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TITLE OF THE INVENTION

Method of Sealing Electronic Parts with Molded Resin
and Mold Employed Therefor

BACKGROUND OF THE INVENTION

5 Field of the Invention

The present invention relates to improvements in a
method of sealing electronic parts such as ICs, LSIs,
diodes or capacitors which are mounted on lead frames with
thermosetting resin materials and a mold employed
10 therefor, and more particularly, it relates to
improvements for preventing formation of voids etc. in the
interior and the exterior of resin-sealed compacts (mold
packages) of such electronic parts.

Description of the Background Art

15 In general, electronic parts are sealed with molded
resin by transfer molding, which is carried out through a
mold for resin sealing in the following manner, for
example:

20 A fixed upper mold section and a movable lower mold
section which are provided on a mold for resin sealing are
previously heated by heating means to a resin molding
temperature, while the upper and lower mold sections are
opened.

25 Then, lead frames which are provided with electronic
parts are set in prescribed positions of a mold surface of



the lower mold section, while resin materials (resin tablets) are supplied into pots of the lower mold section.

Then, the lower mold section is upwardly moved so that the upper and lower mold sections are closed. At
5 this time, the electronic parts and the lead frames provided around the same are engaged/set in upper and lower cavities which are oppositely provided in the mold surfaces of the upper and lower mold sections, while the resin tablets introduced into the pots are heated and
10 successively melted.

Then, the resin tablets provided in the pots are pressurized by plungers so that the melted resin materials are injected into and charged in the upper and lower cavities through resin passages, so that the electronic
15 parts and the lead frames provided around the same which are set in the cavities are sealed in resin compacts which are molded in correspondence to the shapes of the cavities.

After a lapse of a time which is necessary for curing
20 the melted resin materials, therefore, the upper and lower mold sections may be opened to release the resin-sealed compacts as well as the lead frames and the cured resin materials from the upper and lower cavities and the resin passages respectively, through a mold release mechanism.

25 When the upper and lower mold sections are closed,



air containing moisture (water) remains in a space portion which is defined between the mold surfaces, i.e., an internal space portion of the mold which is defined by the pots, the resin passages and the upper and lower cavities, and this residual air is disadvantageously mixed into the melted resin materials to form voids etc. in the interior and the exterior of the resin-sealed compacts.

Therefore, the cavities are made to communicate with the exterior of the mold through proper air vents to transfer the melted resin materials from the pots through the resin passages for injecting and charging the same in the upper and lower cavities, thereby naturally discharging the residual air etc. to the exterior through the air vents due to the injecting/charging action.

As hereinabove described, it is possible to naturally discharge the air remaining in the pots, the resin passages and the upper and lower cavities. In practice, however, it is impossible to effectively prevent the resin-sealed compacts from formation of internal voids and defective parts on outer surfaces thereof. Thus, it is impossible to reliably overcome disadvantages such as deterioration of moisture resistance and appearances of the products.

When internal voids are formed in the resin-sealed compacts, the lead frames are deteriorated in adhesion



with the resin materials, while water easily infiltrates into the compacts through clearances between the resin materials and the lead frames to deteriorate moisture resistance of the product, for example.

5 In a step of bending outer leads projecting from the resin-sealed compacts, further, the resin-sealed compacts may be cracked by bending force which is applied to base portions of the outer leads or these portions may be chipped, and hence it is impossible to attain high quality
10 and high reliability which are strongly required for such products..

 The internal voids etc. which are formed in the resin-sealed compacts are mainly caused by air and/or moisture contained in the resin tablets.

15 The aforementioned resin tablets, which are prepared by simply compacting resin powder into prescribed shapes, generally contain a large quantity of air containing atmospheric moisture. Further, such a large quantity of air contained in the resin tablets is present in the state
20 of a number of bubbles which are independent of each other, such that the independent bubbles cannot communicate with each other and with surfaces of the resin tablets.

 When the resin tablets are heated to a resin molding
25 temperature of at least 175°C, for example, the air and/or



moisture contained in the resin tablets is transformed into steam, which in turn is mixed into the melted resin materials with the aforementioned residual air in the internal space portion and injected and charged in the
5 cavities in this state. 50

Therefore, voids are formed in the interior and the exterior of the resin-sealed compacts due to the air and/or moisture contained in the resin tablets.

In addition, gases such as volatile gases generated
10 by heating of the resin tablets also serve as factors forming voids in the interior and the exterior of the resin-sealed compacts.

In order to prevent such formation of voids in the interior and the exterior of the resin-sealed compacts, it
15 may be possible to employ the following countermeasures:

There has been proposed a method of arranging sealing members such as O-rings on mold surfaces of upper and lower mold sections and closing the mold sections by connecting the mold surfaces with each other, thereby
20 evacuating the mold through air vents.

In this method, however, a sufficient degree of vacuum cannot be attained since the aforementioned residual air etc. is suction-discharged from the internal space portion through small air vents. Further, this
25 method has hardly been put into practice since a



considerably long time is required for attaining a sufficient degree of vacuum and hence respective molding cycle times are too much increased.

Another countermeasure is carried out through a method of arranging bellows-type or cylindrical outside air cutoff means around outer side portions of the mold, for isolating the internal space portion of the mold, defined between the mold surfaces, from the exterior against the outside air and evacuating the mold when the same is closed.

However, such outside air cutoff means tends to be increased in size since the same is arranged in the exterior of the mold, while the large-sized outside air cutoff means must be moved by driving means every molding cycle for opening or closing the mold and a considerably long time is required for such movement. Thus, the large-sized outside air cutoff means cannot be completely moved within the time for a step of opening or closing the mold, and hence a significant influence is exerted on each molding cycle time under the present circumstances.

Particularly when the mold is opened, times for moving the large-sized outside air cutoff means are specifically required for transferring the lead frames to prescribed positions of the mold surfaces and introducing the resin tablets into the respective pots, and for



cleaning the mold surfaces. Such movement of the outside air cutoff means cannot be performed within the time for the step of opening the mold, and hence each molding cycle time is generally increased, to increase the overall resin molding time.

In the aforementioned mold, further, the outside air cutoff means is provided around the outer side portions of the mold with provision of the driving means for moving the same, and hence it is necessary to prevent formation of a clearance between the mold and the outside air cutoff means thereby isolating the internal space portion from the exterior against the outside air. Therefore, considerable working accuracy is required for the mold, and the working time thereof is increased.

Thus, the mold is disadvantageously increased in size and the cost for manufacturing the same is increased.

SUMMARY OF THE INVENTION

An object of the present invention is to efficiently and reliably discharge air and/or moisture remaining in an internal space portion of a mold, air and/or moisture contained in resin tablets, and gases generated upon heating of the resin tablets, serving as significant causes for formation of voids in the interior and the exterior of resin-sealed compacts, to the exterior of the internal space portion, thereby preventing the air,



moisture and gases from being mixed or entrained into melted resin materials for preventing formation of voids and defective parts in the interior and the exterior of the resin-sealed compacts.

5 Another object of the present invention is to solve the aforementioned problems which are related to the outside air cutoff means etc. for reducing molding cycle times, thereby reducing the overall resin molding time.

10 Still another object of the present invention is to miniaturize the aforementioned mold through a structure not utilizing the aforementioned outside air cutoff means, as well as to reduce the manufacturing cost for the mold.

15 A further object of the present invention is to provide a method of and a mold for sealing electronic parts with molded resin, which can prevent formation of voids and defective parts in the interior and the exterior of resin-sealed compacts for molding products having high quality and high reliability with formation of neither voids nor defective parts in the interior and the exterior
20 of the resin-sealed compacts.

In order to attain the aforementioned objects, a method of sealing electronic parts with molded resin according to an aspect of the present invention comprises:

25 a hollow sealing member arranging step of arranging a hollow sealing member on a mold surface of at least one



mold surface of a mold for resin sealing consisting of a fixed mold section and a movable mold section,

a resin tablet supplying step of supplying resin tablets in a plurality of pots which are arranged in the mold respectively,

a lead frame supplying step of supplying and setting electronic parts which are mounted on lead frames in prescribed positions of cavities which are arranged in the mold,

a resin tablet heating step of heating the resin tablets which are supplied in the pots of the mold,

a hollow sealing member expanding step of expanding the hollow sealing member by pressurizing means,

an outside air cutoff step of bringing the expanded hollow sealing member into contact with the mold surface of the mold section which is opposed to the hollow sealing member for isolating an internal space portion which is defined between the expanded hollow sealing member and the mold surfaces of the mold by at least the pots, respective resin passages and the cavities from the exterior,

an internal space portion evacuating step of forcibly suction-discharging residual air and/or moisture in the internal space portion, air and/or moisture flowing out from the interior of the resin tablets, which are heated/expanded in the resin tablet heating step, into the



internal space portion, and gases generated by the heating to the exterior of the internal space portion, thereby improving the degree of vacuum in the internal space portion,

5 a mold closing step of closing the fixed and movable mold sections in a state of engaging the electronic parts which are mounted on the lead frames in the prescribed positions of the cavities, and

 a resin sealing step of pressurizing the resin
10 tablets which are supplied in the pots of the mold for injecting melted resin materials heated and melted in the respective pots into a prescribed number of cavities which are arranged on side portions of the pots through the resin passages respectively, thereby sealing the
15 electronic parts which are engaged in the cavities with the molded resin materials.

 According to the present invention, it is possible to carry out evacuation of forcibly suction-discharging air, moisture and gases from the internal space portion by
20 expanding the hollow sealing member which is arranged on at least one mold surface of the mold consisting of the fixed and movable mold sections for bringing the hollow sealing member into a state convexly expanded on the mold surface and moving the movable mold section in mold
25 closing so that the expanded hollow sealing member is in



contact with another mold surface of the mold for completely sealing the internal space portion, including at least the pots, the resin passages and the cavities, which is defined between the mold surfaces of the mold and isolating this internal space portion from the exterior. Consequently, it is possible to efficiently and reliably suction-discharge all of the air, moisture and gases from the internal space portion.

Thus, it is possible to prevent the air, moisture and gases contained in the internal space portion from being mixed or entrained in the melted resin materials, thereby efficiently and reliably preventing formation of voids and defective parts caused by the presence of the air, moisture and gases in the interior and the exterior of resin-sealed compacts.

According to this method, further, it is possible to expand the hollow sealing member within the time for the mold closing step, i.e., substantially simultaneously with closing of the mold, while it is also possible to contract the hollow sealing member to its original shape within the time for a mold opening step, i.e., substantially similarly with opening of the mold. Thus, the hollow sealing member can be expanded and contracted within the times for opening and closing the mold, whereby the times required for expanding and contracting the hollow sealing



member exert no influences on the molding cycle time.

Therefore, it is possible to reduce each molding cycle time and the overall time for sealing the electronic parts with molded resin as compared with the aforementioned
5 prior art which cannot complete movement of the outside air cutoff means within the times for the steps of opening and closing the mold.

According to another aspect of the present invention, the method of sealing electronic parts with molded resin
10 is carried out by employing a mold having an outside air cutoff member which is engaged with one of fixed and movable mold sections for covering outer peripheral surfaces of the other one and arranging a hollow sealing member on at least either an inner side surface of the
15 outside air cutoff member or an outer peripheral surface of the mold which is opposed thereto. Also in this method, a lead frame supplying step, a resin tablet heating step, a hollow sealing member expanding step, an outside air cutoff step, an internal space portion
20 evacuating step, a mold closing step and a resin sealing step are successively carried out similarly to the aforementioned method.

According to this method, the hollow sealing member is so expanded as to isolate a clearance between the inner
25 side surface of the outside air cutoff member and the



outer peripheral surface of the mold from the outside air, whereby no precise dimensional accuracy is required for engaging the outside air cutoff member with the mold. Therefore, no strict working accuracy is required for the
5 outside air cutoff member, whereby the working time can be reduced to save the manufacturing cost.

In a preferred embodiment of the method of sealing electronic parts with molded resin according to each of the aforementioned aspects of the present invention, the
10 mold closing step includes an internal mold closing step of closing the mold while maintaining a prescribed space between the mold surfaces of the fixed and movable mold surfaces in an outside air cutoff state attained through the outside air cutoff step before completely closing the
15 mold for bringing the mold surfaces of the fixed and movable mold sections into contact with each other.

Due to such inclusion of the intermediate mold closing step, it is possible to relatively easily discharge the residual air and/or moisture from the
20 internal space portion to the exterior since the prescribed space is defined between the mold surfaces in the intermediate mold closing.

The intermediate mold closing step is carried out in a state of stopping the movable mold section while
25 maintaining the prescribed space between the mold



surfaces, or continuously carried out without stopping the movable mold section by gradually reducing the mold closing speed (the speed for moving the movable mold section) from the intermediate mold closing state of
5 maintaining the prescribed space between the mold surfaces to a complete mold closing state.

The inventive mold which is employed for the method of sealing electronic parts with molded resin according to the aforementioned first aspect of the present invention
10 comprises fixed and movable mold sections which are opposed to each other, with pots for supplying resin materials, resin passages and cavities for molding resin provided in at least one of the fixed and movable mold sections. The mold further comprises:

15 a hollow sealing member which is arranged in at least one of mold surfaces of the fixed and movable mold sections, and pressurizing means for expanding the hollow sealing member by pressurizing its interior, and

20 evacuation means for forcibly suction-discharging air, moisture and gases from an internal space portion, including the pots, the resin passages and the cavities, which is defined by bringing the hollow sealing member expanded by the pressurizing means into contact with the mold surface opposite to that provided with the hollow
25 sealing member in closing of the fixed and movable mold



sections, to the exterior while isolating the internal space portion from the exterior, thereby improving the degree of vacuum in the internal space portion.

Due to the structure of arranging the hollow sealing member on the mold surface without separately providing
5 outside air cutoff means and driving means therefor, it is possible to miniaturize the mold and to reduce the cost for manufacturing this mold.

In a preferred embodiment of the mold according to
10 the present invention, the diameter of each cull portion which is provided in a position of each resin passage opposed to each pot is set to be at least twice that of each pot, thereby increasing the total heating value of such cull portions for heating/melting the resin
15 materials.

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

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partially fragmented longitudinal sectional view showing a principal part of a mold for sealing electronic parts with molded resin according to an
25 embodiment of the present invention in a state opened



before sealing electronic parts with molded resin;

Fig. 2 is a partially fragmented longitudinal sectional view showing the mold appearing in Fig. 1 with a hollow sealing member which is expanded and brought into contact with a mold surface of a lower mold section for defining an outside air cutoff space portion;

Fig. 3 is a partially fragmented longitudinal sectional view showing the mold appearing in Fig. 1 in a state completely closed for sealing electronic parts with molded resin;

Fig. 4 is a partially fragmented bottom plan view showing a principal part of a mold surface of an upper mold section which is provided in the mold appearing in Fig. 1;

Fig. 5A is a partially fragmented longitudinal sectional view showing the hollow sealing member according to the embodiment in a state before expansion in correspondence to Fig. 1, Fig. 5B is a partially fragmented sectional view showing the hollow sealing member in a state expanded and brought into contact with the lower mold section in correspondence to Fig. 2, and Fig. 5C is a partially fragmented longitudinal sectional view showing the hollow sealing member in a state compressed by the lower mold section in correspondence to Fig. 3 respectively;



Fig. 6 is a partially fragmented longitudinal sectional view showing a principal part of a mold for sealing electronic parts with molded resin according to another embodiment of the present invention in an
5 intermediately closed state; and

Fig. 7 is a partially fragmented longitudinal sectional view showing a principal part of a mold for sealing electronic parts with molded resin according to still another embodiment of the present invention in a
10 closed state.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention are now described with reference to Figs. 1 to 5C.

Referring to Fig. 1, a mold for resin sealing
15 according to a first embodiment of the present invention comprises an upper mold section 1 (fixed type) mounted on an upper fixed plate and a lower mold section 2 (movable type) mounted on a lower movable plate, which are opposed to each other.

20 A plurality of pots 3 are arranged in the lower mold section 2 so that plungers 4 for pressurizing resin materials are engaged in the respective pots 3, while a required number of resin molding cavities 5 are arranged on side portions of the respective pots 3.

25 On the other hand, cavities 6 corresponding in



position and number to the cavities 5 of the lower mold section 2 are oppositely provided in the upper mold section 1, which is also provided with cull portions 7 oppositely to the pots 3 of the lower mold section 2.

5 The cul portions 7 and the cavities 6 communicate with each other through resin passages 8, whereby the pots 3 and the upper and lower cavities 5 and 6 communicate with each other through the short resin passages 8 including the cull portions 7 when the upper and lower
10 mold sections 1 and 2 are closed.

 Further, the upper and lower mold sections 1 and 2 are provided with heating means 9 and 10 such as heaters respectively, as well as with ejector pins 11 and 12 for ejecting and releasing cured resin materials in the resin
15 passages 8 including the cull portions 7 and resin-sealed compacts cured in the upper and lower cavities 5 and 6 respectively.

 Therefore, the resin materials which are heated and melted in the pots 3 are pressurized by the plungers 4,
20 and injected into the upper and lower cavities 5 and 6 through the resin passages 8 including the cull portions 7.

 The upper cavities 6 are provided with air vents 13.

 On the other hand, the lower mold section 2 is
25 provided in its mold surface with concave portions 16 for



setting lead frames 15 on which electronic parts 14 are mounted.

As shown in Fig. 4, a hollow sealing member 17 which is in the form of an expandable/contractible cylinder (rubber tube) is embedded in the mold surface of the upper mold section 1 at least around outer peripheries of the cull portions 7, the resin passages 8, the cavities 6 and the air vents 13, for isolating an internal space portion which is defined by at least the pots 3, the resin passages 7 and 8 and the upper and lower cavities 5 and 6 from the exterior against the outside air (see Fig. 5A).

This hollow sealing member 17 communicates with a pressurizing mechanism 19 utilizing a fluid pressure of oil or air, through a pressurization path 18 such as a pressure pipe.

Further, the hollow sealing member 17 is made of an elastic material such as heat-resistant rubber or elastomer, for example, and the interior of the cylindrical hollow sealing member 17 is pressurized by the fluid pressure which is applied from the pressurizing mechanism 19, so that the hollow sealing member 17 is expanded (see Fig. 5B).

The position for arranging the hollow sealing member 17 in the upper mold section 1 is not restricted to that shown in Fig. 4, but the position of arrangement and the



shape on the mold surface can be arbitrarily set in accordance with the subject matter of the present invention.

5 The hollow sealing member 17 may alternatively be arranged in the mold surface of the lower mold section 2.

Further, the fluid pressure is not restricted to that of a gas such as air* or nitrogen gas or a fluid such as oil or water, but a material having high viscosity or that having viscoelasticity may alternatively be employed.

10 Expansion of the aforementioned hollow sealing member 17 is now described with reference to Figs. 5A to 5C.

Fig. 5A shows the hollow sealing member 17 in a state before expansion. On the other hand, Fig. 5B shows the hollow sealing member 17 which is internally pressurized by the pressurizing mechanism 19 and expanded.

15 The expanded hollow sealing member 17 is in a state convexly formed on the mold surface of the upper mold section 1. Further, this expanded hollow sealing member 17 is in contact with the lower mold section 2 which is upwardly moved (see Fig. 2).

20 When the upwardly moved lower mold section 2 comes into contact with the expanded hollow sealing member 17, an internal space portion 20 (i.e., an outside air cutoff space) which is isolated from the outside air is defined between the expanded hollow sealing member 17 provided in



the upper mold section 1 and the mold surfaces of the upper and lower mold sections 1 and 2, at least by the pots 3, the resin passages 7 and 8 and the cavities 5 and 6 of the mold (see Fig. 2).

5 Fig. 5C shows the expanded hollow sealing member 17 which is pressed by the upwardly moved lower mold section 2 and compressed in a completely closed state of the upper and lower mold sections 1 and 2.

 In this state, the expanded hollow sealing member 17
10 is continuously pressurized by the pressurizing mechanism 19.

 Thus, the hollow sealing member 17 shown in Fig. 5A is expanded by the pressurizing mechanism 19 while the lower mold section 2 is upwardly moved, so that the mold
15 is completely closed as shown in Fig. 5C through the state shown in Fig. 5B.

 When the pressure which is applied by the pressurizing mechanism 19 is released, the expanded hollow sealing member 17 shown in Fig. 5B is contracted by its
20 elastic restoring force, to return to the state shown in Fig. 5A.

 Referring again to Fig. 4, an exhaust port 21 is provided in an arbitrary portion of the mold surface of the upper mold section 1 which is enclosed with the hollow
25 sealing member 17, for suction-discharging air from the



internal space portion 20. This exhaust port 21 is arranged on an upper side of a pot 7a.

This exhaust port 21 communicates with an end of a vacuum path 22 such as a vacuum pipe, while another end of the vacuum path 22 communicates with an evacuation mechanism 23 consisting of a vacuum pump or the like.

Therefore, the air contained in the internal space portion 20 is suction-discharged by the evacuation mechanism 23 in a state isolated from the outside air, for example, so that the internal space portion 20 is set at a prescribed degree of vacuum.

In the aforementioned operation for evacuating the internal space portion 20, it is possible to forcibly suction-discharge residual air and/or moisture in the space portion 20, air and/or moisture flowing out from resin tablets R which are heated and expanded in the pots 3 into the space portion 20, and gases generated by the heating to the exterior of the space portion 20.

The position and the number of arrangement of the exhaust port 21 are not restricted to those of this embodiment, but such exhaust ports 21 may be properly set on the mold surfaces of the upper and lower mold sections 1 and 2.

Alternatively, such exhaust ports 21 may be properly arranged in the cull portions 7, the pots 3 and the air



vents 13, for example.

In the upper and lower mold sections 1 and 2, further, appropriate sealing members (not shown) are properly interposed between/arranged on engaging surfaces of the mold members such as the pots 3 and the ejector pins 11 and 12, i.e., clearances between the respective mold members.

Suction discharge of the air etc. from the internal space portion 20 is started by the evacuation mechanism 23 when the upwardly moved lower mold section 2 comes into contact with the expanded hollow sealing member 17 of the upper mold section 1.

An operation of sealing the electronic parts 14 which are mounted on the lead frames 15 with molded resin through mold having the aforementioned structure is now described.

First, the lower mold section 2 is downwardly moved to open the upper and lower mold sections 1 and 2, as shown in Fig. 1. Then, the resin tablets R are supplied into the pots 3 which are arranged in the lower mold section 2 respectively, while the lead frames 15 are supplied/set in the concave portions 16 in the mold surface of the lower mold section 2.

The resin tablets R which are supplied in the respective pots 3 are heated by the heating means 9 and 10



provided on the upper and lower mold sections 1 and 2, expanded and softened, to be successively melted.

Then, the hollow sealing member 17 arranged in the upper mold section 1 is pressurized by the pressurizing
5 mechanism 19, to be expanded (see Figs. 5A and 5B).

Then, the lower mold section 2 is upwardly moved as shown in Fig. 2 to close the upper and lower mold sections 1 and 2, so that the mold surface of the lower mold section 2 is brought into contact with the expanded hollow
10 sealing member 17 for defining the internal space portion 20 between the expanded hollow sealing members 17 provided in the upper mold section 1 and the mold surfaces of the upper and lower mold sections 1 and 2 at least by the pots 3, the resin passages 7 and 8 and the cavities 5 and 6.

15 Then, the mold is evacuated by the evacuation mechanism 23 in the aforementioned outside air cutoff state.

Namely, the residual air in the internal space portion 20 is forcibly suction-discharged through the
20 exhaust port 21 which is provided in the mold surface of the upper mold section 1 and the vacuum path 22, to carry out an evacuation step.

As hereinabove described, the resin tablets R which are supplied in the pots 3 are heated by the heating means
25 9 and 10 provided on the mold sections 1 and 2 to be



expanded and softened, while the interior and the exterior of the resin tablets R can be ventilated at this time, so that the air and/or moisture contained therein flows out into the pots 3.

5 Further, the resin tablets R supplied in the pots 3 are heated to generate gases.

 Therefore, it is possible to efficiently and reliably suction-discharge all of the residual air and/or moisture in the space portion 20, the air and/or moisture flowing
10 out from the resin tablets R into the space portion 20 (in the pots 3), and the gases generated by the heating of the resin tablets R into the exterior of the space portion 20 by forcibly evacuating the internal space portion 20 by the evacuation mechanism 23.

15 Namely, it is possible to improve the degree of vacuum in the space portion 20 to a prescribed level.

 In each molding cycle, the upward movement of the lower mold section 2 and the expansion of the hollow sealing member 17 in mold closing, or the downward
20 movement of the lower mold section 2 and the contraction of the hollow sealing member 17 in mold opening are carried out substantially at the same time.

 Therefore, the time required for expanding or contracting the hollow sealing member 17 is within the
25 time for the step of opening or closing the mold, thereby



exerting no influence on each molding cycle time as compared with the aforementioned structure which cannot complete movement of the outside air cutoff means within the time for the step of opening or closing the mold.

5. Due to employment of the hollow sealing member 17, further, the mold can be miniaturized with no requirement for the aforementioned large-sized outside air cutoff means and driving means, while the working time of the mold is also reduced. Thus, the cost for manufacturing
10 the mold is economically reduced.

After the upper and lower mold sections 1 and 2 are completely closed, a resin sealing step is carried out for sealing the electronic parts 14 which are mounted on the lead frames 15 in resin-sealed compacts, as shown in Fig.
15 3. Namely, the resin tablets R provided in the pots 3 are pressurized by the plungers 4 upon complete closing of the upper and lower mold sections 1 and 2, so that the resin materials heated and melted in the pots 3 are injected and charged in a required number of the cavities 5 and 6 which
20 are provided on side positions of the pots 3 through the resin passages 7 and 8, thereby sealing the electronic parts 14 provided on the lead frames 15 which are engaged/set in the cavities 5 and 6 in the resin-sealed compacts.

25 Then, the upper and lower mold sections 1 and 2 are

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again opened after a required curing time, for releasing the resin-sealed compacts and the cured resin materials from the upper and lower cavities 5 and 6 and the resin passages 7 and 8 respectively.

5 Thus, it is possible to forcibly suction-discharge the air, moisture and gases from the internal space portion 20 by the evacuation mechanism 23 while preventing the air, moisture and gases contained in the space portion 20 from being mixed or entrained into the melted resin
10 materials, thereby reliably preventing formation of voids and defective parts caused by presence of the air, moisture and gases in the interior and the exterior of the resin-sealed compacts.

 The operation of the evacuation mechanism 23 for
15 forcibly suction-discharging the residual air etc. from the internal space portion 20 to the exterior is continuously carried out also in formation of the internal space portion 20 and complete closing of the upper and lower mold sections 1 and 2.

20 The hollow sealing member 17 is repeatedly expanded and contracted every molding cycle for sealing the electronic parts 14 with molded resin, while the electronic parts 14 may alternatively be continuously sealed with molded resin in an expanded state of the
25 hollow sealing member 17.



Further, expansion/contraction of the hollow sealing member 17 and upward/downward movement of the lower mold section 2 may be carried out independently of each other.

In the aforementioned embodiment, the following mold closing method may alternatively be employed:

First, the lower mold section 2 is upwardly moved to bring the mold surface of this lower mold section 2 into contact with the expanded sealing member 17, thereby forming an outside air cutoff state by the expanded sealing member 17 and the lower mold section 2.

In this outside air cutoff state, the lower mold section 2 is stopped at a proper position to carry out intermediate closing for defining a required space S between the mold surfaces of the upper and lower mold sections 1 and 2 (see Fig. 2).

Then, residual air etc. contained in the internal space portion 20 which is defined in the aforementioned intermediate closing is forcibly suction-discharged by the evacuation mechanism 23, to set the space portion 20 at a prescribed degree of vacuum.

Then, the mold surfaces of the upper and lower mold sections 1 and 2 are connected with each other to completely close the mold.

In the aforementioned intermediate closing, the required space S is defined in the space portion 20,



particularly between the mold surfaces of the upper and lower mold sections 1 and 2, whereby the residual air and/or moisture can be relatively readily discharged from the space portion 20 to the exterior.

5 When the lower mold section 2 is stopped to carry out the intermediate closing, it is possible to bring the space portion 20²⁰ which is defined in the intermediate closing into a prescribed high vacuum state by a vacuum pump (evacuation mechanism 23) of low dischargeability,
10 due to stopping of the lower mold section 2.

 In the aforementioned mold closing step, setting of the internal closing state may be continuously performed from the position of the intermediate closing state to the position of the complete closing state while reducing the
15 closing speed (speed for upwardly moving the lower mold section 2) without stopping the lower mold section 2.

 A second embodiment of the present invention is now described with reference to Fig. 6.

 Referring to Fig. 6, a mold for resin sealing
20 according to the second embodiment of the present invention comprises upper and lower mold sections 30 and 31 which are opposed to each other.

 An outside air cutoff member 32 for enclosing outer side portions of the lower mold section 31 is engaged in
25 the upper mold section 30, so that inner surfaces of the



outside air cutoff member 32 and outer side surfaces of the lower mold section 31 are engaged with each other through clearances when the upper and lower mold sections 30 and 31 are closed.

5 A hollow sealing member 33a is arranged on the inner surfaces of the outside air cutoff member 32, to be expanded and brought into contact with the outer side surfaces of the lower mold 31 when the upper and lower mold sections 30 and 31 are closed.

10 Another hollow sealing member 33b is also arranged on side surfaces of the lower mold section 31, to be expanded and brought into contact with the inner surfaces of the outside air cutoff member 32.

15 Further, a pressurizing mechanism 19 is connected to the hollow sealing members 33a and 33b respectively.

 In addition, an evacuation mechanism 23 such as a vacuum pump is connected to the outside air cutoff member 32 and ports 3 of the lower mold section 31.

20 Mold members which are identical to those of the aforementioned embodiment are denoted by the same reference numerals, to omit redundant description.

 First, intermediate mold closing is carried out by upwardly moving the lower mold section 31 and stopping the same for defining a required space T between mold surfaces
25 of the upper and lower mold sections 30 and 31.



At this time, the outside air cutoff member 32 arranged on the upper mold section 30 is positioned around the outer side portions of the mold.

Then, the hollow sealing members 33a and 33b are
5 pressurized by the pressurizing mechanism 19 and expanded, for defining an outside air cutoff space portion 34 between the expanded hollow sealing members 33a and 33b, the outside air cutoff member 32 and the mold surfaces of the upper and lower mold sections 30 and 31 at least by
10 the pots 3, resin passages 7 and 8 and cavities 5 and 6.

Then, residual air etc. is forcibly suction-discharged from the outside air cutoff space portion 34 by the evacuation mechanism 23, to improve the degree of vacuum in the outside air cutoff space portion 34.

15 Then, the mold surfaces of the upper and lower mold sections 30 and 31 are connected with each other to completely close the mold, while electronic parts 14 which are mounted on lead frames 15 are engaged/set in the cavities 5 and 6.

20 Then, heated/melted resin tablets R are pressurized by plungers 4, so that melted resin materials are injected and charged in the cavities 5 and 6 through the resin passages 7 and 8, for sealing the electronic parts 14 with molded resin.

25 According to this embodiment, therefore, it is



possible to efficiently and reliably suction-discharge all of the residual air and/or moisture in the space portion 34, air and/or moisture flowing out from the resin tablets R into the space portion 34 (in the pots 3) and gases generated by the heating of the resin tablets R into the exterior of the space portion 34 while reliably preventing formation of voids and defective parts caused by presence of the air, moisture and gases in the interior and the exterior of the resin-sealed compacts, by forcibly evacuating the outside air cutoff space portion 34 by the evacuation mechanism 23.

According to this embodiment, further, a clearance between the outside air cutoff member 32 and the lower mold section 31 is isolated from the outside air by expanding the hollow sealing members 33a and 33b, whereby no precise dimensional accuracy is required for the engagement between the outside air cutoff member 32 and the lower mold section 31.

Namely, no strict working accuracy is required and hence the working time is reduced, while it is possible to reduce the manufacturing cost.

This embodiment may simply be provided with only one of the hollow sealing members 33a and 33b.

In opening/closing of the upper and lower mold sections 30 and 31, the outside air cutoff member 32 may



be upwardly/downwardly moved along the outer side surfaces of the upper mold section 30.

The present invention is not restricted to the aforementioned embodiments, but modification/selection may
5 be properly and arbitrarily employed at need within the scope of the present invention.

In each of the aforementioned embodiments, it is possible to employ a single pot and a plunger which is engaged in this pot, for injecting and charging a melted
10 resin material in upper and lower cavities through resin passages.

In each of the aforementioned embodiments, further, it is possible to inject and charge the melted resin materials in the upper and lower cavities through the
15 resin passages by slot-shaped pots and plungers corresponding to the slot-shaped pots.

A third embodiment of the present invention is now described with reference to Fig. 7.

For example, the resin tablets R (resin materials)
20 are introduced into the pots 3 of the lower mold section 2 shown in Fig. 1, the upper and lower mold sections 1 and 2 are closed and the resin tablets R provided in the pots 3 are heated and melted by the heating means 9 and 10.

In this case, bottom surface portions of the resin
25 tablets R which are provided in the pots 3 are placed on



upper end surfaces of the plungers 4, while slight clearances are defined between side surface portions thereof and inner wall surfaces of the pots 3 and open space portions are defined between upper surface portions thereof and the cull portions 7 (see Fig. 1).

In this state, therefore, conduction heat and radiation heat are applied to the resin tablets R from the bottom surface portions and the side surface portions thereof respectively. Thus, the resin tablets R are heated and melted from the bottom surface portions and the side surface portions, while the upper surface portions thereof are hardly sufficiently heated and melted.

After closing of the upper and lower mold sections 1 and 2, therefore, the resin tablets R are pressurized by the plungers 4 in such a state that the resin materials are not completely melted in the vicinity of the upper surface portions thereof to be pressed against the cull portions 7, while portions close to the upper surface portions of the resin tablets R are heated and melted by the conduction heat from the cull portions 7, and the melted resin materials are transferred to the resin passages 8 to be injected and charged into the upper and lower cavities 5 and 6.

However, the cull portions 7 are generally identical in diameter to the pots 3, and the heating value is



insufficient in this state since the diameters of the cull portions 7 are too small. Thus, the resin materials cannot be sufficiently heated and melted before the same are transferred to the resin passages 8.

5 To this end, this embodiment is adapted to increase the diameters of cull portions as compared with those of pots for increasing the lengths of passages for resin materials which are heated and melted in the cull portions, thereby obtaining a sufficient heating value for
10 heating the resin materials and facilitating the heating/melting action for the resin materials, in order to sufficiently heat and melt resin tablets.

As shown in Fig. 7, diameters of pots 44 which are arranged in a lower mold section 41 are set at L while
15 those of cull portions 42 provided in an upper mold section 40 are set to be at least 2L. Referring to Fig. 7, the aforementioned cull portions 7 are illustrated with dotted lines.

Thus, resin tablets R are heated in the pots 44 and
20 pressurized by plungers 45 so that portions close to upper surface portions of the resin tablets R are pressed against the cull portions 42, whereby it is possible to facilitate heating and melting of the resin tablets R by a sufficient heating value of the cull portions 42 and
25 transferring the same into resin passages 43.



Thus, it is possible to engage/set electronic parts 14 which are mounted on lead frames 15 in upper and lower cavities 5 and 6, while sealing the electronic parts 14 with molded resin materials, which are facilitated in heating/melting in the aforementioned manner.

Heating/melting of the resin tablets R can be further facilitated by the sufficient heating value of the cull portions 42, whereby it is possible to efficiently and reliably remove air, moisture and gases caused by the resin tablets R from the melted resin materials by suction-discharging residual air etc. from the aforementioned internal space portion 20 and bringing the same into a prescribed degree of vacuum.

Thus, it is possible to efficiently and reliably prevent formation of voids and defective parts which are caused by air, moisture and gases contained in the melted resin materials, in the interior and the exterior of resin-sealed compacts which are sealed with molded resin.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of the present invention being limited only by the terms of the appended claims.





WHAT IS CLAIMED IS:

1. A method of sealing electronic parts with molded resin, comprising:

5 a hollow sealing member arranging step of arranging a hollow sealing member (17) on at least one mold surface of a mold consisting of a fixed mold section (1) and a movable mold section (2);

a resin tablet supplying step of supplying resin tablets (R) in a plurality of pots (3) being arranged in said mold respectively;

10 a lead frame supplying step of supplying and setting electronic parts (14) being mounted on lead frames (15) in prescribed positions of cavities (5) being arranged in said mold respectively;

15 a resin tablet heating step of heating said resin tablets (R) being supplied in said pots (3) of said mold;

a hollow sealing member expanding step of expanding said hollow sealing member (17) by pressurizing means;

20 an outside air cutoff step of bringing expanded said hollow sealing member (17) into contact with said mold surface of said mold section being opposed to said hollow sealing member (17) and isolating an internal space portion, including at least said pots (3), respective resin passages (8) and respective cavities (5, 6), being





defined between said expanded hollow sealing member (17)
25 and said mold surfaces of said mold from the exterior;
an internal space portion evacuating step of forcibly
suction-discharging residual air and/or moisture in said
internal space portion, air and/or moisture flowing out
from said resin tablets (R), being heated/expanded in said
30 resin tablet heating step, into said internal space
portion, and gases being generated by said heating to the
exterior of said internal space portion in said outside
air cutoff step, thereby improving the degree of vacuum in
said internal space portion;
35 a mold closing step of closing said fixed mold
section (1) and said movable mold section (2) in a state
engaging said electronic parts (14) being mounted on said
lead frames (15) in prescribed positions of said cavities
(5, 6) of said mold; and
40 a resin sealing step of pressurizing said resin
tablets (R) being supplied in said pots (3) of said mold
for injecting melted resin materials being heated/melted
in said pots (3) into a prescribed number of said cavities
(5, 6) being arranged on side positions of said pots (3)
45 respectively through said resin passages (8), thereby
sealing said electronic parts (14) mounted on said lead
frames (15) being engaged in said cavities (5, 6) with
molded resin.





2. The method of sealing electronic parts with molded resin in accordance with claim 1, wherein

said hollow sealing member arranging step is carried out by engaging said hollow sealing member (17) in a
5 groove being formed in at least one said mold surface of said mold,

said hollow sealing member expanding step being carried out by expanding said hollow sealing member (17) to convexly project from said groove.

3. The method of sealing electronic parts with molded resin in accordance with claim 1, wherein

said mold closing step includes an intermediate mold closing step of closing said fixed mold section (1) and
5 said movable mold section (2) in a state maintaining a prescribed space between said mold surfaces in advance of bringing said mold surfaces of said fixed mold section (1) and said movable mold section (2) into contact with each other for completely closing said mold in an outside air
10 cutoff state being attained through said outside air cutoff step.

4. The method of sealing electronic parts with molded resin in accordance with claim 3, wherein

said intermediate mold closing step is carried out in

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a state stopping said movable mold section (2).

5. The method of sealing electronic parts with molded resin in accordance with claim 3, wherein

said intermediate mold closing step is continuously carried out without stopping said movable mold section (2) while reducing the speed for moving said movable mold section from a state of maintaining a prescribed space between said mold surfaces of said fixed and movable mold sections to a complete mold closing state of bringing said mold surfaces into contact with each other.

6. The method of sealing electronic parts with molded resin in accordance with claim 1, including a contractive tubular member being embedded in at least one of said mold surfaces of said fixed and movable mold sections for enclosing said internal space portion as said hollow sealing member (17).

7. The method of sealing electronic parts with molded resin in accordance with claim 6, wherein said hollow sealing member (17) is expanded by said pressurizing means to project along its overall length from said mold surface being provided with said hollow sealing member (17) in said hollow sealing member

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expanding step.

8. The method of sealing electronic parts with molded resin in accordance with claim 6, wherein said hollow sealing member (17) consists of a heat-resistant elastic material.

9. A method of sealing electronic parts with molded resin, comprising:

a hollow sealing member arranging step of arranging a hollow sealing member (33a, 33b) in at least either an inner side surface of an outside air cutoff member (32) or an outer peripheral surface of a mold including a fixed mold section (30) and a movable mold section (31) having mold surfaces being opposed to each other, either said fixed mold section (30) or said movable mold section (31) being engaged with said outside air cutoff member (32) covering an outer peripheral surface of the other said mold section through a clearance, said inner side surface and said outer peripheral surface being opposed to each other;

15 a resin tablet supplying step of supplying resin tablets (R) in a plurality of pots (3) being arranged in said mold respectively;

a lead frame supplying step of supplying and setting





electronic parts (14) being mounted on lead frames (15) in
20 prescribed positions of cavities (5, 6) being arranged in
said mold respectively;

a resin tablet heating step of heating said resin
tablets (R) being supplied in said pots (3) of said mold
respectively;

25 a hollow sealing member expanding step of expanding
said hollow sealing member (33a, 33b) by pressurizing
means;

an outside air cutoff step of bringing expanded said
hollow sealing member (33a, 33b) into contact with said
30 outer peripheral surface of said mold or said inner side
surface of said outside air cutoff member (32) being
opposed thereto for isolating an internal space portion,
including at least said pots (3), respective resin
passages (8) and said cavities (5, 6), being defined
35 between said expanded hollow sealing member (33a, 33b) and
said mold surfaces of said mold from the exterior;

an internal space portion evacuating step of forcibly
suction-discharging residual air and/or moisture in said
internal space portion, air and/or moisture flowing out
40 from said resin tablets (R), being heated/expanded in said
resin tablet heating step, into said internal space
portion, and gases being generated by said heating to the
exterior of said internal space portion in said outside





air cutoff step, thereby improving the degree of vacuum in
45 said internal space portion;

a mold closing step of closing said fixed mold
section (30) and said movable mold section (31) in a state
engaging said electronic parts (14) being mounted on said
lead frames (15) in prescribed positions of said cavities
50 (5, 6) of said mold; and

a resin sealing step of pressurizing said resin
tablets (R) being supplied in said pots (3) of said mold
for injecting melted resin materials being heated/melted
in said pots (3) into a prescribed number of said cavities
55 (5, 6) being arranged on side positions of said pots (3)
respectively through said resin passages (8), thereby
sealing said electronic parts (14) being engaged in said
cavities (5, 6) with molded resin.

10. The method of sealing electronic parts with
molded resin in accordance with claim 9, wherein

said hollow sealing member arranging step is carried
out by engaging said hollow sealing member (33a, 33b) in a
5 groove being formed in at least either said inner side
surface of said outside air cutoff member (32) or said
outer peripheral surface of said mold,

said hollow sealing member expanding step being
carried out by expanding said hollow sealing member (33a,





10 33b) to convexly project from said groove.

11. The method of sealing electronic parts with molded resin in accordance with claim 9, wherein

5 said mold closing step includes an intermediate mold closing step of closing said fixed mold section (30) and said movable mold section (31) in a state maintaining a prescribed space between said mold surfaces in advance of bringing said mold surfaces of said fixed mold section (30) and said movable mold section (31) into contact with each other for completely closing said mold in an outside
10 air cutoff state being attained through said outside air cutoff step.

12. The method of sealing electronic parts with molded resin in accordance with claim 11, wherein

said intermediate mold closing step is carried out in a state stopping said movable mold section (31).

13. The method of sealing electronic parts with molded resin in accordance with claim 11, wherein

5 said intermediate mold closing step is continuously carried out without stopping said movable mold section (31) while reducing the speed for moving said movable mold section from a state of maintaining a prescribed space





between said mold surfaces of said fixed and movable mold sections to a complete mold closing state of bringing said mold surfaces into contact with each other.

14. The method of sealing electronic parts with molded resin in accordance with claim 9, wherein

5 said hollow sealing member arranging step includes a step of embedding a contractive tubular member in at least either said inner side surface of said outside air cutoff member (32) or said outer peripheral surface of said mold.

15. The method of sealing electronic parts with molded resin in accordance with claim 14, wherein

said hollow sealing member (33a, 33b) is expanded to convexly project from said embedded surface.

16. The method of sealing electronic parts with molded resin in accordance with claim 9, wherein

5 a member consisting of a heat-resistant elastic material is employed as said hollow sealing member (33a, 33b).

17. A mold for sealing electronic parts with molded resin, comprising a fixed mold section (1) and a movable mold section (2) being opposed to each other,





at least either said fixed mold section (1) or said
5 movable mold section (2) being provided with pots (3) for
supplying resin materials, resin passages (8) and cavities
(5, 6) for molding resin,

for setting electronic parts (14) being mounted on
lead frames (15) in prescribed positions of said cavities
10 (5, 6), closing said fixed mold section (1) and said
movable mold section (2), and injecting said resin
materials being heated/melted in said pots (3) into said
cavities (5, 6) through said resin passages (8)
respectively, thereby sealing said electronic parts (14)
15 with molded resin,

said mold further comprising:

a hollow sealing member (17) being arranged in at
least one of mold surfaces of said fixed mold section (1)
and said movable mold section (2);

20 pressurizing means (19) for expanding said hollow
sealing member (17) by pressurizing its interior; and

evacuation means (23) for forcibly suction-
discharging air, moisture and gases from an internal space
portion, including said pots (3), said resin passages (8)
25 and said cavities (5, 6), being defined by bringing said
hollow sealing member (17) being expanded by said
pressurizing means (19) into contact with one said mold
surface being opposed to that provided with said hollow





30 sealing member (17) in closing of said fixed mold section (1) and said movable mold section (2) to the exterior of said internal space portion while isolating said internal space portion from the exterior, thereby improving the degree of vacuum in said internal space portion.

18. The mold for sealing electronic parts with molded resin in accordance with claim 17, wherein said hollow sealing member (17) includes a contractive tubular member being embedded in at least one of said mold surfaces of said fixed mold section (1) and said movable mold section (2) to enclose said internal space portion.

19. The mold for sealing electronic parts with molded resin in accordance with claim 18, wherein said hollow sealing member (17) is so formed as to partially project along its overall length from said mold surface being provided with said hollow sealing member (17) in a state being pressurized by said pressurizing means (19).

20. The mold for sealing electronic parts with molded resin in accordance with claim 17, wherein said hollow sealing member (17) consists of a heat-





resistant elastic material.

21. The mold for sealing electronic parts with molded resin in accordance with claim 17, wherein

the diameter of each cull portion (7), provided in each said resin passage (8), being opposed to each said
5 pot (3) is at least twice that of each said pot (3).

22. A mold for sealing electronic parts with molded resin comprising a fixed mold section (30) and a movable mold section (31) being opposed to each other,

at least either said fixed mold section (30) or said
5 movable mold section (31) being provided with pots (3) for supplying resin materials, resin passages (8) and cavities (5, 6) for molding resin,

either said fixed mold section (30) or said movable mold section (31) being provided with an outside air
10 cutoff member (32) being so engaged as to cover an outer peripheral surface of the other said mold section through a clearance,

for setting electronic parts (14) being mounted on lead frames (15) in prescribed positions of said cavities
15 (5, 6), closing said fixed mold section (30) and said movable mold section (31), and injecting said resin materials being heated/melted in said pots (3) into said





cavities (5, 6) through said resin passages (8), thereby
sealing said electronic parts (14) with molded resin,
20 said mold further comprising:
 a hollow sealing member (33a, 33b) being arranged in
at least either an inner side surface of said outside air
cutoff member (32) or an outer peripheral surface of said
fixed mold section (30) or said movable mold section (31)
25 being covered with said outside air cutoff member (32);
 pressurizing means (19) for expanding said hollow
sealing member (33a, 33b) by pressurizing its interior;
and
 evacuation means (23) for forcibly suction-
30 discharging air, moisture and gases from an internal space
portion, including said pots (3), said resin passages (8)
and said cavities (5, 6), being defined in closing of said
fixed mold section (30) and said movable mold section (31)
to the exterior of said internal space portion while
35 isolating said internal space portion from the exterior,
thereby improving the degree of vacuum in said internal
space portion.

23. The mold for sealing electronic parts with
molded resin in accordance with claim 22, wherein
said hollow sealing member (33a, 33b) includes a
contractive tubular member being embedded in at least





5 either said inner side surface of said outside air cutoff member (32) or an outer peripheral surface of said fixed mold section (30) or said movable mold section (31) being opposed thereto for enclosing said internal space portion.

24. The mold for sealing electronic parts with molded resin in accordance with claim 23, wherein

5 said hollow sealing member (33a, 33b) is so formed as to partially project along its overall length from said surface having said hollow sealing member (33a, 33b) being embedded therein in a state being pressurized by said pressurizing means (19).

25. The mold for sealing electronic parts with molded resin in accordance with claim 22, wherein

said hollow sealing member (33a, 33b) consists of a heat-resistant elastic material.

26. The mold for sealing electronic parts with molded resin in accordance with claim 22, wherein

5 the diameter of each cull portion (7), provided in each said resin passage (8), being opposed to each said pot (3) is at least twice that of each said pot (3).

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