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(54) **ICE MAKING ASSEMBLY**

(57) A portable ice making assembly (100) comprises an outer container (110) having a cup shape comprising a peripheral wall (111) and a bottom wall (112), an array of cavities (113) connected among each other by way of channels (114) being formed in said peripheral wall (111). The ice making assembly also comprises an inner container (120) having the shape of a bucket and designed to be coaxially fitted into the outer container (110) so as to seal substantially all cavities (113), as well as a lid (130) dimensioned to be fitted on the top of the outer container 110. The inner container (120) comprises a phase change material (140), said phase change material (140) being housed in a peripheral wall (121) of the inner container (120) and/or in a bottom wall (123) thereof.

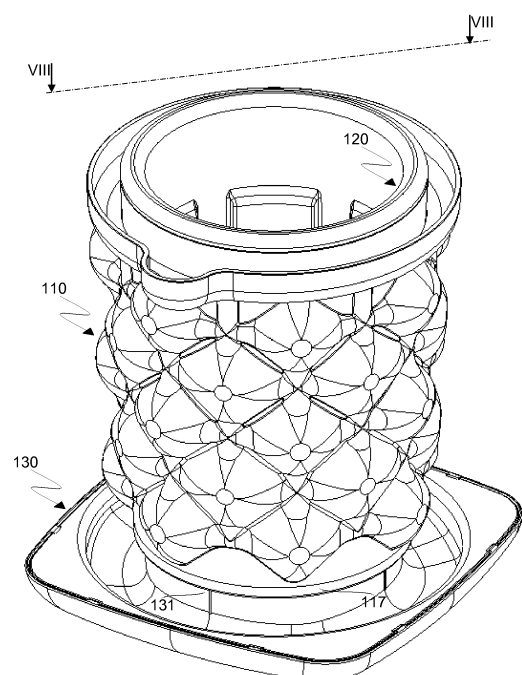


Fig.7

Description

Technical field of the invention

[0001] The present invention generally relates to portable ice making devices and in particular to a multipurpose ice making assembly.

Background

[0002] Conventional portable ice making devices such as e.g. ice trays are usually employed to make ice pieces in a freezer compartment of a refrigerator appliance. These devices typically have a number of cavities where water is poured and let freeze. Once water is frozen, ice pieces, e.g. in the form of cubes, truncated pyramid and the like, may be removed from the cavities by slightly warping the tray.

[0003] Filling the cavities at a correct level in order to make ice pieces of a homogeneous size is one of the problems that typically affect ice trays. Another typical problem is water spilling when ice trays are transported and placed inside a freezer compartment. It is also known that food odors may be absorbed by water during the freezing process, thereby making ice cubes to go stale.

[0004] Bottle-style ice makers are also known alternatives to ice trays. These devices allow to improve filling and to avoid spilling problems. Odor absorption may also be effectively minimized. However, ice pieces made by bottle-style ice makers generally do not have a homogeneous size and their extraction from the bottle is often difficult. Moreover, similarly to trays, bottle-shaped ice makers are rather stiff and thus difficult to deform to extract ice pieces.

[0005] Also known are cup-shaped ice makers comprising an outer container, an inner container and a lid. The outer container has a generally cylindrical shape and comprises a plurality of cavities formed on its inner peripheral wall and protruding outwards. The inner container has the shape of a bucket and is designed to be fitted into the outer container so as to seal the cavities. The lid is dimensioned to be fitted on the top of the outer container, thus avoiding absorption of odors during the freezing process.

[0006] In order to make ice pieces, water is poured into the outer container up to a predefined level. The bucket-shaped inner container is then fitted into the outer container thus displacing water, which is forced to enter the cavities formed in its peripheral wall. The lid is then mounted on the outer container thus closing the whole assembly and protecting it from odors. The closed assembly is then placed in a freezer compartment. Once water has frozen, the lid is removed and the bucket-shaped inner container is extracted from the outer container. Ice pieces can be removed from their cavities by pressing and slightly deforming the peripheral wall of the outer container, from which they fall and are collected inside the outer container itself. The ice pieces so col-

lected can be transferred and stored in the bucket-shaped inner container, thus being able to fill in water again and use the assembly to form further ice pieces.

[0007] An example of an ice maker of this type is described in US 2011/061421 A1.

[0008] The availability of different types of ice makers notwithstanding, solutions allowing to make ice pieces in shorter and shorter times are highly desired.

[0009] Moreover, there is still a need to improve ergonomics particularly concerning water filling and extraction of ice pieces.

Summary of the invention

[0010] The technical problem underlying and solved by the present invention is therefore to provide an ice maker that allows to overcome the drawbacks mentioned above with reference to the prior art.

[0011] This problem is solved by an ice making assembly according to the independent claim 1. Preferred features of the present invention are set forth in the dependent claims.

[0012] An idea of solution underlying the invention is to provide an ice making assembly having the same general structure of the ice maker of US 2011/061421 A1, but wherein a phase change material (PCM) is housed in the bucket-shaped inner container. During a solid-to-liquid phase change, PCM materials behave like sensible heat storage materials and absorb large amounts of heat at an almost constant temperature. This allows to accelerate the freezing process of the water received in the pockets formed in the outer container of the ice making assembly.

[0013] Compared to a prior art ice maker where water is subjected to freezing only at the exterior of the outer container facing a freezer compartment, in the ice making assembly of the invention freezing occurs simultaneously at the exterior and the interior of the outer container. Hence, the use of phase change materials allows to speed up the freezing process. All the more so, considering that freezing of water inside the pockets of the outer container is caused by thermal conduction thanks to the contact with the PCM material stored in the inner container, whereas freezing in a prior art ice maker occurs mainly by way of thermal convection.

[0014] According to an embodiment of the invention, a UV light system is integrated in the ice making assembly, thus allowing to sanitize water poured into the outer container and to effectively improve quality and taste of the ice pieces.

[0015] According to an embodiment of the invention, temperature sensors may advantageously be used to monitor the freezing process and inform a user by exploiting a wireless connection to a remote appliance.

[0016] Further advantages, features and operation modes of the present invention will become clear from the following detailed description of embodiments thereof, which are given for illustrative and not-limiting purposes.

es.

Brief description of the drawings

[0017] Reference will be made to the figures of the accompanying drawings, in which:

- figure 1 is a perspective view from above showing an ice making assembly according to the present invention;
- figure 2 is a perspective view showing the ice making assembly without a lid thereof;
- figure 3 is a perspective view from below of the lid of the ice making assembly according to the present invention;
- figure 4 is a longitudinal cross-sectional view of the ice making assembly of figure 1 taken along a plane passing through line IV-IV;
- figure 5 is a perspective view from above showing an inner container of the ice making assembly according to the present invention;
- figure 6 is a partial longitudinal cross-sectional view of the inner container of figure 5 taken along a plane passing through line VI-VI;
- figure 7 is a perspective view from above showing the ice making assembly of figure 1 in an open configuration allowing extraction of ice pieces;
- figure 8 is a longitudinal cross-sectional view of the ice making assembly of figure 7 taken along a plane passing through line VIII-VIII;
- figure 9 shows a chart where the duration of a freezing process in an ice making assembly according to the prior art is compared to the duration of the same process in an ice making assembly according to the invention.

Detailed description of preferred embodiments

[0018] With reference initially to figures 1 to 6, an ice making assembly according to the invention is generally indicated by reference number 100.

[0019] The ice making assembly 100 has the shape of a cup and comprises an outer container 110, an inner container 120 and a lid 130. The outer container 110 substantially has a cup shape, e.g. substantially cylindrical as shown in the figures, polygonal or the like, comprising a peripheral wall 111 and a bottom wall or base 112. A plurality of cavities or pockets 113 intended to receive water are formed in the peripheral wall 111. The cavities 113 face the inside of the outer container 110

and have e.g. a diamond shape.

[0020] According to the embodiment shown in the figures, the cavities 113 are preferably fluidly connected among each other by way of channels 114, e.g. arranged at the vertexes of the diamond shapes. Still according to the embodiment shown in the figures, the peripheral wall 111 of the outer container 110 is rather thin and the cavities 113 protrude outwards maintaining the same wall thickness. It will be appreciated that these features do not limit the invention. The channels 114 in fact are not strictly necessary even though they ease filling of the cavities 113, and that the cavities or pockets 113 might also be formed as dimples in a thicker peripheral wall.

[0021] The outer container 110 is preferably made of an elastic rubber material, which is easily deformable and advantageously allows to ease extraction of ice pieces from the cavities 113 as it will be discussed in greater detail below. Natural rubber materials, as well as synthetic rubber such as e.g. silicone, may be used to make the outer container 110.

[0022] A flange 115 may be formed at an upper edge of the outer container 110. The flange 115 is preferably concave-shaped so as to ease pouring of water into the outer container 110. The flange 115 may advantageously comprise a lip portion 116 protruding radially outwards, which makes pouring of water into the outer container 110 easier.

[0023] Particularly referring to figures 4 and 5, the inner container 120 substantially has the shape of a bucket and is designed to be coaxially fitted into the outer container 110 so as to seal substantially all cavities 113. To this aim the inner container 120 is substantially as tall as the outer container 110.

[0024] The lid 130 is dimensioned to be fitted on the top of the outer container 110, e.g. on the flange 115 so as to seal the cavity where the inner container 120 is fitted. This prevents ingress of odors, as well as possible water spills.

[0025] As shown in the illustrated embodiment, the lid 130 has a central portion 131 that is sized to be fitted, preferably tightly fitted, in the inner container 120 and a flange 132 surrounding the central portion 131 and defining a concave portion 133 around it. The flange 132 is so sized as to surround and seal the flange 115 of the outer container 110.

[0026] In the figures, the ice making assembly 100 is shown with reference to a three dimensional coordinate system. A first axis X and a second axis Y that are mutually perpendicular define a horizontal plane where the bottom wall 112 of the outer container 110 rests, while a third axis Z defines a vertical axis along which the force of gravity acts.

[0027] With particular reference to figures 2 and 4, in order to make ice pieces, water is poured in the outer container 110 up to a predefined level indicated by a suitable marking and the inner container 120 is then fitted into the outer container 110 along an axial direction, thereby forcing water to enter and fill all cavities 113. It

will be appreciated that the provision of the flange 115, possibly with the lip portion 116, facilitates pouring while preventing spilling of water.

[0028] Once filled water in the pockets 113, the lid 130 is placed on the outer container 110 at the flange 115, thus sealing the ice making assembly 100, which is then placed in a freezer compartment of a refrigerator appliance.

[0029] According to an embodiment of the invention, the inner container 120 is sized such that its peripheral wall slightly interferes with the outer container 110 in an assembled configuration, thus achieving a tight fit by elastic deformation of the latter and hence effectively preventing water spills from the cavities 113. Thanks to this feature, the ice making assembly 100 can be stored in any position either vertical or horizontal during the freezing process.

[0030] According to the invention, the inner container 120 comprises a phase change material (PCM) 140 housed in a peripheral wall 121 of the inner container 120 where a cavity 122 is formed. Alternatively or additionally, the phase change material may be housed in a bottom wall 123 of the inner container 120 in a suitable cavity 124 thereof, which may possibly be in communication with the cavity 122 formed in the peripheral wall 121 as shown in the illustrated embodiment.

[0031] It is known that phase change materials are substances having a high heat of fusion which are capable of storing and releasing large amounts of energy when melting and solidifying. Heat is absorbed or released when the material changes from solid to liquid and vice versa.

[0032] During a solid-to-liquid phase change PCM materials behave like sensible heat storage means, as their temperature rises when they absorb heat. When PCM materials reach the temperature at which they change phase, e.g. their melting temperature, they absorb large amounts of heat at an almost constant temperature. A PCM material continues to absorb heat without a significant rise in temperature until phase change is complete, e.g. until all the material is transformed from the solid phase to the liquid phase.

[0033] The invention exploits this physical property in order to accelerate freezing of water received in the cavities 113. In fact, compared to a known ice maker like e.g. that disclosed in US 2011/061421 A1, where water is subjected to freezing only at the exterior of the outer container facing a freezer compartment, in the ice making assembly of the invention freezing occurs simultaneously at the exterior and the interior of the outer container 110.

[0034] Moreover, while freezing at the exterior of the outer container 110 occurs mainly through thermal convection due to cold air present in a freezer compartment of a refrigerator appliance, the freezing process at the interior of the outer container 110 is caused by thermal conduction thanks to the contact with the PCM material stored in the peripheral wall 121 of the inner container 120.

[0035] Phase change materials suitable to be employed in the ice making assembly of the present invention have a temperature at which solid to liquid phase change occurs comprised between about -20°C and about -5°C, for instance about -14°C. Water-based materials comprising an amount of glycol between 10 and 40 wt% have successfully been tested. Good freezing results have also been obtained by employing water-based materials comprising an amount of ammonium chloride between 15 and 20 wt%.

[0036] It will be appreciated that in order to make ice pieces, the phase change material 140 housed in the inner container 120 received into the outer container 110 must be in the solid phase. To this aim, the whole ice making assembly 100 or at least the inner container 120 must be kept in a freezer compartment of a refrigerator appliance before use.

[0037] Once water has frozen, the inner container 120 is removed from the outer container 110 and ice pieces can be released from their respective cavities 113 by simply deforming the peripheral wall 111 of the outer container 110.

[0038] Now referring to figures 7 and 8, according to an embodiment of the invention the lid 130 may be used as a supporting member when extracting the inner container 120 in order to release ice pieces. To this aim the lid 130 is removed from the top of the outer container 110 and inner container 120 and arranged upside down such that its central portion 131 supports the base of the outer container 110. Thanks to this arrangement, the concave portion 133 of the lid 130 may serve as a trough to collect water spills or condensation dripping down the exterior of the outer container 110. As shown in figures 7 and 8, the outer container 110 may advantageously comprise a sleeve 117 protruding from the bottom wall 112 and sized so as to receive and hold the central portion 131 of the lid 130, thus improving stability of the ice making assembly 100 in this open configuration. It will be appreciated that the outer container 110 might alternatively comprise a protruding central portion and that the lid might correspondingly comprise a sleeve, thus achieving the same coupling above in an equivalent manner.

[0039] According to an alternative embodiment of the invention that is not shown in the figures, the inner container 120 is configured to be coupled with the lid 130. To this aim a protrusion, e.g. having a circular shape, is formed on the bottom wall of one between the inner container 120 and the lid 130 and a cavity having a corresponding shape is formed on the other one between the inner container 120 and the lid 130 so as to receive the protrusion and achieve a form fit. Thanks to this configuration, the inner container 120 may be used independently of the outer container 110 as a bottle holder, still exploiting the PCM material 140 to keep temperature constant, while the outer container 110 may be used to store and serve the ice pieces previously formed.

[0040] According to an embodiment of the invention, a hydrophobic coating may be applied to the peripheral

wall of the inner container 120 in order to minimize formation of wet or icy areas due to condensation of moisture during the freezing process and afterwards when the inner container 120 is extracted and used. Thanks to this configuration, only water droplets are formed, which can be easily collected by gravity into the lid 130 as described above. Alternatively, a nano-texture, i.e. a surface texture made up of a plurality of nanometric-sized structures, may be formed by way of a molding process of the inner container 120 or afterwards e.g. by laser processing.

[0041] Tests were performed by the inventors on a first sample of the ice making assembly 100 like that shown in the figures compared to a second sample of the ice making assembly 100 having the same configuration but wherein the inner container 120 did not include a phase change material 140, hence similar to the prior art device described by US 2011/061421 A1. In both samples an amount of water of about 150 ml was poured into the cavities 113. The freezing process was monitored in both ice making assemblies. The chart of figure 9 shows that the freezing process of the first sample, made according to the invention, took about 22 minutes, while the freezing process of the second sample, made according to the prior art, took about 70 minutes, hence more than three times.

[0042] According to an embodiment of the invention, the lid 130 may be polygonal shaped, e.g. square shaped as shown in the drawings, thus allowing to prevent rolling of the ice making assembly 100 when stored horizontally, i.e. with the axis of the outer container parallel to the horizontal plane XY.

[0043] According to another embodiment of the invention, a UV light system may be advantageously integrated into the ice making assembly 100 to disinfect water. As shown in the figures, UV LEDs may be embedded in suitable seats e.g. formed in the peripheral wall 121 of the inner container 120 and facing the cavities 113. A control unit powered by a supply system such as e.g. a battery can be used to drive the UV light system.

[0044] According to a further embodiment of the invention, temperature sensors may advantageously be embedded in the ice making assembly 100 to inform a user when ice has formed. The temperature sensors, e.g. of a wireless type, may be embedded in suitable seats e.g. formed in the peripheral wall 111 of the outer container 110. Also in this case a control unit powered by a supply system such as e.g. a battery can be used to drive the temperature sensors and establish a wireless connection with a control unit of e.g. a refrigerator appliance, household appliance and/or remote e.g. mobile device. This configuration is advantageous in that it e.g. allows to monitor the ice-making process over time and inform a user when ice is actually available, e.g. by sending a sound signal, a light signal and the like through a control interface of the appliance and/or the device.

[0045] The present invention has hereto been disclosed with reference to preferred embodiments thereof.

It will be appreciated that there may be other embodiments relating to the same inventive idea, all of which are included in the scope of protection defined by the claims set out below.

Claims

1. A portable ice making assembly (100) comprising:
 - a. an outer container (110) substantially having a cup shape comprising a peripheral wall (111) and a bottom wall (112), a plurality of cavities (113) connected among each other by way of channels (114) being formed in said peripheral wall (111),
 - b. an inner container (120) substantially having the shape of a bucket, said inner container (120) being designed to be coaxially fitted into the outer container (110) so as to seal substantially all cavities (113),
 - c. a lid (130) dimensioned to be fitted on the top of the outer container 110,
 wherein the inner container (120) comprises a phase change material (140), said phase change material (140) being housed in a peripheral wall (121) of the inner container (120) and/or in a bottom wall (123) thereof.
2. The ice making assembly (100) of claim 1, wherein the phase change material (140) has a temperature at which solid to liquid phase change occurs comprised between -20°C and -5°C.
3. The ice making assembly (100) of claim 1 or 2, wherein the outer container (110) is made of an elastic rubber material.
4. The ice making assembly (100) of any one of claims 1 to 3, wherein a flange (115) is formed at an upper edge of the outer container (110), said flange (115) being substantially concave-shaped.
5. The ice making assembly (100) of claim 4, wherein the flange (115) comprises a lip portion (116) protruding radially outwards.
6. The ice making assembly (100) of any one of claims 1 to 5, wherein the outer container (110) comprises a sleeve (117) protruding from the bottom wall (112) and wherein the lid (130) comprises a central portion (131), said sleeve (117) being so sized as to receive and hold said central protrusion (131).
7. The ice making assembly (100) of any one of claims 1 to 5, wherein the inner container (120) comprises a sleeve protruding from the bottom wall (112) and

wherein a protrusion is formed on the bottom wall of one between the inner container (120) and the lid (130) and a cavity having a corresponding shape is formed on the other one between the inner container (120) and the lid (130), said cavity being so sized as to receive said protrusion and achieve a form fit. 5

8. The ice making assembly (100) of any one of claims 1 to 7, wherein the lid (130) is polygonal shaped. 10
9. The ice making assembly (100) of any one of claims 1 to 8, wherein a hydrophobic coating is formed on the peripheral wall of the inner container (120).
10. The ice making assembly (100) of any one of claims 1 to 8, wherein a nano-texture is formed on the peripheral wall of the inner container (120). 15
11. The ice making assembly (100) of any one of claims 1 to 10, further comprising a UV light system configured to disinfect water received in the cavities (113). 20
12. The ice making assembly (100) of claim 11, wherein the UV light system comprises UV LEDs embedded in seats formed in the peripheral wall (121) of the inner container (120), said seats facing the cavities (113) formed in the outer container (110). 25
13. The ice making assembly (100) of any one of claims 1 to 12, further comprising temperature sensors configured to monitor the temperature of water received in the cavities (113) formed in the outer container (110). 30
14. The ice making assembly (100) of claim 13, wherein said temperature sensors are embedded in seats formed in the peripheral wall (111) of the outer container (110). 35

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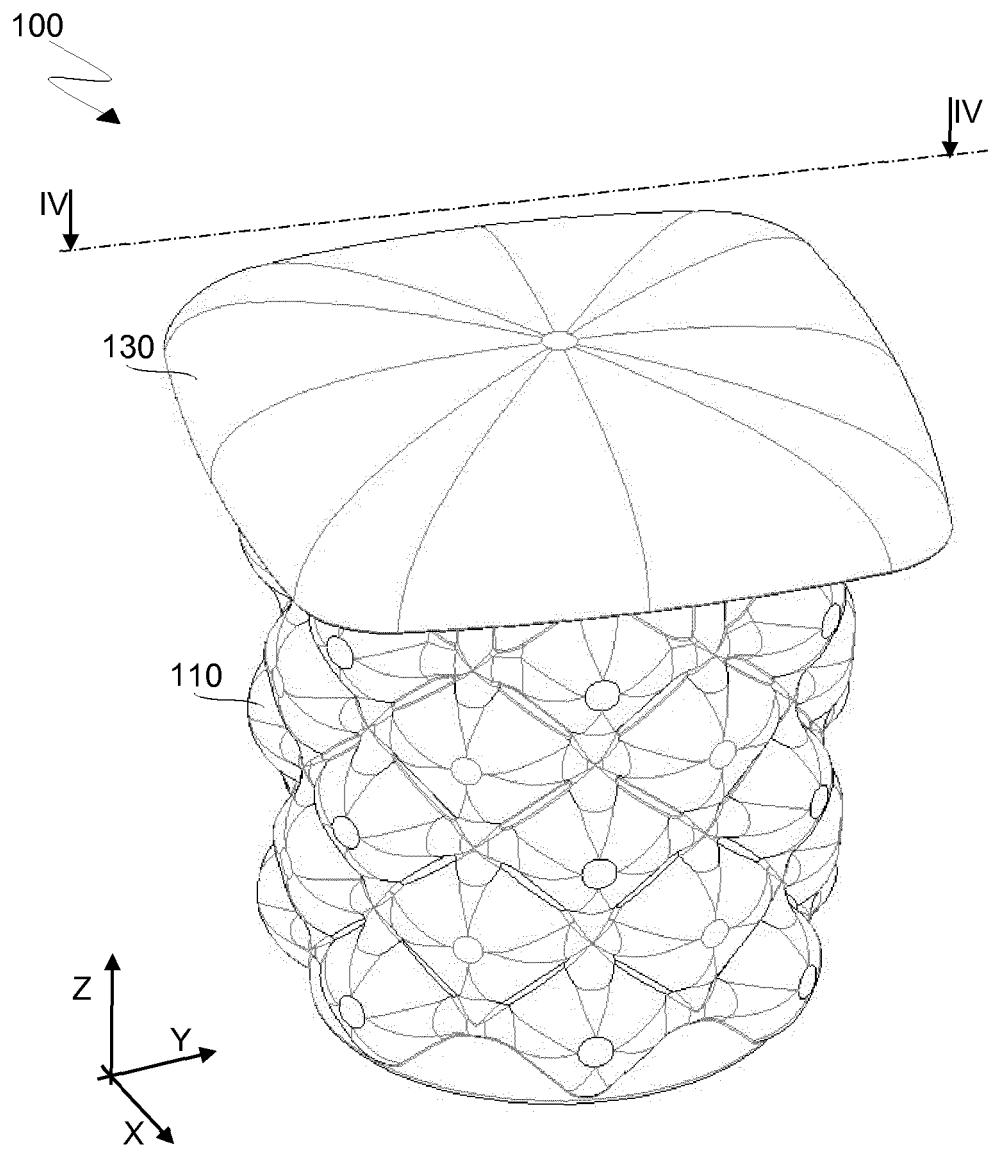


Fig.1

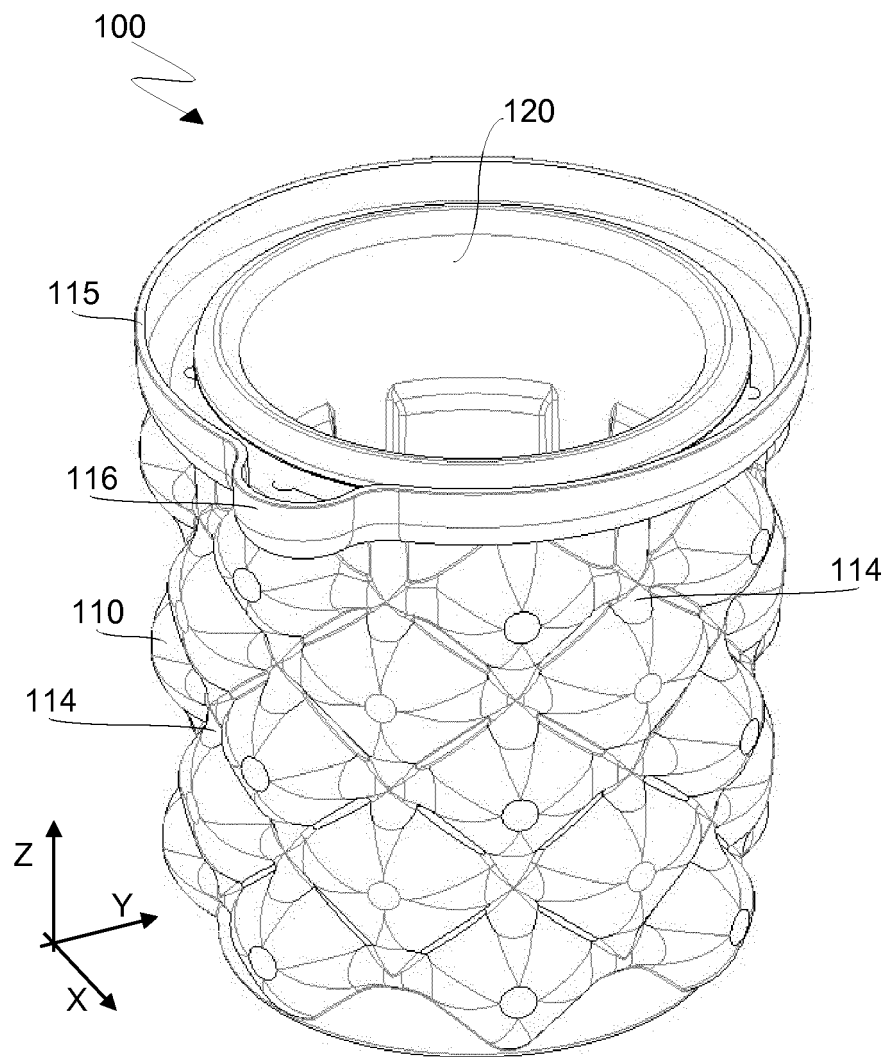


Fig.2

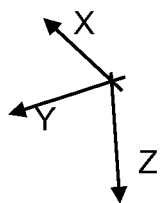
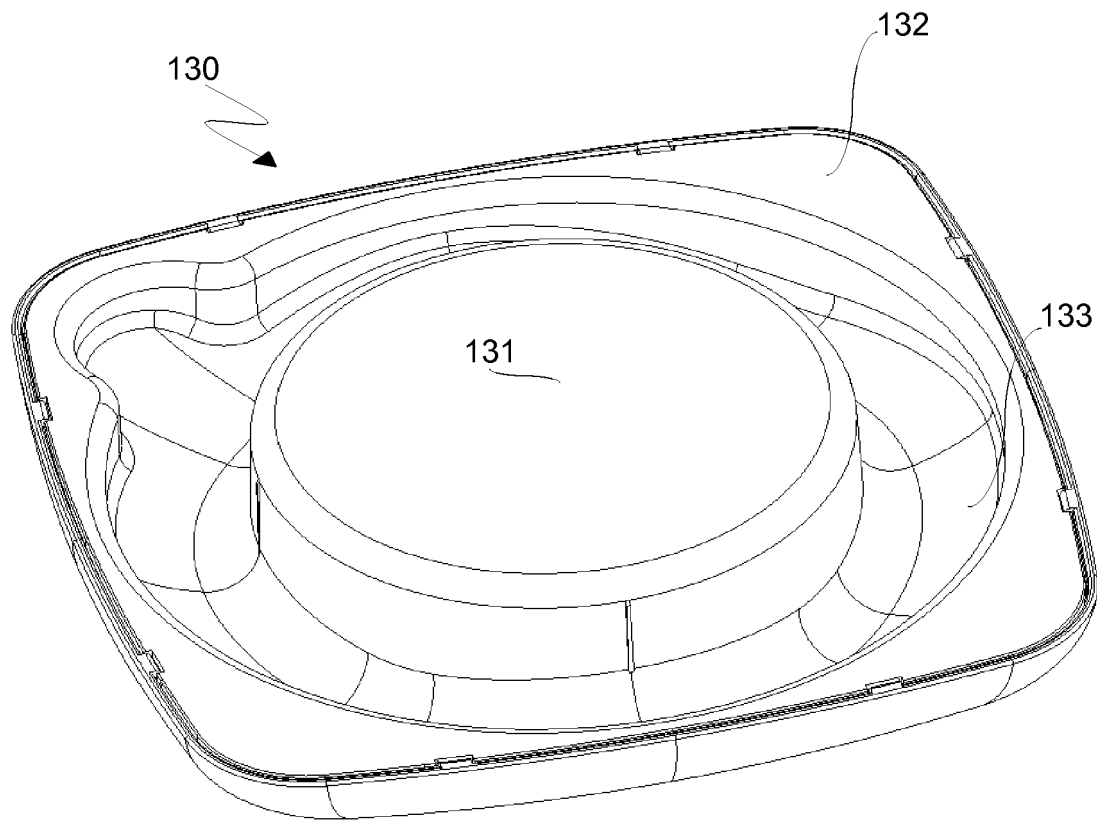


Fig.3

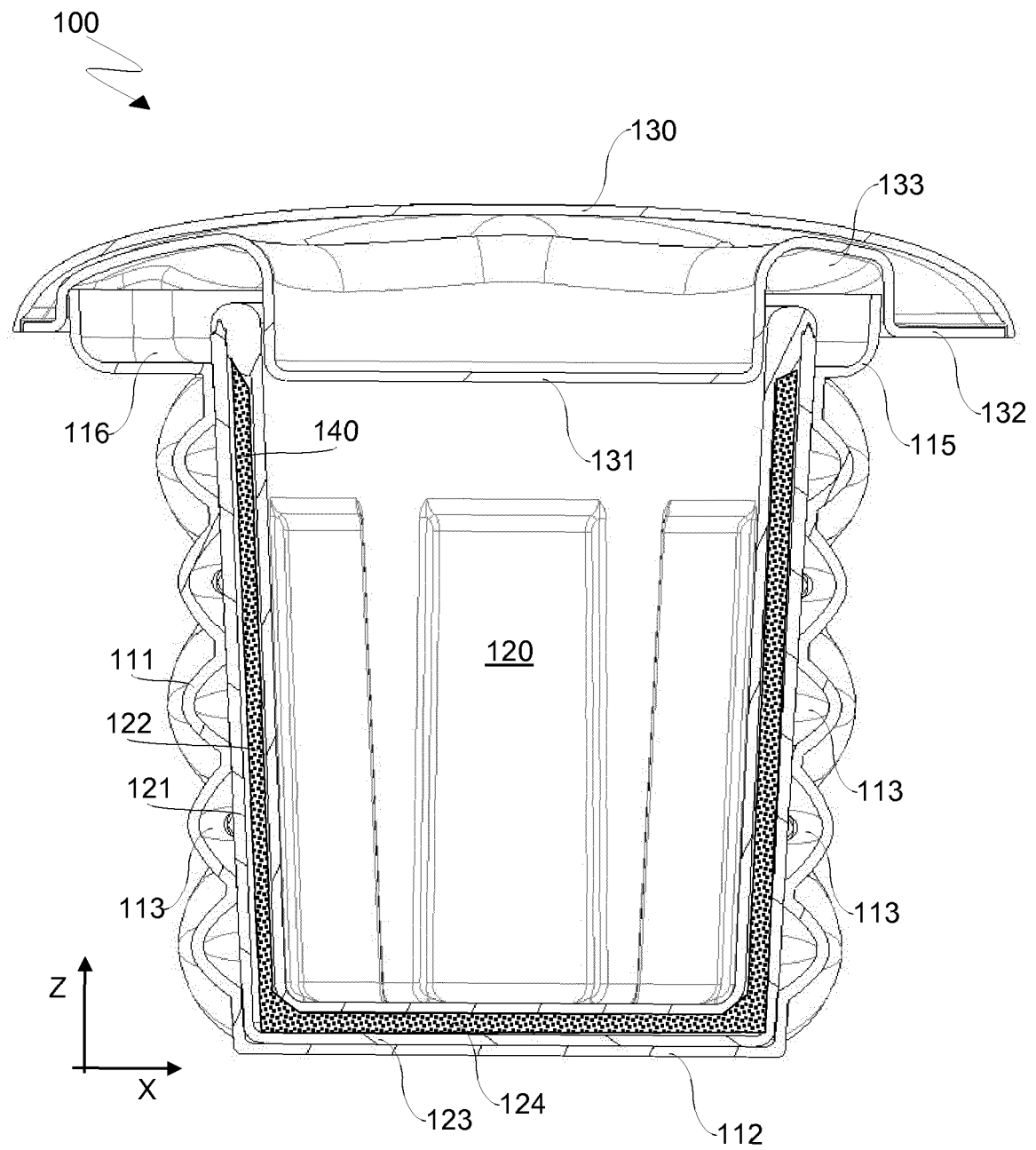


Fig.4

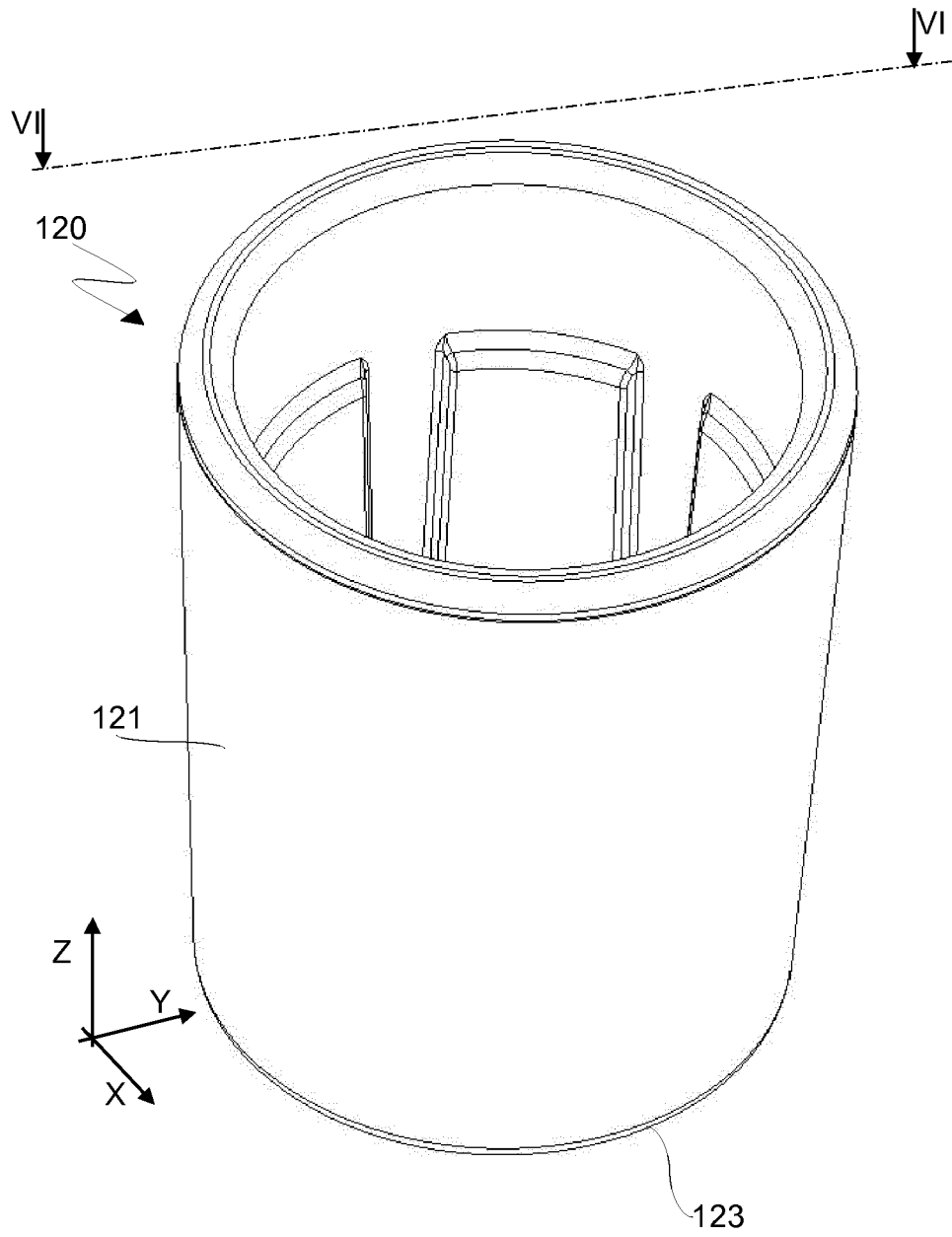


Fig.5

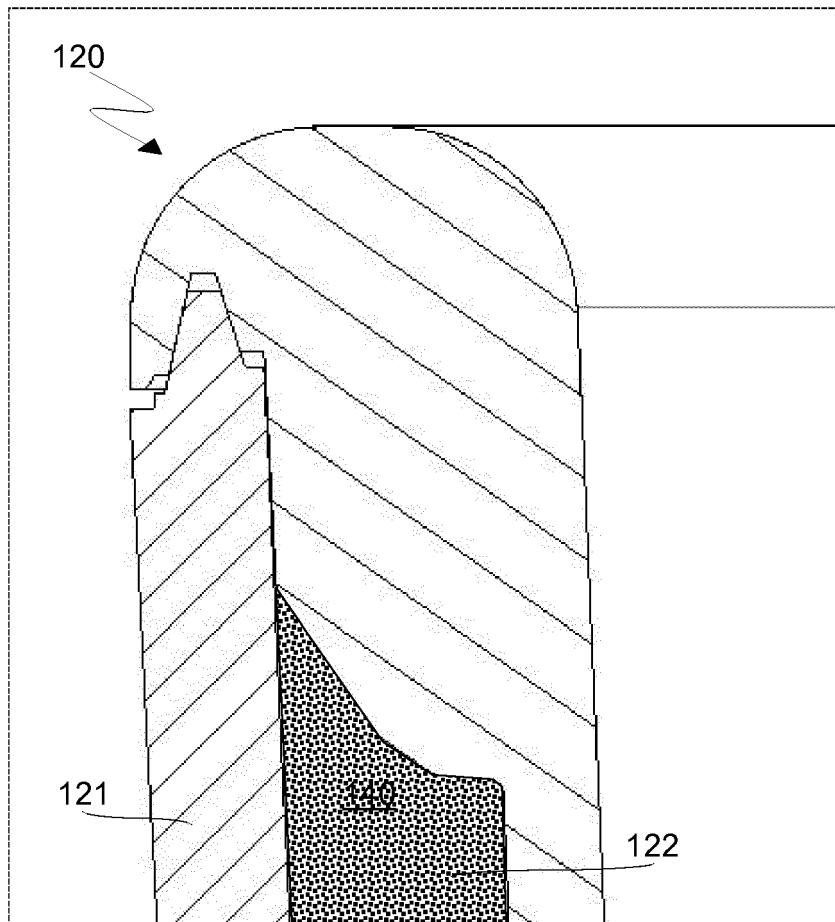


Fig.6

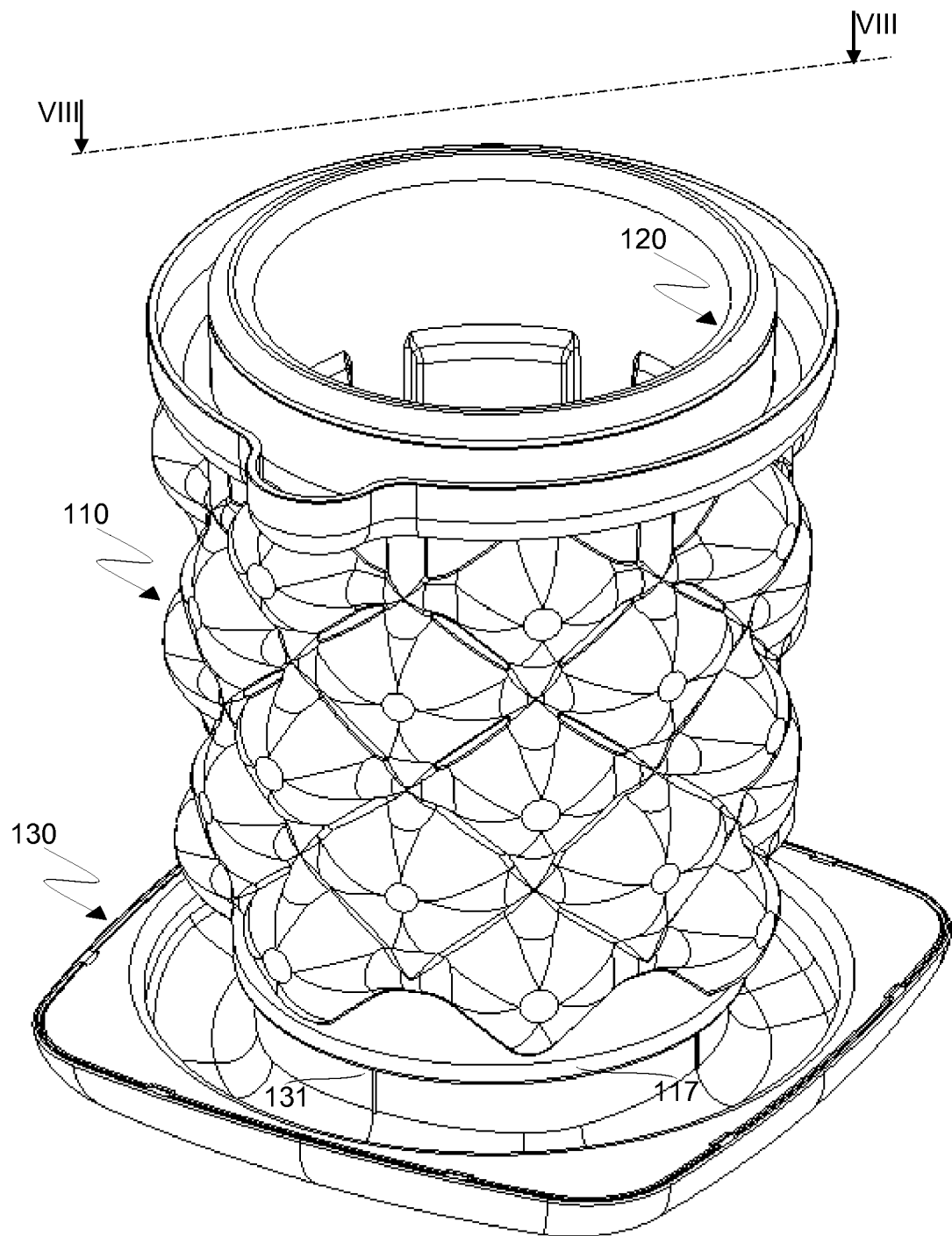


Fig.7

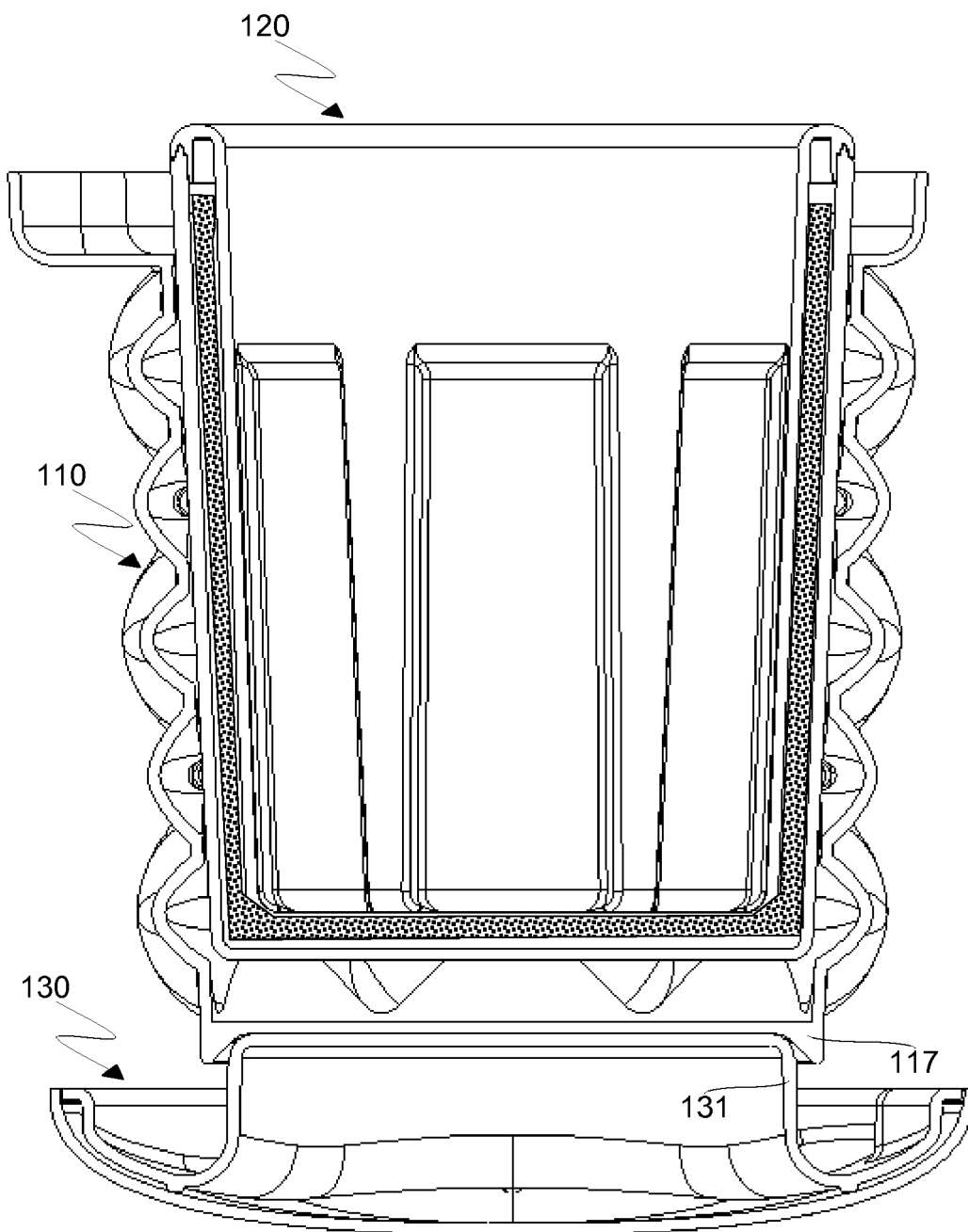


Fig.8

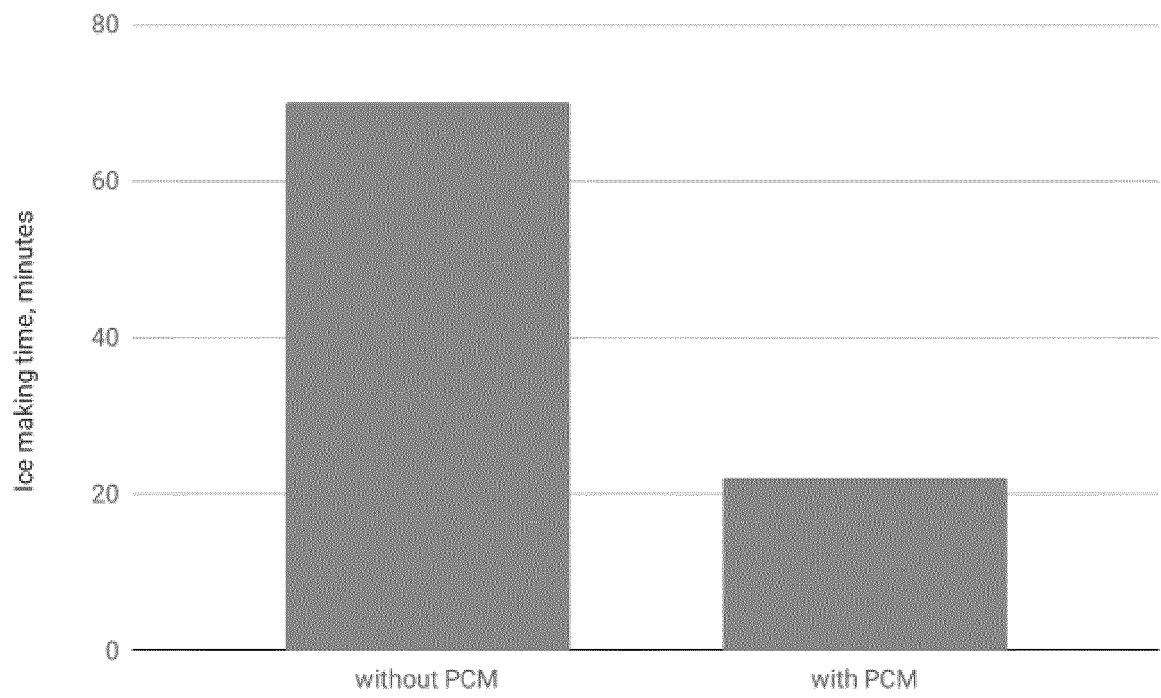


Fig.9



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Application Number
EP 19 15 9528

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 9 August 2019	Examiner Yousufi, Stefanie
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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