

DESCRIPTION

FROZEN DESSERT INGREDIENTS MOLDING APPARATUS AND FROZEN DESSERT INGREDIENTS MOLDING METHOD

Technical Field

5 [0001]

The present invention relates to a frozen dessert ingredients molding apparatus and a frozen dessert ingredients molding method for molding part of ingredients of a frozen dessert such as ice cream or sherbet.

10 Background Art

[0002]

Molding containers that can form, in a frozen dessert (frozen sweets) such as ice cream, a hollow (a recess) into which a drink such as coffee, juice, or alcohol is to be
15 poured have been widely known. With such a molding container, by pouring a drink such as coffee, juice, or alcohol into the hollow formed in the frozen dessert and then mixing the frozen dessert and the drink, a drink in a frozen state (a frozen drink) can be easily prepared.

20 [0003]

For example, Patent Literature 1 discloses an example of such a molding container, i.e., a frozen dessert (frozen sweets) container including a container lid having a conical protrusion. This container lid can form a conical recess in
25 the central portion of a frozen dessert.

[0004]

In recent years, a system in which a dedicated server for a drink such as coffee is installed and customers purchase the drink in a self-service style has become common, for example,
5 at convenience stores.

[0005]

At such convenience stores, frozen desserts produced using the frozen dessert container as described in Patent Literature 1 are also being sold. A service according to which
10 a customer can purchase such a frozen dessert in a frozen state together with a drink, and the customer is allowed to eat and drink by mixing the drink and the frozen dessert together at a store is also provided. The aforementioned frozen dessert container is configured to create a recess in a
15 frozen dessert by the removal of the container lid. A customer can break up the frozen dessert with the use of such a recess and pour a drink thereinto to eat and drink.

[0006]

Along with the spread of such a service, a demand for
20 frozen desserts each having a recess formed so as to allow for the breaking up of the frozen dessert and the pouring of a drink has been rapidly increasing. To achieve an adequate supply to the market, improvement in production efficiency of such a frozen dessert (molding efficiency of frozen dessert
25 ingredients) has been strongly desired.

Citation List

Patent Literature

[0007]

Patent Literature 1: Japanese Patent No. 5536273

5 Summary of Invention

Technical Problem

[0008]

For a technique of producing a frozen dessert having a recess, however, various methods exist and there is still a
10 room for study. Specifically, when the container lid as described in Patent Literature 1 is used, for example, its special shape leads to a problem of a cost increase as compared to a typical lid for frozen dessert ingredients.

[0009]

15 Although it is conceivable to form a recess in frozen dessert ingredients (freeze frozen dessert ingredients into a recess shape) by a mold without using the above-described container lid, no techniques capable of successively producing such recesses, and achieving both improved production
20 efficiency and satisfactory molding finish have been known so far.

[0010]

The present invention has been made in order to solve such conventional problems. It is an object of the present
25 invention to provide a frozen dessert ingredients molding

apparatus and a frozen dessert ingredients molding method capable of successive production when successively molding recesses in sets of frozen dessert ingredients by a mold, and achieving both improved production efficiency and satisfactory molding finish.

Solution to Problem

[0011]

The present invention provides a frozen dessert ingredients molding apparatus for successively hardening parts of sets of frozen dessert ingredients so as to each have a hollow recess shape. The frozen dessert ingredients molding apparatus includes: a transporting unit configured to transport a plurality of containers; a filling unit configured to fill the containers with the sets of frozen dessert ingredients; a molding unit configured to sequentially immerse and pull a cooled protruding mold into and out of the sets of frozen dessert ingredients being transported so as to harden at least part of each of the sets of frozen dessert ingredients around the mold; and a refrigerant feeding unit configured to feed a refrigerant to the mold. The mold is configured to be cooled to a predetermined temperature during a period from completion of hardening of a first set of frozen dessert ingredients to start of hardening of a second set of frozen dessert ingredients being successively transported while conducting a predetermined number of hardening processes

within a predetermined amount of time.

[0012]

The present invention further provides a frozen dessert ingredients molding method for successively hardening parts of sets of frozen dessert ingredients so as to each have a hollow recess shape. The frozen dessert ingredients molding method includes the steps of: transporting a plurality of containers; filling the containers with the sets of frozen dessert ingredients; sequentially immersing and pulling a cooled protruding mold into and out of the sets of frozen dessert ingredients being transported so as to harden at least part of each of the sets of frozen dessert ingredients around the mold; and feeding a refrigerant to the mold. The mold is cooled to a predetermined temperature during a period from completion of hardening of a first set of frozen dessert ingredients to start of hardening of a second set of frozen dessert ingredients being successively transported while conducting a predetermined number of hardening processes within a predetermined amount of time.

Advantageous Effects of Invention

[0013]

The frozen dessert ingredients molding apparatus and the frozen dessert ingredients molding method according to the present invention can provide an advantageous effect such as achieving both improved production efficiency and satisfactory

molding finish when recesses are successively molded in sets of frozen dessert ingredients.

Brief Description of Drawings

[0014]

5 Fig. 1 includes diagrams illustrating a frozen dessert produced by a frozen dessert ingredients molding apparatus according to an embodiment of the present invention, where Fig. 1(a) is a cross-sectional view of the frozen dessert, and Fig. 1(b) is an external perspective view thereof.

10 Fig. 2 is a front view illustrating a general configuration of the frozen dessert ingredients molding apparatus according to the embodiment of the present invention.

 Fig. 3 includes diagrams used for explaining a recess molding device according to the embodiment of the present
15 invention, wherein Fig. 3(a) is a front view of the recess molding device and Fig. 3(b) is a top view thereof, and Fig. 3(c) is an external view of a mold and Fig. 3(d) is a cross-sectional view thereof.

 Fig. 4 includes conceptual diagrams each illustrating a
20 hardened portion according to the embodiment of the present invention.

 Fig. 5 includes schematic views used for explaining operations of the recess molding device according to the embodiment of the present invention.

25 Description of Embodiments

[0015]

A frozen dessert ingredients molding apparatus 10 according to the present invention will be described below in detail with reference to the drawings.

5 [0016]

<Overall Configuration>

Fig. 1 includes diagrams illustrating a finished state of a frozen dessert (frozen sweets) 50 having a recess molded with the frozen dessert ingredients molding apparatus 10 according to an embodiment of the present invention. Fig. 1(a) is a cross-sectional view of the frozen dessert 50, and Fig. 1(b) is an external perspective view thereof. Fig. 2 is a front external view illustrating the frozen dessert ingredients molding apparatus 10, and Fig. 3 includes diagrams illustrating a mold unit 151U. Fig. 3(a) is a front view of the mold unit 151U, and Fig. 3(b) is a top view thereof. Fig. 3(c) is an external view of a mold 151, and Fig. 3(d) is a cross-sectional view thereof.

[0017]

20 For explanatory convenience, directions in the frozen dessert ingredients molding apparatus 10 are defined as follows: a first direction corresponding to the direction heading from an upstream side toward a downstream side (the direction heading from the left to the right in Fig. 1) is referred to as a transporting direction T; a second direction

25

corresponding to the direction perpendicular to the transporting direction T is referred to as a transportation width direction W; and a third direction corresponding to the direction (the vertical direction in the figure) perpendicular to the transporting direction T and the transportation width direction W is referred to as a transportation height direction H.

[0018]

As shown in Fig. 1, the frozen dessert (frozen sweets) 50 is contained in a cup-shaped container 21 and frozen with a recess 30 formed in an approximately central portion thereof. Although the recess 30 in the present embodiment has a substantially conical shape with its apex located in a lower position, the shape of the recess 30 is not limited thereto. The recess 30 may have a cylindrical, prism, or semispherical shape, for example. The interior of the recess 30 is a hollow portion.

[0019]

With reference to Fig. 2, the frozen dessert ingredients molding apparatus 10 is a molding apparatus configured to successively harden (freeze) part of frozen dessert ingredients 23 so as to have a hollow recess shape. The frozen dessert ingredients molding apparatus 10 includes a transporting unit 11, a filling unit 13, a molding unit 15, a refrigerant feeding unit 17, and a refrigerant injection unit

19. These components of the frozen dessert ingredients molding apparatus 10 are centrally controlled by a control unit. The control unit is constituted by a CPU, a RAM, and a ROM, for example, and executes various control operations. The CPU is what is called a central processing unit, and executes various programs to implement various functions. The RAM is used as a workspace for the CPU. The ROM stores a basic operating system (OS) and programs executed in the CPU.

[0020]

10 The transporting unit 11 is, for example, a conveyer for successively transporting a plurality of containers 21. For example, the transporting unit 11 intermittently transports, in the transporting direction T, a plurality of (for example, 5 to 10) containers 21 arranged along the transportation width direction W. The container 21 herein refers to a main body of a frozen dessert container (frozen dessert ingredients container) including the cup-shaped main body (see Fig. 1) and a lid (not shown).

[0021]

20 The filling unit 13 is a mixture filling machine 13 that sequentially fills the containers 21 transported by the transporting unit 11 with the frozen dessert ingredients 23. The frozen dessert ingredients 23 are ingredients for a shaved ice-type frozen dessert, for example. The mixture filling machine 13 is filled with, for example, the frozen dessert

ingredients 23 in which an ice cream mixture is mixed with ice shaved by an ice-shaving device (not shown) and then adjusted by a line crusher (not shown) to have a certain grain size.

The mixture filling machine 13 detects the container 21 moving on the lower side of the mixture filling machine 13 in the transportation height direction H and fills the container 21 with a predetermined amount of the frozen dessert ingredients 23. In such filling, an overrun of the frozen dessert ingredients 23 is adjusted within 10% to 30%, for example.

[0022]

The molding unit 15 is a recess molding device 15 disposed above the transporting unit 11, and is configured to successively harden at least part of the frozen dessert ingredients 23 so as to have a hollow recess shape. The recess molding device 15 at least includes the cooled protruding molds 151, and a driving unit 153 that causes the molds 151 to go down and up in the transportation height direction H (the vertical direction). The recess molding device 15 sequentially immerses the mold 151 into the frozen dessert ingredients 23 filled in the container 21 and being transported below the recess molding device 15, and then pulls the mold 151 out of the frozen dessert ingredients 23. Consequently, at least part of the frozen dessert ingredients 23 around the mold 151 (the frozen dessert ingredients 23 in contact with a surface of the mold 151) is successively cooled and hardened (frozen) so as

to have a hollow recess shape. The mold 151 is used for forming the shape of the recess 30 shown in Fig. 1. The frozen dessert ingredients 23 are not hardened entirely in the recess molding device 15, but the entire frozen dessert ingredients 23 are cooled and hardened (hereinafter referred to simply as "hardened") in a downstream process so as to produce the frozen dessert 50 shown in Fig. 1.

[0023]

The refrigerant feeding unit 17 is a unit that cools the mold 151 by feeding a refrigerant to the mold 151 through a pipe 175 from a storage tank (not shown). As an example, liquid nitrogen (liquefied nitrogen: LN_2) is employed in the present embodiment as a refrigerant. The refrigerant feeding unit 17 feeds liquefied nitrogen into the recess molding device 15 in a stable manner by causing liquefied nitrogen in the pipe 175 to have a supercooled state.

[0024]

The refrigerant injection unit 19 is a liquid nitrogen injection device that additionally injects the refrigerant (liquid nitrogen) directly into the recess of the frozen dessert ingredients 23 hardened by the recess molding device 15.

<Recess Molding Device>

With reference to Fig. 3, the recess molding device 15 includes the mold unit 151U having a plurality of molds 151

integrally attached thereto. The plurality of molds 151 are arranged in a matrix shape along the transporting direction T and the transportation width direction W. The number of molds 151 in the transportation width direction W corresponds to the number of containers 21 transported by the transporting unit 11. Along the transporting direction T, a plurality of molds 151 are arranged on a front side and a rear side (the upstream side and the downstream side) in this example (Figs. 3(a) and 3(b)).

[0025]

Specifically, the recess molding device 15 includes: a first mold 151A located on the upstream side (the left side in Figs. 3(a) and 3(b)); and a second mold 151B located on the downstream side (the right side in Figs. 3(a) and 3(b)) in the transporting direction T. Although the plurality of first molds 151A and the plurality of second molds 151B are arranged in the transportation width direction W (Fig. 3(b)) as mentioned above, the recess molding device 15 having two molds, the first mold 151A and the second mold 151B, will be described below for the sake of convenience.

[0026]

With reference to Figs. 3(c) and 3(d), the molds 151 (151A and 151B) are each obtained by forming a metal into a substantially conical shape, and each include a hollow portion 159 therein. The hollow portion 159 has a substantially

conical shape conforming to the outer shape of the mold 151. The mold 151 includes an opening 157 provided in an area opposed to an apex TP of the cone. The mold 151 is attached to a hopper 173 (described later) with the apex TP located on a lower side in the transportation height direction H, i.e., in a downwardly-protruding state. Liquid nitrogen is fed into the hollow portion 159 via the hopper 173 and an outer surface in the substantially conical shape comes into contact with the frozen dessert ingredients 23.

10 [0027]

The metal of the mold 151 is a material capable of being in direct contact with foods safely, having a heat conductivity high enough to perform efficient heat exchange with the frozen dessert ingredients 23, and capable of being easily processed, for example, into the substantially conical shape as illustrated in the figure. An example of such a metal is stainless steel (SUS304). A plate thickness D of the substantially conical portion in a finished state shown in the figure is substantially uniform over the entire portion. For example, the plate thickness D is 0.1 mm to 2.0 mm, preferably 0.3 mm to 1.5 mm, and more preferably 0.5 mm to 1.0 mm. As an example, the plate thickness D of the mold 151 in the present embodiment is set to 0.5 mm.

[0028]

25 At least an outer surface 1510 to be in contact with the

frozen dessert ingredients 23 has been subjected to a surface treatment by electrolytic polishing, for example. Note that the outer surface may be subjected to a process for preventing the sticking of the frozen dessert ingredients 23 (for example, surface roughening or water repellent finishing).

[0029]

Without being limited to stainless steel, any metallic material capable of being in direct contact with foods safely, having a heat conductivity high enough to perform efficient heat exchange with the frozen dessert ingredients 23, and capable of being processed easily may be employed. For example, gunmetal (an alloy of copper (Cu) and tin (Sn)) may be employed as a metal for the mold 151. The heat conductivity of gunmetal is three to four times higher than that of stainless steel and sufficient to perform heat exchange with the frozen dessert ingredients 23 satisfactorily. Gunmetal, on the other hand, has hardness lower than that of stainless steel, and is thus difficult to be processed. Gunmetal, however, can have an increased plate thickness D due to its high heat conductivity as compared to the above-described case of stainless steel, thereby compensating the processing difficulty. Note that the two molds 151A and 151B in the present embodiment have the same configuration.

[0030]

The mold unit 151U relatively moves closer to and away

from the containers 21. For example, the recess molding device 15 moves the mold unit 151U down and up, thereby simultaneously causing the first mold 151A and the second mold 151B to move down and up, so that the first mold 151A and the second mold 151B are immersed into the frozen dessert ingredients 23 and pulled out of the frozen dessert ingredients 23. Note that the first mold 151A and the second mold 151B may not move down and up simultaneously. Alternatively, the transporting unit 11 may be configured to move up and down so that the containers 21 move closer to and away from the mold unit 151U.

[0031]

A pitch between the first mold 151A and the second mold 151B is equal to a pitch between two (two columns on the front side and the rear side) containers 21 arranged along the transporting direction T. Specifically, a distance L between central axes of the first mold 151A and the second mold 151B passing through the apexes TP of their substantially conical shapes (see Fig. 3(a)) is approximately equal to a distance between central axes of the substantially cylindrical containers 21 arranged on the front side and the rear side along the transporting direction T. That is, two sets of frozen dessert ingredients 23 arranged on the front side and the rear side along the transporting direction T are (substantially) simultaneously subjected to the recess molding

process by the first mold 151A and the second mold 151B arranged on the front side and the rear side along the transporting direction T.

[0032]

5 The recess molding device 15 moves the mold 151 so that the mold 151 can perform a predetermined number of molding processes in a predetermined amount of time. That is, a single mold 151 is repeatedly immersed into and pulled out of at least two sets of frozen dessert ingredients 23 filled in the
10 containers 21 and successively transported, thereby performing a hardening process by which at least part of the frozen dessert ingredients 23 in contact with the outer surface of the mold 151 is formed into a hollow recess shape.

[0033]

15 The single mold 151 is then cooled to a predetermined temperature during a period from the completion of the hardening process of the preceding (downstream in the transporting direction T) frozen dessert ingredients (first set of frozen dessert ingredients), of the two sets of frozen
20 dessert ingredients 23 successively transported on the front side and the rear side along the transporting direction T, to the start of the hardening process of the subsequent (upstream in the transporting direction T) frozen dessert ingredients (second set of frozen dessert ingredients). That is, the
25 recess molding device 15 moves the mold 151 up and down at a

speed allowing the mold 151 to be cooled to the predetermined temperature during the period from the completion of the hardening process of the frozen dessert ingredients 23 on the downstream side (specifically, pulling the mold 151 out of the partially-hardened frozen dessert ingredients 23) to the start of the hardening process of the frozen dessert ingredients 23 on the upstream side (immersing the mold 151 into the mixture again).

[0034]

Specifically, from the standpoint of a single set of frozen dessert ingredients 23, the frozen dessert ingredients 23, being transported in an unhardened state, are first hardened by the first mold 151A on the upstream side so as to have a recess in a portion around its center, and a hardened portion 35 in the form of a thin layer (see Fig. 4) is thereby formed. The second mold 151B on the downstream side is then inserted over the hardened portion 35 (the recess-shaped portion) so as to further harden the frozen dessert ingredients 23 (in an overlapping manner). That is, the recess-shaped hardened portion 35 in the single set of frozen dessert ingredients 23 is formed by inserting and removing the mold 151 more than once (two times in this example), and the recess of the single set of frozen dessert ingredients 23 is formed by inserting and removing different molds 151A and 151B.

[0035]

In the present embodiment, the plurality of moving-down and moving-up operations are performed on the frozen dessert ingredients 23 contained in the single container 21 by the plurality of molds 151 (151A and 151B) so as to form the recess-shaped hardened portion 35. This can reduce an amount of time during which each of the molds 151A and 151B is in contact with the frozen dessert ingredients 23 and thus can minimize an increase in temperature (cooling temperature) (temperature increase) in the molds 151A and 151B. Moreover, the satisfactory hardened state can be maintained (the frozen dessert ingredients 23 can be transferred to the next process with the sufficient molded state) by performing the plurality of molding processes on a single hardened portion 35 to compensate for the reduction in the contact time of the single mold 151.

[0036]

The recess 30 formed by the recess molding device 15 will be described with reference to Fig. 4. Fig. 4 shows states of a single set of frozen dessert ingredients 23 over time. Fig. 4(a) shows a state after hardening (molding) has been performed by the first mold 151A. Fig. 4(b) shows the following state after hardening (molding) has been performed by the second mold 151B. Fig. 4(c) shows a state in which liquid nitrogen has been injected.

[0037]

As shown in Fig. 4(a), when the frozen dessert ingredients 23 is cooled by moving the mold 151 down and up under predetermined conditions (an amount of time, described later), only part of the frozen dessert ingredients 23 in contact with the mold 151 is hardened. Consequently, the hardened portion 35 in the form of a thin layer is formed in conformity with the shape of the mold 151 as shown in Fig. 4(a). The recess 30 is created in the vicinity of the center of the frozen dessert ingredients 23 by the formation of the hardened portion 35.

[0038]

As shown in Fig. 4(b), after the additional second hardening process (the second mold 151B) is performed, the hardened portion 35 is formed as two thin layers stacked on each other. This can prevent the hardened portion 35 from collapsing as compared to the case of a single such layer.

[0039]

Thereafter, liquid nitrogen 37 is injected into an inner area of the hardened portion 35 by the liquid nitrogen injection device 19 as shown in Fig. 4(c). Consequently, the frozen dessert ingredients 23 near the bottom thereof, being in contact with the liquid nitrogen 37, are also hardened (the hardened portion 35 is further enlarged). Even when a hardening level of the frozen dessert ingredients 23 near the opening is insufficient, the hardened frozen dessert

ingredients 23 near the bottom can endure their load, further preventing the collapse of the hardened portion 35.

[0040]

If the number of molds (the number of operations) inserted into and removed from a single set of frozen dessert ingredients 23 is increased, the number of thin layers in the hardened portion 35 is increased. Thus, such an increase is effective in terms of the prevention of the collapse of the hardened portion 35. Such an increase, however, causes a delay in transfer to a downstream process (a quick-freezer). The degree of hardening varies also depending on the composition of the frozen dessert ingredients 23. Thus, the above-described processing conditions (operating conditions) and the number of molding processes performed by the mold 151 are appropriately selected depending on, for example, processing efficiency and the composition of the frozen dessert ingredients 23.

<Refrigerant Feeding Unit>

Referring back to Fig. 2, the refrigerant feeding unit (liquid nitrogen feeding device) 17 includes a liquid nitrogen storage tank (not shown), a liquid nitrogen supercooling system 171, the hopper 173, and the pipe 175 connecting these components together, etc. As shown in Fig. 3, the hopper 173 has a substantially cubic shape, for example, and includes feed ports (not shown) provided at the bottom thereof. The

mold unit 151U is attached to this bottom, and the openings 157 of the molds 151 (151A and 151B) completely cover the feed ports of the hopper 173 and become communicated with the feed ports.

5 [0041]

Liquid nitrogen in the liquid nitrogen storage tank is fed through the pipe 175 into the hopper 173 via the liquid nitrogen supercooling system 171, and then fed, through the openings 157 of the molds 151, into the hollow portions 159 of the molds 151 from the feed ports of the hopper 173. The hopper 173 includes a level sensor at an upper part thereof, and automatically feeds liquid nitrogen into the hollow portions 159 of the molds 151 by switching a solenoid valve so as to keep the level of liquid nitrogen at a desired position. Consequently, the molds 151 is cooled.

[0042]

The liquid nitrogen supercooling system 171 is a device capable of feeding supercooled liquid nitrogen in a stable manner (e.g., a subcooler manufactured by Cool Technos Co. Ltd). The liquid nitrogen supercooling system 171 is used to supercool liquid nitrogen in the pipe 175 while its detailed description is omitted since such a device is well known. Liquid nitrogen has an extremely low boiling point of -196°C at 1 atmospheric pressure. Thus, if a distance from the liquid nitrogen storage tank to a point of use is long, liquid

nitrogen in the pipe 175 is gasified (nitrogen gas GN_2).
Consequently, the supply of liquid nitrogen at an end
component (such as the hopper 173) becomes unstable, or
pulsation occurs if a liquid nitrogen nozzle, for example, is
5 used, thus resulting in a phenomenon such as failing to
achieve fine control. In the present embodiment, liquid
nitrogen is fed to the hopper 173 in a stable manner by
disposing the liquid nitrogen supercooling system 171 near the
hopper 173 so as to make liquid nitrogen in the pipe 175
10 supercooled.

<Liquid Nitrogen Injection Device>

The liquid nitrogen injection device 19 is provided
downstream of the recess molding device 15 to inject a
predetermined amount of liquid nitrogen directly to the
15 recess-shaped hardened portion 35 of the frozen dessert
ingredients 23 molded by the recess molding device 15. The
injection of liquid nitrogen allows for the hardening of the
hardened portion 35 and the vicinity thereof more sufficiently
(an additional hardening process is performed), thereby
20 preventing the collapse of the hardened portion 35 until being
transferred to the downstream process.

[0043]

The liquid nitrogen injection device 19 includes a hopper
191 and an injection nozzle 193. The liquid nitrogen injection
25 device 19 is connected to the liquid nitrogen supercooling

system 171 via the pipe 175. Liquid nitrogen in the liquid nitrogen storage tank is also fed through the pipe 175 to the hopper 191 via the liquid nitrogen supercooling system 171. The injection nozzle 193 is attached to the hopper 191, and liquid nitrogen is automatically fed to the hardened portion 35 of the frozen dessert ingredients 23 from the injection nozzle 193. Although liquid nitrogen is continuously injected from the injection nozzle 193, an amount of injected liquid nitrogen can be adjusted by the degree of opening of a needle valve (not shown) provided between the hopper 191 and the injection nozzle 193.

[0044]

The injected liquid nitrogen is gasified before the frozen dessert ingredients 23 reach the downstream end of the frozen dessert ingredients molding apparatus 10. After the injected liquid nitrogen is gasified, the lid (not shown) is attached to the container 21. The lid is attached to the container 21, for example, by a lid attaching device (not shown) provided near the downstream of the frozen dessert ingredients molding apparatus 10 so as to seal the frozen dessert ingredients 23. For example, a lid conforming to the molded recess-shaped hardened portion 35, i.e., having the same protruding portion as the mold 151 (substantially cone shape) may be employed. Alternatively, a film-like or flat plate-shaped lid without the protruding portion may be

employed, for example.

[0045]

In the frozen dessert ingredients molding apparatus 10 of the present embodiment, the recess-shaped hardened portion 35 is formed approximately in the central portion of the frozen dessert ingredients 23 by the recess molding device 15 and the liquid nitrogen injection device 19. The frozen dessert ingredients 23 ejected from the frozen dessert ingredients molding apparatus 10 and attached with the lid are then transferred to the quick-freezer (not shown) so as to cool and harden the unhardened portion of the frozen dessert ingredients 23.

[0046]

The frozen dessert ingredients molding apparatus 10 employs the above-described recess molding device 15 (the molds 151) to produce the frozen dessert 50 having the recess 30 near its center, and achieves both improved production efficiency and satisfactory molding finish by effectively controlling the recess molding device 15 and the liquid nitrogen injection device 19. Including this respect, operations of the frozen dessert ingredients molding apparatus 10 and a frozen dessert ingredients molding method by the frozen dessert ingredients molding apparatus 10 will be described below.

<Operations of Frozen Dessert Ingredients Molding Apparatus

and Frozen Dessert Ingredients Molding Method>

The operations of the frozen dessert ingredients molding apparatus 10 and the frozen dessert ingredients molding method will be described with reference to Figs. 5 and 2. Fig. 5

5 includes schematic views used for explaining the operations of the recess molding device 15. In each of Figs. 5(a) to 5(h), the left side corresponds to the upstream side, and the right side corresponds to the downstream side. The container 21 including the frozen dessert ingredients 23 therein is
10 transported from the left to the right in Fig. 5.

[0047]

With reference to Fig. 2, empty containers 21 (cup-shaped main bodies) are first supplied at an upstream end of the frozen dessert ingredients molding apparatus 10. For example,
15 eight to ten containers 21 arranged along the transportation width direction W are supplied to the transporting unit 11.

[0048]

On its downstream side, the frozen dessert ingredients 23 are fed into the containers 21, being sequentially transported,
20 by the mixture filling machine 13. The mixture filling machine 13 detects the container 21 moving thereunder and fills the container 21 with a predetermined amount of the frozen dessert ingredients 23.

[0049]

25 Liquid nitrogen in the liquid nitrogen storage tank (not

shown) is fed through the pipe 175 to the hopper 173 via the liquid nitrogen supercooling system 171, and then fed into the hollow portions 159 of the molds 151 via the feed port of the hopper 173. The hopper 173 includes the level sensor at an upper part thereof, and automatically feeds liquid nitrogen into the hollow portions 159 of the molds 151 by switching the solenoid valve so as to keep the level of liquid nitrogen at a desired position. Consequently, the molds 151 is cooled.

[0050]

Thereafter, a recess is molded by the recess molding device 15. Specifically, as shown in Fig. 5, the recess molding device 15 detects the container 21 moving thereunder and lowers the mold unit 151U (Fig. 5(a)). This first causes the first mold 151A on the upstream side to be immersed into a set of frozen dessert ingredients 23 (unhardened frozen dessert ingredients 23) located on the downstream side of two sets of frozen dessert ingredients 23 arranged on the front side and the rear side along the transporting direction T (Fig. 5(b)).

[0051]

The frozen dessert ingredients 23 come into contact with the first mold 151A sufficiently cooled by liquid nitrogen, thereby being cooled and hardened around the first mold 151A to form the hardened portion 35 in the form of a thin layer as shown in Fig. 4. From the standpoint of the first mold 151A,

this hardening process is the preceding hardening (first hardening) process on the frozen dessert ingredients 23 among successive molding processes. From the standpoint of the frozen dessert ingredients 23, this is the first hardening process and is a hardening process on the upstream side (upstream-side hardening). Consequently, the hardened portion 35 having a substantially conical shape is formed along the outer surface of the first mold 151A.

[0052]

After the elapse of a predetermined amount of time (for example, 1 to 2 seconds, preferably about 1.5 seconds, and more preferably about 1.33 seconds), the recess molding device 15 moves the first mold 151A (the mold unit 151U) up so as to pull the first mold 151A out of the frozen dessert ingredients 23 (Fig. 5(c)). Note that the transporting unit 11 in the present embodiment intermittently transports the container 21 (the frozen dessert ingredients 23) in the downstream direction. That is, the container 21 (the frozen dessert ingredients 23) does not move in the downstream direction while molding is performed by the mold 151. Thus, the mold 151 (the mold unit 151U) is configured to perform only the moving-down and moving-up operations.

[0053]

Note that the aforementioned cooling time by the mold 151 is given by way of example. Although a longer cooling time is

better, the cooling time is appropriately selected in consideration of production capacity.

[0054]

Once the mold unit 151U moves up, the transporting unit
5 11 moves the containers 21 (the frozen dessert ingredients 23)
by one column in the transporting direction T. Thereafter, the
mold unit 151U is lowered again (Fig. 5(d)). At this time, the
lowered second mold 151B on the downstream side is inserted
into the recess-shaped portion of the hardened portion 35
10 previously formed by the hardening (upstream-side hardening)
performed by the first mold 151A (Fig. 5(e)). The second mold
151B comes into contact with, or comes close to, the hardened
portion 35, thereby further promoting the hardening. From the
standpoint of the second mold 151B, this hardening process is
15 the preceding hardening (first hardening) process on the
mixture among successive molding processes. From the
standpoint of the frozen dessert ingredients 23, this is the
second hardening process after the formation of the hardened
portion 35 and is a hardening process on the downstream side
20 (downstream-side hardening).

[0055]

Concurrently, the first mold 151A is immersed into new
unprocessed frozen dessert ingredients 23 on the upstream side,
thereby cooling and hardening a portion around the first mold
25 151A. From the standpoint of the first mold 151A, this

hardening process is the subsequent hardening (second hardening) process on the frozen dessert ingredients 23 among the successive molding processes. From the standpoint of the frozen dessert ingredients 23, this is the first hardening process and is a hardening process on the upstream side (upstream-side hardening).

[0056]

Once the mold unit 151U moves up after the elapse of a predetermined amount of time (for example, 1 to 2 seconds, preferably about 1.5 seconds, and more preferably about 1.33 seconds) (Fig. 5(f)), the transporting unit 11 moves the containers 21 (the frozen dessert ingredients 23) by one column in the transporting direction T. Thereafter, the mold unit 151U is lowered again (Fig. 5(g)). At this time, the lowered second mold 151B on the downstream side is inserted into the hardened portion 35 of the frozen dessert ingredients 23 (the frozen dessert ingredients 23 on the downstream side) previously formed by the hardening (upstream-side hardening) performed by the first mold 151A (Fig. 5(h)). The second mold 151B comes into contact with, or comes close to, the hardened portion 35, thereby further promoting the hardening. From the standpoint of the second mold 151B, this hardening process is the subsequent hardening (second hardening) process on the frozen dessert ingredients 23 among the successive molding processes. From the standpoint of the frozen dessert

ingredients 23, this is the second hardening process and is a hardening process on the downstream side (downstream-side hardening).

[0057]

5 These operations are sequentially repeated so that the first mold 151A and the second mold 151B each form the recess-shaped hardened portions 35 in the frozen dessert ingredients 23 in a continuous manner. More specifically, the first mold 151A repeats the hardening process (first hardening process) 10 on the preceding unhardened frozen dessert ingredients 23, and the hardening process (second hardening process) on the subsequent unhardened frozen dessert ingredients 23. Similarly, the second mold 151B repeats the hardening process (first hardening process) on the preceding frozen dessert ingredients 15 23 having the hardened portion 35, and the hardening process (second hardening process) on the subsequent frozen dessert ingredients 23 having the hardened portion 35.

[0058]

 From the standpoint of a single set of frozen dessert 20 ingredients 23, the frozen dessert ingredients 23 in an unhardened state receive the first mold 151A immersed thereinto, thereby forming the recess-shaped hardened portion 35 (upstream-side hardening process). The frozen dessert ingredients 23 successively receive the second mold 151B 25 inserted over the formed hardened portion 35, thereby causing

additional hardening (downstream-side hardening process).

[0059]

At this time, the frozen dessert ingredients molding apparatus 10 of the present embodiment controls (a time of) the moving-up and moving-down operation in each of the molds 151 (the second mold 151B and the first mold 151A) so as to cool the molds 151 to a predetermined temperature during a period from the completion of the first hardening (hardening of the preceding frozen dessert ingredients 23) process to the start of the second hardening (hardening of the subsequent frozen dessert ingredients 23) while successively performing a predetermined number of hardening processes (e.g., 160 hardening processes per minute if the mold unit 151U moves up and down at a rate of 20 times per minute in the frozen dessert ingredients molding apparatus 10 capable of simultaneously producing eight products (eight rows) in the transportation width direction W) in a predetermined amount of time.

[0060]

The predetermined temperature is a temperature sufficient for hardening at least part of the frozen dessert ingredients 23 in contact with (or close to) the outer surface of the mold 151. More specifically, the predetermined temperature is a low temperature lower than or equal to the boiling point (-183°C) of liquid oxygen.

[0061]

Each mold 151 immersed into the frozen dessert ingredients 23 undergoes heat exchange with the frozen dessert ingredients 23. Consequently, the surface temperature of the mold 151 rises above the boiling point (-196°C) of liquid nitrogen. Once the mold 151 is pulled out of the frozen dessert ingredients 23 after the completion of the first hardening process on the preceding frozen dessert ingredients 23, the mold 151 is cooled again by liquid nitrogen, and its temperature is eventually lowered to the boiling point of liquid nitrogen. For a single mold 151 (the same applies to both of the first mold 151A and the second mold 151B), the recess molding device 15 immerses the mold 151 into the subsequent frozen dessert ingredients 23 only after the surface temperature of the mold 151, which has been pulled out of the preceding frozen dessert ingredients 23, is lowered at least to the boiling point (-183°C) of liquid oxygen. In other words, after the mold 151 is pulled out of the preceding frozen dessert ingredients 23, the mold 151 is kept in an elevated state (a state not in contact with the frozen dessert ingredients 23) (waits above) so as to be cooled at least to the boiling point of liquid oxygen (may be cooled to an even lower temperature). After the mold 151 is sufficiently cooled, the mold 151 is immersed into the subsequent frozen dessert ingredients 23 to perform the second hardening process.

[0062]

When the mold 151 having the hollow portion 159 supplied with liquid nitrogen is exposed to air, oxygen gas in the air comes into contact with the outer surface 1510 of the mold 151, thus turning into liquid oxygen. When the mold 151 having the outer surface 1510 attached with liquid oxygen is immersed into the frozen dessert ingredients 23, an amount of the frozen dessert ingredients 23 sticking to the mold 151 can be significantly reduced as compared to when the mold 151 having the dried outer surface 1510 is inserted into the frozen dessert ingredients 23. Even when the frozen dessert ingredients 23 stick to the mold 151 as a result of the mold 151 being in contact with the frozen dessert ingredients 23, the sticking frozen dessert ingredients 23 can be removed from the mold 151 by pulling the mold 151 out of the frozen dessert ingredients 23 so as to be exposed to air and thereby causing liquid oxygen to stick to the surface of the mold 151.

[0063]

For a single mold 151, timing for the moving-up and moving-down operations of the mold 151 is controlled in the present embodiment so that liquid oxygen is attached to the outer surface 1510 of the mold 151 during a period until the mold 151 is immersed into the subsequent frozen dessert ingredients 23 after the mold 151 is pulled out of the preceding frozen dessert ingredients 23.

[0064]

When the hardened portion 35 is formed in the frozen dessert ingredients 23 having a given composition, for example, the shortest time until liquid oxygen is attached to the outer surface 1510 of the mold 151 exposed to air after the mold 151 is pulled out of the frozen dessert ingredients 23 is, for example, 1 to 2 seconds, preferably 1.5 to 1.8 seconds, and more preferably 1.6 to 1.7 seconds on the basis of the premise of predetermined production capacity (capable of forming hardened portions 35 for 160 sets of frozen dessert ingredients 23 per minute, for example).

[0065]

Note that a speed at which the frozen dessert ingredients 23 are hardened (the hardened portion 35 is formed) varies depending on the composition or temperature of the frozen dessert ingredients 23. That is, a temperature increase in the mold 151 in contact with the frozen dessert ingredients 23 also varies depending on the composition or conditions of the frozen dessert ingredients 23, and thus an amount of time needed for the mold 151 not in contact with the frozen dessert ingredients 23 to be cooled also varies depending on the composition or conditions of the frozen dessert ingredients 23.

[0066]

That is, the aforementioned shortest time taken until liquid oxygen is attached to the surface of the mold 151 is

given by way of example. For each mold 151 successively immersed into sets of frozen dessert ingredients 23, the recess molding device 15 in the present embodiment keeps the mold 151 so as not to be in contact with the frozen dessert ingredients 23 at least during a period until liquid oxygen is attached to the surface of the mold 151. Such a period during which the mold 151 is kept in a non-contact state is appropriately selected depending on the composition or conditions of the frozen dessert ingredients 23.

10 [0067]

Note that the timing for the moving-up and moving-down operations of the mold 151 (the mold unit 151U) can be set as desired. A single moving-up and moving-down operation (hereinafter referred to as "one shot") of a single mold 151 is adjusted by an air cylinder, for example, and synchronized with the moving speed of the container 21.

[0068]

After the hardened portion 35 is molded, the container 21 is transported further downstream, and liquid nitrogen is injected into the molded hardened portion 35 by the liquid nitrogen injection device 19 (see Fig. 2). An amount of such injection is, for example, about $1/5$ to $1/2$ of a depth D1 of the hardened portion 35, preferably about $1/4$ of the depth D1 (about 9 ml in volume, for example).

25 [0069]

Such a process is performed for hardening the hardened portion 35 molded by the recess molding device 15 and the vicinity thereof more reliably. As shown in Fig. 4, the hardened portion 35 in which the frozen dessert ingredients 23 are hardened in the form of a thin layer is obtained after the molding performed by the recess molding device 15. In such a case, if no additional hardening process (hardening process by liquid nitrogen injection) is performed, an unhardened portion, especially the frozen dessert ingredients 23 near the bottom, cannot endure the weight of the frozen dessert ingredients 23 near the opening, thus leading to the collapse of the hardened portion 35.

[0070]

On the other hand, as long as the hardened portion 35 even in the form of a thin layer is formed (even when the entire frozen dessert ingredients 23 are not hardened), the container 21 can be sealed by the lid and transferred to the quick-freezer in the downstream process. That is, it is only necessary to form only the hardened portion 35 within a short period of time.

[0071]

Moreover, the smaller the amount of liquid nitrogen used during the production process is, the greater the cost reduction will be. In the present embodiment, as conditions capable of achieving a sufficient hardening level just enough

to prevent the collapse of the hardened portion 35 before being transferred to the subsequent quick-freezer process, an amount of liquid nitrogen injection is set to, for example, a depth corresponding to about 1/4 of the depth D1 for the entire recess 30 from the bottom (about 9 ml in volume, for example). This can promote hardening of the frozen dessert ingredients 23 especially near the bottom. Thus, the hardened portion 35 can be prevented from collapsing due to the load of the frozen dessert ingredients 23 near the opening, and the frozen dessert ingredients 23 with the hardened portion 35 kept in the satisfactory state can be transferred to the quick-freezer on the downstream side.

[0072]

The frozen dessert ingredients molding apparatus 10 is configured to inject liquid nitrogen, for example, at a timing (broken line t2) downstream of the first mold 151A (broken line t1 shown in Fig. 2) on the upstream side by four columns (after 12 seconds). In this case, if liquid nitrogen is injected to a depth corresponding to about 1/4 of the depth D1 of the hardened portion 35, the liquid nitrogen is gasified before a timing (broken line t3) downstream of the injection by six columns (after 18 seconds) in the environments of the production process. That is, the lid can be attached to the container 21 at a timing downstream of the injection by seven or more columns.

[0073]

A larger injection amount leads to a delay in gasified timing, and a delay in the attachment of the lid leads to a delay in the transfer to the downstream process. The injection amount in the present embodiment is set to be the minimum injection amount capable of hardening the region around the hardened portion 35 just enough for the transfer to the downstream process. Thus, the lid attachment and the transfer to the downstream quick-freezer can be performed in the shortest possible time, thereby achieving the prevention of cost increase and reduction in processing time.

[0074]

The container 21 (where the frozen dessert ingredients 23 having the hardened portion 35 is being sealed by the lid) ejected from the frozen dessert ingredients molding apparatus 10 is transferred onto a tray after the ejection and hardened in the not-shown quick-freezer (for example, -40°C) for 20 minutes, for example. This produces the frozen dessert 50 (see Fig. 1) having the recess 30 near its center.

Example 1

[0075]

For a single mold 151, when the mold 151 was pulled out of the preceding frozen dessert ingredients 23 and exposed to air, liquid oxygen was attached to the surface of the mold 151 within about 1.5 to 1.8 seconds. On the basis of this, the

hardened portion 35 was formed under the following conditions,
and being able to achieve satisfactory hardening and obtain
predetermined production capacity was demonstrated.

[0076]

5 As an example, the frozen dessert ingredients 23 are
those obtained by mixing an ice cream mixture with crushed ice,
and ingredients of such an ice cream mixture are sugar, dairy
products, coffee, and flavoring agents, for example. The solid
content of the mixture before being mixed with crushed ice is
10 40%, for example.

[0077]

The transporting unit 11 conducts an intermittent
operation such that the container 21 is moved in the
transporting direction T by one column in one second and
15 stopped for two seconds. A single moving-up and moving-down
operation (one shot) of a single mold 151 is performed in
three seconds. Accordingly, the hardened portions 35 can be
formed for about 80 to 240 sets of frozen dessert ingredients
23 for one minute, for example.

20 [0078]

In this case, from the standpoint of a single mold 151,
the recess molding device 15 forms the hardened portion 35 in
the preceding frozen dessert ingredients 23 (first set of
frozen dessert ingredients) by immersing the mold 151 into the
25 frozen dessert ingredients 23 and holding the mold 151 for

about 1.33 seconds. Thereafter, a period until the mold 151 is immersed into the subsequent frozen dessert ingredients 23 (second set of frozen dessert ingredients) after the mold 151 is pulled out of the preceding frozen dessert ingredients 23 is about 1.67 seconds.

[0079]

That is, from the standpoint of a single set of frozen dessert ingredients 23, the set of frozen dessert ingredients 23 receives the first mold 151A immersed thereinto, thereby being hardened for 1.33 seconds (the first mold 151A is then pulled out therefrom), and after 1.67 seconds, receives the second mold 151B immersed thereinto, thereby being further hardened for 1.33 seconds.

[0080]

Thereafter, about 9 ml of liquid nitrogen was injected into the formed recess-shaped hardened portion 35 by the liquid nitrogen injection device 19.

[0081]

As a result of this, the formed hardened portion 35 was sufficiently hardened just enough to prevent its collapse until being transferred to the downstream process (quick-freezer) without the sticking of the frozen dessert ingredients 23 to the mold 151, and the formed hardened portion 35 retained a satisfactory state without any unwanted sticking of the frozen dessert ingredients 23 to the surface

of the hardened portion 35.

[0082]

An example of the present embodiment has been described above. The recess molding device 15 of the present invention, however, is not limited to the above-described example as long as a recess molding device is configured, when at least one mold 151 cools and hardens the subsequent frozen dessert ingredients 23 different from the preceding frozen dessert ingredients 23 being successively transferred, to cause the mold 151 pulled out of the preceding frozen dessert ingredients 23 to be kept (wait) in air until the mold 151 is lowered to a temperature lower than the boiling point of liquid oxygen and then cool the subsequent frozen dessert ingredients 23.

[0083]

In order to prevent an increase in the temperature of the mold 151, it is preferable to employ the configuration in which a plurality of (two in this example) inserting and removing operations are performed by the molds 151 on the hardened portion 35 of a single set of frozen dessert ingredients 23 and different molds 151A and 151B are used for those inserting and removing operations as described above. The present invention, however, is not limited to the above-described example. That is, the hardened portion 35 in a single set of frozen dessert ingredients 23 may be molded by

inserting and removing a single mold 151 more than once (two in this example).

[0084]

If a total amount of time needed to mold the recess 30 in a single frozen dessert 50 is defined as time T, for example, time for a single molding process of the hardened portion 35 by the mold 151 is set to 1/2 of time T, and the mold 151 is inserted and removed two times. By doing so, an increase in the surface temperature of the mold 151 can be kept low, and thus waiting time in air can be reduced as compared to when time for molding the hardened portion 35 by a single insertion and removal operation of the mold 151 is set to time T. Thus, efficient molding can be achieved.

[0085]

Although the mold 151 is preferably inserted into, and removed from, a single set of frozen dessert ingredients 23 more than once, a single such operation may be performed.

[0086]

In the above-described example, the mold unit 151U includes the molds 151 arranged in a plurality of rows in the transportation width direction W (a row direction, for example) and a plurality of columns in the transporting direction T (a column direction, for example). The mold unit 151U, however, may include the molds 151 arranged in a single row × a plurality of columns or in a plurality of rows × a

single column, for example.

[0087]

When a plurality of (M) molds 151 are provided along the transporting direction T, each mold 151 is inserted into, and removed from, the frozen dessert ingredients 23 every N ($N = M - 1 > 0$) sets of frozen dessert ingredients 23, and the mold 151 is controlled to be cooled to a temperature lower than the boiling point of liquid oxygen during the waiting period between its removal and its insertion.

10 [0088]

Alternatively, depending on the conditions of the frozen dessert ingredients 23 (their ease of hardening, their viscosity in a mixed state, their hardness as the frozen dessert ingredients 23, etc.), a single mold (one row $\times$ one column) may be provided in the mold unit 151U to sequentially mold sets of frozen dessert ingredients 23, and waiting time in air between the preceding frozen dessert ingredients 23 and the subsequent frozen dessert ingredients 23 may be set so that the mold is cooled to be a temperature lower than the boiling point of liquid oxygen.

20

[0089]

Alternatively, the molding unit 15 may be configured to be able to move a plurality of molds 151 up and down individually. In this case, the molding unit 15 may control the molds 151 so that the subsequent mold 151B goes up while

25

the preceding mold 151A goes down and the subsequent mold 151B goes down while the preceding mold 151A goes up, for example.

[0090]

Although the above-described embodiment has shown the case where the transporting unit transports the containers intermittently, the transporting unit may transport the containers continuously. In this case, the recess molding device 15 and the liquid nitrogen injection device 19 are configured to be movable along the transporting direction T in synchronization with the transporting unit 11. In such a case, however, the devices and their control become complicated. Therefore, the intermittent operation as described above is desirable in terms of keeping the cost low.

[0091]

Moreover, the composition of the frozen dessert ingredients 23 (percentages of the ingredients), and the values such as an overrun are not limited to the above-described examples. Those are appropriately selected in accordance with the conditions of the frozen dessert (frozen sweets) 50. Moreover, the frozen dessert ingredients 23 are not limited to a mixture of shaved ice. The frozen dessert ingredients 23 may be a mixture of ice cream, sherbet, or any other dessert provided in a frozen (freezing) state.

[0092]

Moreover, the above-described operating conditions of the

frozen dessert ingredients molding apparatus 10 are given by way of example. Operating conditions are appropriately selected to mold the hardened portion 35 depending on the composition or conditions of the frozen dessert ingredients 23 and the conditions of the frozen dessert 50 to be produced.

[0093]

The present invention is not limited to the above-described embodiments, and modifications can be made thereto without departing from the scope of the present invention.

10 Reference Signs List

[0094]

- | | | |
|----|-----------------|---|
| 10 | 10 | frozen dessert ingredients molding apparatus |
| | 11 | transporting unit |
| | 13 | filling unit (mixture filling machine) |
| 15 | 15 | molding unit (recess molding device) |
| | 17 | refrigerant feeding unit |
| | 19 | refrigerant injection unit (liquid nitrogen injection device) |
| | 21 | container |
| 20 | 23 | frozen dessert ingredients |
| | 30 | recess |
| | 35 | hardened portion |
| | 37 | liquid nitrogen |
| | 50 | frozen dessert |
| 25 | 151, 151A, 151B | mold |

	171	liquid nitrogen supercooling system
	173	hopper
	175	pipe
	191	hopper
5	193	injection nozzle

Statements of Invention

1. A frozen dessert ingredients molding apparatus for successively hardening parts of sets of frozen dessert ingredients so as to each have a hollow recess shape, the

5 frozen dessert ingredients molding apparatus comprising:

a transporting unit configured to transport a plurality of containers;

a filling unit configured to fill the containers with the sets of frozen dessert ingredients;

10 a molding unit configured to sequentially immerse and pull a cooled protruding mold into and out of the sets of frozen dessert ingredients being transported so as to harden at least part of each of the sets of frozen dessert ingredients around the mold; and

15 a refrigerant feeding unit configured to feed a refrigerant to the mold, wherein

the mold is configured to be cooled to a predetermined temperature during a period from completion of hardening of a first set of frozen dessert ingredients to start of hardening of a second set of frozen dessert ingredients being
20 successively transported while conducting a predetermined number of hardening processes within a predetermined amount of time.

2. The frozen dessert ingredients molding apparatus
25 according to statement 1, wherein

the predetermined temperature is a temperature sufficient for hardening the at least part of each of the sets of the frozen dessert ingredients around the mold.

3. The frozen dessert ingredients molding apparatus

5 according to statement 1 or 2, wherein

the molding unit immerses the mold having been pulled out of the first set of frozen dessert ingredients into the second set of frozen dessert ingredients after a surface temperature of the mold is lowered at least to a boiling point of liquid oxygen.

4. The frozen dessert ingredients molding apparatus

according to any one of statements 1 to 3, wherein

the mold is formed by a metal having a plate thickness smaller than 1 mm.

15 5. The frozen dessert ingredients molding apparatus

according to any one of statements 1 to 4, wherein

the molding unit inserts the mold into each of the sets of frozen dessert ingredients more than once.

6. The frozen dessert ingredients molding apparatus

20 according to any one of statements 1 to 4, wherein

the molding unit includes a plurality of molds, and

the molding unit moves the plurality of molds down and up so as to immerse the molds into the sets of frozen dessert ingredients.

25 7. The frozen dessert ingredients molding apparatus

according to any one of statements 1 to 6, comprising an injection unit configured to inject a refrigerant into a recess hardened by the mold.

8. The frozen dessert ingredients molding apparatus

5 according to any one of statements 1 to 7, wherein

the molding unit conducts about 80 to 240 hardening processes per minute.

9. A frozen dessert ingredients molding method for successively hardening parts of sets of frozen dessert

10 ingredients so as to each have a hollow recess shape, the frozen dessert ingredients molding method comprising the steps of:

transporting a plurality of containers;

filling the containers with the sets of frozen dessert

15 ingredients;

sequentially immersing and pulling a cooled protruding mold into and out of the sets of frozen dessert ingredients being transported so as to harden at least part of each of the sets of frozen dessert ingredients around the mold; and

20 feeding a refrigerant to the mold, wherein

the mold is cooled to a predetermined temperature during a period from completion of hardening of a first set of frozen dessert ingredients to start of hardening of a second set of frozen dessert ingredients being successively transported

25 while conducting a predetermined number of hardening processes

within a predetermined amount of time.

10. The frozen dessert ingredients molding method according to statement 9, wherein

the predetermined temperature is a temperature sufficient
5 for hardening the at least part of each of the sets of the frozen dessert ingredients around the mold.

11. The frozen dessert ingredients molding method according to statement 9 or 10, comprising pulling the mold out of the first set of frozen dessert ingredients and immersing the mold
10 into the second set of frozen dessert ingredients after a surface temperature of the mold is lowered at least to a boiling point of liquid oxygen.

12. The frozen dessert ingredients molding method according to any one of statements 9 to 11, wherein

15 the mold is formed by a metal having a plate thickness smaller than 1 mm.

13. The frozen dessert ingredients molding method according to any one of statements 9 to 12, comprising moving a plurality of the molds down and up in synchronization with
20 each other so as to immerse the molds into the sets of frozen dessert ingredients.

14. The frozen dessert ingredients molding method according to any one of statements 9 to 13, comprising inserting the mold into each of the sets of frozen dessert ingredients more
25 than once.

15. The frozen dessert ingredients molding method according to any one of statements 9 to 14, comprising injecting a refrigerant into a recess hardened by the mold.

16. The frozen dessert ingredients molding method according
5 to any one of statements 9 to 15, comprising conducting about 80 to 240 hardening processes per minute by the mold.

CLAIMS

1. A frozen dessert ingredients molding apparatus for successively hardening parts of sets of frozen dessert ingredients so as to each have a hollow recess shape, the frozen dessert ingredients molding apparatus comprising:

a transporting unit configured to transport a plurality of containers;

a filling unit configured to fill the containers with the sets of frozen dessert ingredients;

a molding unit configured to sequentially immerse and pull a cooled protruding mold into and out of the sets of frozen dessert ingredients being transported so as to harden at least part of each of the sets of frozen dessert ingredients around the mold; and

a refrigerant feeding unit configured to feed a refrigerant to the mold, wherein

the mold is configured such that the mold waits until liquid oxygen is attached to an outer surface of the mold after the mold has been pulled out of one of the sets of frozen dessert ingredients, and then is immersed into another one of the sets of frozen desert ingredients.

2. The frozen dessert ingredients molding apparatus according to claim 1, wherein

the mold is immersed into the another one of the sets of frozen dessert ingredients in a state in which liquid oxygen is attached to the outer surface of the mold.

5 3. The frozen dessert ingredients molding apparatus according to claim 1 or 2, wherein

the refrigerant feeding unit feeds the refrigerant into a hollow portion of the mold.

10 4. A frozen dessert ingredients molding method for successively hardening parts of sets of frozen dessert ingredients so as to each have a hollow recess shape, the frozen dessert ingredients molding method comprising the steps of:

15 transporting a plurality of containers;

filling the containers with the sets of frozen dessert ingredients;

sequentially immersing and pulling a cooled protruding mold into and out of the sets of frozen dessert ingredients
20 being transported so as to harden at least part of each of the sets of frozen dessert ingredients around the mold; and

feeding a refrigerant to the mold, wherein

the mold waits until liquid oxygen is attached to an outer surface of the mold after the mold has been pulled out
25 of one of the sets of frozen dessert ingredients, and then is

immersed into another one of the sets of frozen desert ingredients.

5. The frozen dessert ingredients molding method according
5 to claim 4, wherein

the mold is immersed into the another one of the sets of frozen desert ingredients in a state in which liquid oxygen is attached to the outer surface of the mold.

10 6. The frozen dessert ingredients molding method according to claim 4 or 5, wherein

the refrigerant is fed into a hollow portion of the mold.