out the melted resin. By this action, even if height variation is caused,

by thicknesses of the electronic parts 29, in the surface of the base resin part 27a and convexoconcaves are formed in the surface thereof, the melted resin from the convex resin part 27b flows on the surface of the base resin part 27a and flattens the surface. Namely, the resin molding apparatus 1 is capable of reducing mold defects of the molded product (the resin-sealed part 27c) such as incomplete filling caused by air pockets.

As described above, a die clamping action is completed in the state where the upper clamper 47 is pushed back and the workpiece W is clamped between the clamping face 43a of the upper die 43 and the clamping face 44 of the lower die 44. At this time, the electronic parts 29 of the workpiece W are covered with the resin 27 in the cavity 45. Next, a resin pressure in the cavity 45 is maintained at a prescribed pressure so as to cure (thermally cure) the resin 27. By the above described actions, the workpiece W can be resin-molded and the resin-sealed part 27c can be formed in the press section 21 of the resin molding apparatus 1.

Next, the upper die 43 and the lower die 44 are moved away from each other so as to open the pair of dies, the resin-molded workpiece W is separated from the upper die 43 and the lower die 44, and the workpiece W (molded product) is taken out by the unloader 5.

As described above, in the resin supply section 12, the base resin part 27a is formed from the granular resin 27 in the first supply step, and the convex resin part 27b is formed, on the base resin part 27a, from the granular resin 27, whose amount is smaller than that of the resin forming the base resin part 27a, in the second supply step. By almost entirely

covering the workpiece W with the base resin part 27a, the resin flow on the workpiece W is restrained and the granular resin 27 of the convex resin part 27b actively flows on the base resin part 27a while molding, so that forces applied to the electronic parts 29 can be reduced. Note that, in case that the electronic parts 29 are electrically connected to the substrate 28 by bonding wires, wire deformation can be prevented and quality of the molded products can be improved.

In the resin supply section 12, the convex resin part 27b is formed in the center part of the base resin part 27a in the second supply step. Therefore, in the press section 21, the melted resin 27 of the convex resin part 27b can flow from the center part of the base resin part 27a to the outer part thereof. Even if the workpiece W has a planar rectangular shape, the melted resin 27 can sufficiently spread to four corners. Therefore, mold defects such as incomplete filling in corner parts of the molded product can be reduced.

(Embodiment 2)

In the above described Embodiment 1, the antiscattering frame is provided to the resin supply section so as to deposit the prescribed amount of the granular resin on the workpiece, by dropping the resin from the end part of the resin dropping part, without scattering the resin. In the present embodiment, the prescribed amount of the granular resin is deposited on the workpiece without using the antiscattering frame. Note that, overlapping matters described in Embodiment 1 will be omitted.

A resin supply section 12A (dispenser) of the present embodiment will be explained with reference to Figs. 1 and

15-18. The resin supply section 12A is provided to the workpiece/resin supply section A as well as the resin supply section 12 of Embodiment 1.

In the resin supply section 12A, the first supply step, in which the granular resin 27 is flatly supplied on the workpiece W, and the second supply step, in which the granular resin 27 is deposited on the workpiece W as dot, are performed as well as the former embodiment. By performing the first and second supply steps, the resin supply section 12A supplies the prescribed amount of the granular resin 27, which is capable of resin-molding the workpiece W once. Note that, in the workpiece W, a plurality of the electronic parts 29 are matrically arranged and mounted on the substrate 28 whose planar shape is a reed shape (rectangular shape).

The resin supply section 12A includes: an X-Y-Z driven stage 31A being moved in X-, Y- and Z-directions in a state where the workpiece W is mounted thereon; an X-Y-Z driving mechanism 33A for supporting and moving the stage 31A in the X-, Y- and Z-directions; and a weight sensor 57 for measuring a weight of the workpiece W (including a weight of the resin supplied to the workpiece W).

In the stage 31a, a through-hole 31a, which is extended in a thickness direction, is formed in a center part. With this structure, the stage 31a sucks and holds the workpiece W by an outer periphery part. Namely, the through-hole pierces the stage 31A except the part holding an outer periphery of the workpiece W. The weight sensor 57 measures the weight of the workpiece W in a state of piercing through the through-hole 31a.

In the X-Y-Z driving mechanism 33A, the slider 35 is slid, in the X-direction, on an X-axis rail 34, and the slider 36 is slid, in the Y-direction, on the slider 35 which acts as the Y-axis rail, by the driving unit not shown. A Z-axis rail 55 is provided on the slider 36, and a slider 56 is slid, in the Z-direction, on the Z-axis rail 55. Note that, in the resin supply section 12A, the stage 31A is capable of moving in the X-, Y- and Z-directions, but a resin dropping part 32A is fixed.

The resin supply section 12A includes the resin dropping part 32A for dropping the granular resin 27 onto the workpiece W (e.g., shooter). In case that the resin dropping part 32A is a shooter, the granular resin 27 supplied from a hopper is received by a trough, the tough is vibrated, by an electromagnetic feeder, so as to feed the granular resin 27 forward, and the granular resin 27 is dropped onto the workpiece W from an end part of the trough. By using the shooter to make a diameter of an end part of the resin dropping part 32A small, the prescribed amount of the granular resin 27 can be correctly supplied to prescribed positions in the horizontal surface of the workpiece W (the writing method). Therefore, supply amounts of the resin for each position can be highly precisely controlled. Since the resin is supplied by moving the shooter, which is extended downward, close to the workpiece W, the base resin part 27a and the convex resin part 27b, which are formed from the granular resin 27, can be easily formed without using the antiscattering frame 37 used in Embodiment 1.

In the resin supply section 12A, firstly the stage 31A receives the workpiece W, and then the stage 31A is moved

downward and mounted on the weight sensor 57, as shown in Fig. 15, so as to weighs the weight of the workpiece W. Next, the slider 56 is moved upward in the Z-direction so as to transfer the workpiece W from the weight sensor 57 to the table 31A.

Next, the granular resin is supplied (dropped) onto the workpiece W on the basis of the resin supply data (supply amount of the resin). In the resin supply section 12A, a large part of total supply amount of the granular resin 27 (e.g., 90% or more) is firstly dropped onto the workpiece W as the first supply step. In the first supply step, the stage 31A is moved, in the X- and Y-directions, in the horizontal surface of the workpiece W with dropping the granular resin 27 from the end part of the resin dropping part 32A (see Fig. 16) so as to form the base resin part 27a on the workpiece W (see Fig. 17). Namely, the large part of prescribed supply amount of the granular resin 27 is evenly spread out in the prescribed area of the workpiece W.

Next, in the resin supply section 12A, the second supply amount of the granular resin 27, which is obtained by subtracting the first supply amount from the total supply amount, (e.g., 10% or less) is dropped as the second supply step. In the second supply step, the granular resin 27 is dropped in the center part of the workpiece W from the end part of the resin dropping part 32A, without moving the stage 31A, so as to form the convex resin part 27b (see Fig. 18).

After the prescribed amount of the granular resin 27 is supplied onto the workpiece W, the stage 31A is moved to a prescribed position so as to measure the weight of the

workpiece W, on which the granular resin 27 is supplied, by the weight sensor 57 again. The difference between the current measured weight and the former measured weight is the weight of the resin actually supplied onto the workpiece W. If the actual weight is not enough, the rest granular resin 27 is precisely added. Therefore, every time the resin supply section 12A is capable of correctly supplying the desired amount of the granular resin 27 to the workpiece W. In the resin molding apparatus 1 having the resin supply section 12A of the present embodiment, mold defects such as incomplete filling can be reduced.

(Embodiment 3)

In Embodiment 1, the upper die and the lower die are moved close to the workpiece mounted on the lower die, and the upper die is brought into contact with the convex resin part to spread out the melted resin on the base resin part, so that the cavity is filled with the resin. With this action, even if convexoconcaves exist in the surface of the base resin part, the melted resin from the convex resin part fills the convexoconcaves without leveling the surface of the base resin part. In the present embodiment, the surface of the base resin part is leveled by a blade 58 so as to further flatten the surface of the base resin part. Note that, some overlapping matters described in Embodiment 1 will be omitted.

The blade 58 of the present embodiment is shown in Fig. 19. The resin supply section 12 includes the blade 58 so as to level the granular resin 27 supplied to the workpiece W. The blade 58 is produced by bending a part of a plate-shaped material. Concretely, the blade 58 has a parallel part 58a,

which is arranged parallel to the surface of the workpiece W to which the resin will be supplied, and a bent part 58b, which is bent upward from a center of the parallel part 58a.

For example, the granular resin 27 is supplied onto the workpiece W from the resin dropping part 32A without moving the stage 31A, as well as the second supply step of the above described embodiment, so as to heap the total amount of the granular resin 27, and then the granular resin 27 supplied on the workpiece W can be leveled, by the blade 58 rotating about a rotary shaft 59, in the resin supply section 12. Namely, the parallel part 58a levels the base resin part 27a, and the bent part 58b shapes the convex resin part 27b.

With the above described structure, a part of the resin corresponding to the base resin part 27a can be leveled, and the convex resin part 27b can be shaped. No convexoconcaves are formed in the surface of the part of the resin corresponding to the base resin part 27a, and the melted resin from the convex resin part 27b can flow on the leveled surface. Therefore, forming air pockets can be highly restrained, so that mold defects such as incomplete filling can be reduced.

Another blade 58A shown in Fig. 20 may be employed instead of the blade 58. The blade 58A is produced by bending a part of a plate-shaped material. The blade 58A is bent toward the rotary shaft 59 and inclined several degrees (angle θ) with respect to the surface of the workpiece W to which the resin will be supplied.

In the resin supply section 12, after the step shown in Fig. 5 is performed, the granular resin 27 supplied on the workpiece W is leveled by the blade 58A rotating about the rotary shaft 59.

Namely, the granular resin 27 on the workpiece W is leveled and shaped like a circular cone. So, the melted resin from the top of the circular cone can flow on the leveled surface while molding. Therefore, forming air pockets can be highly restrained, so that mold defects such as incomplete filling can be reduced.

(Embodiment 4)

In Embodiment 1, the workpiece is treated in the preheating section and the cooling section in the state where the resin is deposited on the workpiece. In the present embodiment, the resin on the workpiece W is clamped, by dies, in the preheating section and the cooling section.

As shown in Fig. 21, a preheating section 16A includes: an upper die 61 and a lower die 62 for preheating, which have built-in heaters (not shown) and which are faced each other and moved close to and away from each other; and a housing which accommodates the upper die 61 and the lower die 62 so as to increase heat efficiency. In the preheating section 16A, a recess 61a of the upper die 61 and the convex resin part 27b of the granular resin 27 are aligned with each other, and the upper die 61 and the lower die 62 are moved close to the workpiece W mounted on the lower die 62, so that the upper die 61 contacts (presses) the convex resin part 27b so as to melt the granular resin 27.

By the recess 61a of the preheating section 16A, the convex resin part 27b can be left and the entire workpiece can be directly heated, from the upper side, without applying no stress to the electronic parts provided in the center part. Further, the base resin part 27a can be flatly clamped by a die

face 61b of the preheating section 16A. By employing the preheating section 16A, the workpiece can be rapidly heated, and the thickness can be reduced so that the workpiece can be easily heated. Further, air between resin grains can be purged out and reduced by the melted resin.

Note that, the recess 61a and the die face 61b may be coated with Teflon (registered trademark) or covered with a release film so as to prevent the resin from adhesion.

As shown in Fig. 22, a cooling section 17A includes: an upper die 63 and a lower die 64 for cooling, which have built-in coolers (not shown) and which are faced each other and moved close to and away from each other; and a housing which accommodates the upper die 63 and the lower die 64 so as to increase heat efficiency. In the cooling section 17A, a recess 63a of the upper die 63 and the convex resin part 27b of the granular resin 27 are aligned with each other, and the upper die 63 and the lower die 64 are moved close to the workpiece W mounted on the lower die 64, so that the upper die 63 contacts (presses) the convex resin part 27b and cools the workpiece W. Note that, the shape of the recess 63a of the upper die 63 for cooling is the same as that of the recess 61a of the upper die 61 for preheating.

By the recess 63a of the cooling section 17A, the workpiece can be directly cooled, from the upper side, with maintaining the shape of the convex resin part 27b preheated by the preheating section 16A, so that the workpiece can be rapidly cooled. Therefore, shortening the gel time until molding can be restrained.

The embodiments of the present invention have been

described above, but the present invention is not limited to the above described embodiments, the present invention, of course, may be variously modified without departing the scope of the invention.

For example, in Embodiment 1, the writing method is performed, by the resin dropping part, in the first supply step and the second supply step. The present invention is not limited to the embodiment, so the first supply step and the second supply step may be performed by the opening method, in which a holder or a shutter is used, or the diffusing method, in which a shooter or a diffusing member is used. Namely, in the resin supply section, the method of supplying the resin is not limited as far as the base resin part of the granular resin is formed on the workpiece in the first supply step and the convex resin part of the granular resin is formed on the base resin part in the second supply step. Further, the writing method, the opening method and the diffusing method may be combined to perform the first supply step and the second supply step.

In any cases, mold defects can be reduced as well. Note that, in case of performing the diffusing method or the opening method, two sets of the shooters or holders, etc. for supplying the resin to the resin supply areas, where the resin is supplied in the first and second supply steps (i.e., the areas in which the base resin part and the convex resin part will be formed), are required. On the other hand, in case of performing the writing method, the resin can be dropped from one resin dropping part in the first and second supply steps, so that number of parts of the resin molding apparatus (resin supply section) can be reduced.

For example, in Embodiment 1, the resin is dropped onto the supply target (workpiece), in which the base resin part will be formed, in the first supply step, and the resin is further dropped onto one place (the center part) of the supply target so as to form the convex resin part in the second supply step. But, in the present invention, the resin may be dropped onto the planar rectangular workpiece at a plurality of places (e.g., two places arranged in the longitudinal direction) in the second supply step.

In some cases, even if the resin is dropped onto the one place, i.e., the center part, of the planar rectangular (especially, reed-shaped) supply target, the resin cannot spread to corners of the supply target while molding. On the other hand, by dropping the resin at the plurality of places in the second supply step, the resin can spread to the corners of said object. Therefore, mold defects such as incomplete filling can be reduced.

For example, in Embodiment 1, the supply target (i.e., workpiece) has the planar rectangular shape. The planar shape of the supply target is not limited, so it may be polygonal shapes including rectangular shapes, circular shapes, etc. Even if the supply target has a different planar shape, mold defects such as incomplete filling can be reduced by forming the base resin part in the first supply step and forming the convex resin part in the second supply step.

For example, in Embodiment 1, the supply target (i.e., workpiece) is the substrate on which the electronic parts are mounted. The supply target is not limited, so a wafer, carrier stage, reed-shaped film, rolled film may be treated as the

supply target. Even if the resin supply target is changed, mold defects can be reduced, as well, by forming the base resin part in the first supply step and forming the convex resin part in the second supply step.

For example, in Embodiment 1, the electronic parts are matrically mounted on the substrate, the part of the electronic parts which are located in the inner part of the matrix are entirely covered with the granular resin, and the rest electronic parts are partially covered with the granular resin. The present invention is not limited to the embodiment, so the rest electronic parts may be entirely covered with the granular resin. In this case too, all of the electronic parts are finally entirely covered with the granular resin as the molded product.

For example, in Embodiment 1, the preheating section and the cooling section are provided in the pretreating section. The present invention is not limited to the embodiment, so no cooling section may be provided in the pretreating section. By providing no cooling section, when the resin-sealed part is formed by thermally curing the granular resin in the cavity of the press section, a range of temperature increase until reaching the molding temperature can be small by preheating the workpiece. By preheating the workpiece, the entire workpiece is previously heated, so that the heat can be easily conducted while molding. A treating time of the press section, which is the longest of the treatments performed in the resin molding apparatus, can be shortened, and a production cost of the molded product can be reduced.

For example, as shown in Figs. 23A-23F, various writing patterns for dropping the granular resin, from the resin

dropping part, onto the surface of the workpiece may be applied. The patterns shown in Figs. 23A-23C can be applied to the workpiece having a planar rectangular shape, and the patterns shown in Figs. 23D-23F can be applied to the workpiece having a planar circular shape. In Figs. 23A and 23D, one-way scanning is repeated in the entire surface of the workpiece. In Figs. 23B and 23E, scanning tracks are similar to the shape of the workpiece, and the scanning is concentrically repeated in the entire surface. In Figs. 23C and 23F, scanning is spirally performed, along the outer profile of the workpiece, in the entire surface.

In case of evenly supplying a prescribed amount of the granular resin onto the surface of the workpiece by scanning with each of the patterns shown in Figs. 23B, 23C, 23E and 23F, when, for example, the scanning is performed from the outer periphery of the workpiece to the center part thereof, the granular resin is supplied to the outer periphery at a prescribed supply rate and a prescribed scanning speed, and the supply rate and the scanning speed are adjusted so as to supply the right amount of the granular resin to the center part. Further, in case of forming the convex resin part in the center part of the workpiece by scanning with each of the patterns shown in Figs. 23B, 23C, 23E and 23F, when, for example, the scanning is performed from the outer periphery of the workpiece to the center part thereof, the granular resin is supplied to the outer periphery at a prescribed supply rate and a prescribed scanning speed, and the supply rate and the scanning speed are adjusted so as to supply a larger amount of the granular resin to the center part.

Various types of workpieces shown in Figs. 24A-24G (dotted lines show profiles of resin-sealed parts) can be resin-molded by the resin molding apparatus of the present invention. In Fig. 24A, a workpiece is a wafer on which a plurality of bumps are formed. In Fig. 24B, a workpiece is a wafer on which a plurality of semiconductor chips or laminated chips of TSV (Through Silicon Via) are mounted. In Fig. 24C, a workpiece is a wafer (substrate) on which a plurality of light emitting or receiving chips (semiconductor chips) are mounted. In Fig. 24D, a workpiece is a wafer on which a plurality of MEMS (Micro Electro Mechanical System) chips are mounted. In Fig. 24E, a workpiece is an interposer substrate on which a plurality of semiconductor chips are mounted and bumps or vias are formed. In Fig. 24F, a workpiece is a substrate on which a plurality of laminated chips are mounted and vias are formed. In Fig. 24G, a workpiece is a carrier (composed of, for example, stainless steel, glass, wafer) on which a plurality of semiconductor chips are fixed with a peeling sheet, e.g., thermal peeling sheet. The resin may be supplied in the shape of packages shown by dotted lines in each of the above drawings.

For example, a control system for controlling the resin supply section has a structure shown in Fig. 25. In the control system, a PC (Personal Computer), which has an input section, a control section, a transmitting section and a displaying section, is connected to the resin molding apparatus, which has a receiving section, a control section, a storing section and a table (stage) driving section, and the both are capable of communicating with each other. The PC makes a drive control

pattern for each pattern ID, sends the patterns to the resin molding apparatus and makes the apparatus store the patterns. The resin molding apparatus makes the pattern ID for each product (workpiece) and retrieves it so as to supply the resin in the desired pattern (actual supply pattern). In a stage of starting the table, a moving speed is unsteady, so a dummy pattern may be included in the drive control patterns and the resin may be supplied after the moving speed of the table stabilizes.

For example, in Embodiment 1, the resin dropping part is fixed and the workpiece mounting part is moved (for scanning). The present invention is not limited to that structure, so the resin dropping part may be moved (for scanning) and the workpiece mounting part may be fixed. In this case, the resin dropping part and movable parts around the resin dropping part will be improperly made large so as to precisely supply granular resin, but the granular resin can be dropped by moving the resin dropping part, in the X- and Y-directions with respect to the workpiece mounting part, so as to scan the workpiece mounting part.

A technology for precisely supplying granular resin with a fixed workpiece mounting part and a movable resin dropping part will be explained with reference to Fig. 26. Fig. 26 shows a modified example of the resin supply section 12 (hereinafter referred to as “resin supply section 12B”). Note that, when granular resin is dropped from an end part of a trough 102 (shown by dotted lines) onto the workpiece W, a stage 110 (workpiece mounting part) is located immediately under the end part.

The resin supply section 12B includes: a movable section 100, which stores granular resin whose amount is equal to or more than a required amount for one molding action and which is moved to drop and supply the granular resin to the workpiece; and a fixed first storing part 101 (fixed section), which stores the granular resin and supplies the resin to the movable section. The resin supply section 12B further includes a weight scale 111, which is provided to the table 110 (workpiece mounting part) and which measures the weight of the resin to be dropped onto the workpiece W or the supply amount of the granular resin.

The movable section 100 includes: the trough 102 (resin dropping part) for dropping the granular resin onto the workpiece W from the end part; an electromagnetic feeder 103 for vibrating the trough 102 to send the granular resin toward the end part; and a second storing part 104 (resin storing part), in which the granular resin whose amount is equal to or more than the required amount for molding one workpiece is temporarily stored (reserved). The movable section 100 is suspended by a driving mechanism 105 and can be moved in the X-, Y- and Z-directions. When the weight or volume of the granular resin stored in the movable section 100 is less than the required amount for one molding action, the movable section is moved toward the fixed section so as to receive and restock the granular resin. Note that, the amount of the granular resin stored in the second storing part 104 may be less than the required amount for one molding action. In this case, a large-sized workpiece W can be molded by repeatedly supplying the granular resin to parts of the workpiece W.

The first storing part 101 includes a hopper 107, to which a large amount of granular resin for molding many workpieces is manually supplied, and supplies the granular resin to the second storing part 104 when the movable section 100 is moved to a prescribed position close to the first storing part 101.

By employing the resin supply section 12B, the movable section 100 including the trough 102 and the movable parts around the trough can be lightened and downsized, so that the trough 102 can be smoothly moved and the driving mechanism 105 can be downsized. Further, an error between an actual amount of the dropped resin weighed by the weight scale 111 and a predetermined weight thereof can be corrected. Therefore, mold defects such as incomplete filling can be reduced.

Next, a resin supply step (resin dropping step) performed in the resin supply section 12B will be explained. In the resin supply step, for example, the trough 102 having a flat bottom face is used, and the trough is moved, at a fixed speed, with dropping the granular resin, in the width direction, at an even supply rate, so that the granular resin can be dropped onto the workpiece W with an even thickness.

Concretely, while the trough 102 is reciprocally moved, in the longitudinal direction of the trough, with dropping the granular resin, an action for dropping the granular resin onto the workpiece W with a width corresponding to that of the trough 102 and the action for moving the movable section 100 to a predetermined supply-starting position, at which the resin can be dropped in an area adjacent to the area to which the resin has been previously dropped, without dropping the granular resin, are repeated, so that the granular resin can be

supplied onto the entire surface of the workpiece (see Fig. 23A).

Therefore, the granular resin is dropped in one belt-like area by performing one dropping action, so the granular resin can be evenly supplied in the arranged belt-like areas by repeating the action. In this case, the actual supply amount of the resin supplied to the belt-like area is measured every time by the weight scale 111, and the supply amount for the next area is adjusted to correct the error between the measured actual supply amount and the predetermined amount, so that an error of the total supply amount for one workpiece W can be highly reduced.

The granular resin may be dropped so as to make the belt-like areas, each of which is formed by one dropping action, partially or wholly overlap each other. For example, when the granular resin is dropped into gaps between the semiconductor chips matrically mounted on the workpiece W, the resin is dropped to repeatedly form the belt-like areas, so that the supply amount of the resin can be greater than that for merely dropping the granular resin onto the chips. Therefore, convexoconcaves formed on the surface of the granular resin dropped onto the workpiece W can be reduced, and the resin flow in compression molding can be restrained, so that quality of the molded product can be improved. Further, in case of supplying the granular resin to overlap the belt-like areas in a state where a half the width of the one belt-like area overlaps the adjacent belt-like area, the granular resin can be supplied with even thickness or with partially varying or changing the thickness by repeating this supply action.

In the above described structure, by moving only the movable section 100 which stores a small amount of the granular resin, growing the apparatus in size can be prevented, scattering the granular resin from the workpiece W can be prevented, and the dropping action can be performed without applying stress to the workpiece W. Even if the dropped granular resin is partially scattered, the driving mechanism 105, which is located above the trough 102 and the second storing part 104, is not contaminated, so that maintenance can be efficiently performed.

Preferably, the trough 102 can be exchanged to other troughs having different widths according to size of the workpiece W. In this case, the wide trough 102 is selected for molding the large workpiece W and the narrow trough 102 is selected for molding the small workpiece W according to types of the workpiece W, so that number of dropping the resin can be reduced and a required time for dropping the resin can be shortened in case of molding the large workpiece W, and the resin can be easily dropped on the basis of the dropping pattern.

Further, the resin supply action of Embodiment 1 can be performed by the resin supply section 12B. Concretely, the trough 102 is relatively moved with respect to the table 110 by the driving mechanism 105, and the writing method, in which the granular resin is continuously dropped onto the workpiece W from the end part of the trough 102, is performed to form the base resin part on the workpiece W and form the convex resin part in the center part of the base resin part.

CLAIMS

[Claim 1]

A resin molding apparatus, comprising:

a resin supply section for dropping granular resin onto a supply target;

a conveying hand for conveying the supply target; and

a press section including a pair of dies, in which a recessed cavity will be formed,

wherein the resin supply section includes:

a trough for dropping the granular resin onto the supply target;

a supply target mounting part, on which the supply target will be mounted, being located immediately under the trough;

a driving mechanism for moving the trough;

a first storing part storing the granular resin;

a second storing part being smaller than the first storing part, the granular resin being supplied to the second storing part when the second storing part is moved to a prescribed position close to the first storing part thereby the second storing part temporarily stores the granular resin sent from the first storing part and supplies the granular resin to the trough; and

a weight scale, which measures a supply amount of the dropped granular resin in a state where the supply target is mounted on the supply target mounting section, being provided to the supply target mounting part, and

wherein the first storing part is fixed, the trough is moved, by the driving mechanism, together with the second storing part, the supply target mounting part is fixed, and the trough is moved to supply the granular resin onto the supply target and form the same in a desired pattern thereon,

wherein the conveying hand conveys the supply target, on which the granular resin has been supplied, into the pair of dies and sets therein, and

wherein the press section clamps the supply target, on which the granular resin has been supplied, by the pair of dies and thermal-cures the granular resin in the cavity for resin molding.

[Claim 2]

The resin molding apparatus according to claim 1,

wherein a base resin part is formed by a writing method, which is performed by continuously dropping the granular resin onto the supply target from the trough, with relatively moving the supply target mounting part with respect to the trough by the driving mechanism, and a convex resin part, which is higher than the base resin part, is formed on a center part of the base resin part by supplying the resin.

[Claim 3]

The resin molding apparatus according to claim 1,

wherein the granular resin is supplied onto the entire surface of the supply target by repeating an action for supplying the granular resin onto the supply target in the form of a belt when the trough is reciprocally moved in the longitudinal direction of the trough.

[Claim 4]

The resin molding apparatus according to claim 3,

wherein measuring the actual supply amount of the former dropping action by the weight scale and adjusting the supply amount for the next dropping action to correct an error between the measured supply amount and the predetermined amount are repeated.

[Claim 5]

The resin molding apparatus according to any one of claims 1 to 4,

further comprising a preheating section being provided on a supply target conveying route between the resin supply section and the press section,

the preheating section preheating the supply target, on which the granular resin has been supplied, at a temperature lower than a molding temperature.

[Claim 6]

The resin molding apparatus according to claim 5,

further comprising a cooling section being provided on the supply target conveying route between the preheating section and the press section, the cooling section cooling the preheated supply target.

[Claim 7]

A resin supplying apparatus, which is capable of dropping granular resin onto a supply target, comprising:

a trough for dropping the granular resin onto the supply target;

a supply target mounting part, on which the supply target will be mounted, being located immediately under the trough;

a driving mechanism for moving the trough;

a first storing part storing the granular resin;

a second storing part being smaller than the first storing part, the granular resin being supplied to the second storing part when the second storing part is moved to a prescribed position close to the first storing part thereby the second storing part temporarily stores the granular resin sent from the first storing part and supplies the granular resin to the trough; and

a weight scale, which measures a supply amount of the dropped granular resin in a state where the supply target is mounted on the supply target mounting section, being provided to the supply target mounting part,

wherein, in the resin supply section, the first storing part is fixed, the trough is moved, by the driving mechanism, together with the second storing part, the supply target mounting part is fixed, and the trough is moved to supply the granular resin onto the supply target and form the same in a desired pattern thereon.