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(54) MULTI-CAVITY ICE MAKING ASSEMBLY

(57) An ice making assembly for a refrigerated appliance includes a mold body including an upper mold and a lower mold coupled to the upper mold, the mold body defining a cavity for the formation of an ice shape; a mold frame at least partially surrounding the mold body, the first upper mold piece and the second upper mold piece being coupled together via the mold frame; an ejector positioned adjacent to the mold body, the ejector being rotatable together with the mold body and the mold frame between a first position and a second position; and a motor for rotating the mold body, the mold frame, and the ejector between the first position and the second position.

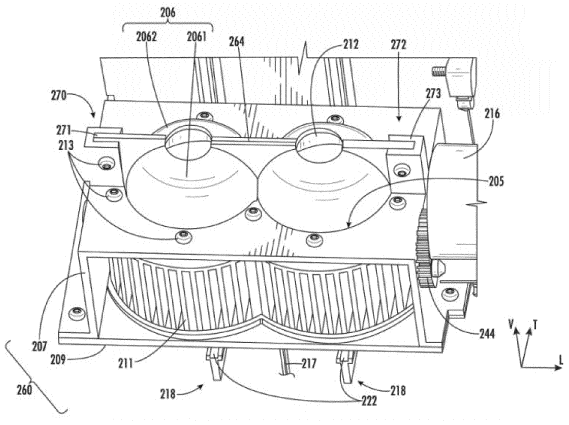

Fig. 3

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Description

TECHNICAL FIELD

[0001] The present subject matter relates generally to ice making appliances, and more particularly to ice making appliances for making multiple large ice pieces.

BACKGROUND

[0002] Ice makers are commonly provided as standalone appliances or may be incorporated within larger refrigerated appliances used to store food items in both commercial and residential applications. Typically, such ice makers are configured for the bulk production of ice where e.g., multiple pieces of ice are used to cool the same beverage or used to cool other food items. The individual pieces of ice may have different shapes and are typically relatively smaller in size (e.g., largest dimension of an individual piece might be 2 inches or less, or even 1 inch or less). These bulk ice makers typically do not create multiple, larger pieces or pieces of ice and some do not create pieces that are uniformly of a particular shape such as spherical.

[0003] Some consumers may prefer a particular size or shape of ice for certain beverages. For example, in the consumption of some alcohol-based drinks, consumers may prefer to use a single piece of ice for cooling the beverage. Where a glass or metal cup is used, a spherical ice cube having a diameter nearly as large as the opening of the cup may also be preferred. A diameter of e.g., two inches or more may be preferred. While other shapes may also be utilized, a single piece of ice in a spherical shape may melt more slowly that other shapes or multiple pieces of ice, which can mean less dilution of the alcohol-based drink. In addition, certain consumers may also prefer ice that is relatively clear or transparent.

[0004] Manually-filled ice molds in particular shapes and sizes are available. These molds may be one or multiple pieces. The consumer manually fills the mold with water and may also have to remove entrapped air. The mold is then placed into a refrigerated space maintained at freezing temperatures. The mold is later removed after enough time has elapsed to freeze the water. The mold may have to be slightly heated and/or flexed to cause the ice to be released from the mold. The process must be manually repeated if the consumer wants additional ice. Drawbacks to the manual process may include spills, difficulties in removing ice from the mold, the rate of ice piece production is limited by the number of molds, and the user must remember to refill the molds each time.

[0005] Accordingly, an ice maker that can automatically or repeatedly make larger pieces of ice in a particular shape would be desirable. An ice maker capable of producing multiple large pieces of ice at a time would be particularly beneficial.

SUMMARY

[0006] Aspects and advantages of the invention will be set forth in part in the following description, or may be obvious from the description, or may be learned through practice of the invention.

[0007] In one exemplary aspect of the present disclosure, an ice making assembly for a refrigerator appliance is provided. The ice making assembly may include a mold body including an upper portion and a lower portion, the mold body defining a plurality of cavities for the formation of ice shapes, wherein the upper portion defines a plurality of apertures into which water is supplied; a mold frame at least partially surrounding the mold body, wherein the mold body is coupled together via the mold frame; an ejector positioned adjacent to the mold body, the ejector being rotatable together with the mold body and the mold frame between a first position and a second position, wherein the ejector deflects the lower portion toward the upper portion, and wherein the upper portion is separated between the plurality of apertures to define a single aperture when in the second position; and a motor for rotating the mold body, the mold frame, and the ejector between the first position and the second position.

[0008] In another exemplary aspect of the present disclosure, a refrigerator appliance is provided. The refrigerator appliance may include a cabinet comprising a freezer chamber; and an ice making assembly provided within the freezing chamber. The ice making assembly may include a mold body including an upper portion and a lower portion, the mold body defining a plurality of cavities for the formation of ice shapes, wherein the upper portion defines a plurality of apertures into which water is supplied; a mold frame at least partially surrounding the mold body, wherein the mold body is coupled together via the mold frame; an ejector positioned adjacent to the mold body, the ejector being rotatable together with the mold body and the mold frame between a first position and a second position, wherein the ejector deflects the lower portion toward the upper portion, and wherein the upper portion is separated between the plurality of apertures to define a single aperture when in the second position; and a motor for rotating the mold body, the mold frame, and the ejector between the first position and the second position.

[0009] These and other features, aspects and advantages of the present invention will become better understood with reference to the following description and appended claims. The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF DRAWINGS

[0010] A full and enabling disclosure of the present invention, including the best mode thereof, directed to

one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures.

FIG. 1 provides a perspective view of a refrigerator appliance according to exemplary embodiments of the present disclosure.
FIG. 2 provides a front view of the exemplary refrigerator appliance of FIG. 1 with refrigerator and freezer doors in an open position.
FIG. 3 provides a perspective view of an ice making appliance according to exemplary aspects of the present disclosure.
FIG. 4 provides a front cross-section view of the exemplary ice making appliance of FIG. 3.
FIG. 5 provides a perspective cross-section view of the exemplary ice making appliance of FIG. 3.
FIG. 6 provides a perspective view of an ice mold of the exemplary ice making appliance of FIG. 3.
FIG. 7 provides a top view of the exemplary ice making appliance of FIG. 3.
FIG. 8 provides a side cross-section view of the exemplary ice making appliance of FIG. 3 with the ice mold in a first position.
FIG. 9 provides a side cross-section view of the exemplary ice making appliance of FIG. 3 with the ice mold in a second position.
FIG. 10 is a schematic depicting relative locations of an axis of rotation of the mold body and an arcuate surface of a cam of the exemplary ice making assembly.
FIG. 11 depicts a portion of the exemplary ice making assembly in the first position.
FIG. 12 depicts a portion of the exemplary ice making assembly in the second position.

[0011] Repeat use of reference characters in the present specification and drawings is intended to represent the same or analogous features or elements of the present invention.

DETAILED DESCRIPTION OF EMBIDEMENTS

[0012] Reference now will be made in detail to embodiments of the invention, one or more examples of which are illustrated in the drawings. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope of the invention. For instance, features illustrated or described as part of one embodiment can be used with another embodiment to yield a still further embodiment. Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents.

[0013] As used herein, the term "or" is generally intended to be inclusive (i.e., "A or B" is intended to mean "A or B or both"). The phrase "in one embodiment," does not necessarily refer to the same embodiment, although it may.

[0014] The terms "first," "second," and "third" may be used interchangeably to distinguish one component from another and are not intended to signify location or importance of the individual components. The terms "upstream" and "downstream" refer to the relative flow direction with respect to fluid flow in a fluid pathway. For example, "upstream" refers to the flow direction from which the fluid flows, and "downstream" refers to the flow direction to which the fluid flows.

[0015] FIG. 1 provides a perspective view of a refrigerator appliance 100 according to an exemplary embodiment of the present subject matter. Refrigerator appliance 100 includes a cabinet or housing 102 that extends between a top 104 and a bottom 106 along a vertical direction V, between a first side 108 and a second side 110 along a lateral direction L, and between a front side 112 and a rear side 114 along a transverse direction T. Each of the vertical direction V, lateral direction L, and transverse direction T are mutually perpendicular to one another.

[0016] Housing 102 defines chilled chambers for receipt of food items for storage. In particular, housing 102 defines fresh food chamber 122 positioned at or adjacent top 104 of housing 102 and a freezer chamber 124 arranged at or adjacent bottom 106 of housing 102. As such, refrigerator appliance 100 is generally referred to as a bottom mount refrigerator. It is recognized, however, that the benefits of the present disclosure apply to other types and styles of refrigerator appliances such as, e.g., a top mount refrigerator appliance or a side-by-side style refrigerator appliance. Consequently, the description set forth herein is for illustrative purposes only and is not intended to be limiting in any aspect to any particular refrigerator chamber configuration.

[0017] Refrigerator doors 128 are rotatably hinged to an edge of housing 102 for selectively accessing fresh food chamber 122. Similarly, freezer doors 130 are rotatably hinged to an edge of housing 102 for selectively accessing freezer chamber 124. To prevent leakage of cool air, refrigerator doors 128, freezer doors 130, or housing 102 may define one or more sealing mechanisms (e.g., rubber gaskets, not shown) at the interface where the doors 128, 130 meet housing 102. Refrigerator doors 128 and freezer doors 130 are shown in the closed configuration in FIG. 1 and in the open configuration in FIG. 2. It should be appreciated that doors having a different style, position, or configuration are possible and within the scope of the present subject matter.

[0018] Refrigerator appliance 100 also includes a dispensing assembly 132 for dispensing liquid water or ice. Dispensing assembly 132 includes a dispenser 134 positioned on or mounted to an exterior portion of refrigerator appliance 100, e.g., on one of refrigerator doors 128. Dispenser 134 includes a discharging outlet 136 for accessing ice and liquid water. An actuating mechanism 138, shown as a paddle, is mounted below discharging

outlet 136 for operating dispenser 134. In alternative exemplary embodiments, any suitable actuating mechanism may be used to operate dispenser 134. For example, dispenser 134 can include a sensor (such as an ultrasonic sensor) or a button rather than the paddle. A control panel 140 is provided for controlling the mode of operation. For example, control panel 140 includes a plurality of user inputs (not labeled), such as a water dispensing button and an ice-dispensing button, for selecting a desired mode of operation such as crushed or non-crushed ice.

[0019] Discharging outlet 136 and actuating mechanism 138 are an external part of dispenser 134 and are mounted in a dispenser recess 142. Dispenser recess 142 is positioned at a predetermined elevation convenient for a user to access ice or water and enabling the user to access ice without the need to bend-over and without the need to open refrigerator doors 128. In the exemplary embodiment, dispenser recess 142 is positioned at a level that approximates the chest level of a user. According to an exemplary embodiment, the dispensing assembly 132 may receive ice from an icemaker or icemaking assembly 300 disposed in a sub-compartment of the refrigerator appliance 100 (e.g., IB compartment 180).

[0020] Refrigerator appliance 100 further includes a controller 144. Operation of the refrigerator appliance 100 is regulated by controller 144 that is operatively coupled to or in operative communication with control panel 140. In one exemplary embodiment, control panel 140 may represent a general purpose I/O ("GPIO") device or functional block. In another exemplary embodiment, control panel 140 may include input components, such as one or more of a variety of electrical, mechanical or electro-mechanical input devices including rotary dials, push buttons, touch pads, or touch screens. Control panel 140 may be in communication with controller 144 via one or more signal lines or shared communication busses. Control panel 140 provides selections for user manipulation of the operation of refrigerator appliance 100. In response to user manipulation of the control panel 140, controller 144 operates various components of refrigerator appliance 100. For example, controller 144 is operatively coupled or in communication with various components of a sealed system, as discussed below. Controller 144 may also be in communication with a variety of sensors, such as, for example, chamber temperature sensors or ambient temperature sensors. Controller 144 may receive signals from these temperature sensors that correspond to the temperature of an atmosphere or air within their respective locations.

[0021] In some embodiments, controller 144 includes memory and one or more processing devices such as microprocessors, CPUs or the like, such as general or special purpose microprocessors operable to execute programming instructions or micro-control code associated with operation of refrigerator appliance 100. The memory can represent random access memory such as DRAM, or read only memory such as ROM or FLASH. The processor executes programming instructions stored in the memory. The memory can be a separate component from the processor or can be included onboard within the processor. Alternatively, controller 144 may be constructed without using a microprocessor (e.g., using a combination of discrete analog or digital logic circuitry; such as switches, amplifiers, integrators, comparators, flip-flops, AND gates, and the like; to perform control functionality instead of relying upon software).

[0022] FIG. 2 provides a front view of refrigerator appliance 100 with refrigerator doors 128 and freezer doors 130 shown in an open position. According to the illustrated embodiment, various storage components are mounted within fresh food chamber 122 and freezer chamber 124 to facilitate storage of food items therein as will be understood by those skilled in the art. In particular, the storage components include bins 146, drawers 148, and shelves 150 that are mounted within fresh food chamber 122 or freezer chamber 124. Bins 146, drawers 148, and shelves 150 are configured for receipt of food items (e.g., beverages or solid food items) and may assist with organizing such food items. As an example, drawers 148 can receive fresh food items (e.g., vegetables, fruits, or cheeses) and increase the useful life of such fresh food items.

[0023] FIGS. 3 through 12 illustrate an exemplary embodiment of an ice making assembly 200 as may be used in refrigerator appliance 100 or another appliance configuration (including a dedicated ice making appliance) as discussed above. For example, ice making assembly 200 may be located in lower freezer chamber 124 as shown in FIG. 2. An ice bin 202 may be included for the collection of ice.

[0024] Ice making assembly 200 may include a mold body 204 that defines a chamber or cavity 210 in which liquid (e.g., water) may be supplied to form ice shapes 234 (such as a sphere, as shown in FIG. 8). It should be understood that the examples given herein and shown in the figures are not limiting, and that any suitably shaped ice mold may be implemented to form a wide variety of ice shapes. Additionally or alternatively, although two distinct ice shape volumes are shown in the figures and discussed herein, any suitable number of ice shape volumes may be implemented, and the disclosure is not limited to the examples given herein.

[0025] Ice making assembly 200 may include a mold frame (or mold shell) 260. Mold frame 260 may at least partially surround mold body 204. For instance, mold frame 260 may be coupled to mold body 204 at a plurality of connection points. Accordingly, mold body 204 may be restrained by mold frame 260. As will be explained in more detail below, mold frame 260 and mold body 204 may be collectively rotated (e.g., within freezer chamber 124) by a rotation mechanism or assembly. Mold frame 260 may include an upper mold shell 207 and a lower mold shell 209.

[0026] In this exemplary embodiment, mold body 204 is constructed from an upper mold portion 206 and a

lower mold portion 208 (FIG. 4) contained within upper mold shell 207 and lower mold shell 209. The two mold portions 206 and 208 may be pressed together between upper mold shell 207 and lower mold shell 209 connected by various fasteners 213. Lower mold shell 209 may include a plurality of heat exchanging fins 211 in thermal communication with lower mold portion 208 to assist with heat transfer during the freezing process. For instance, heat exchanging fins 211 may be a separate component from lower mold shell 209. Heat exchanging fins 211 may be composed of a metal while lower mold shell 209 may be composed of a plastic. Accordingly, heat exchanging fins 211 may be coupled to lower mold shell 209.

[0027] A thermocouple 215 or other temperature sensor may be connected with controller 134 through wires 217 so that the freezing process can be monitored during ice production. Upper mold shell 207 may define an opening 205 through which the upper mold portion 206 extends. Upper mold portion 206 may define an opening 212 to chamber 210. In some embodiments, pleats may be formed about opening 212 and may be uniformly spaced. Accordingly, opening 212 may be selectively enlarged, as will be described in more detail below.

[0028] Moreover, chamber 210 formed within mold body 204 may include a first chamber 2101 and second chamber 2102. In detail, as shown in FIGS. 3 through 7, first chamber 2101 may define a first shape and second chamber 2102 may define a second shape. Each of the first shape and the second shape (e.g., first chamber 2101 and second chamber 2102) may be identical in shape. However, it should be understood that any suitable combination of shapes may be incorporated within chamber 210. Additionally or alternatively, it should be understood that any suitable amount of distinct chambers may be formed within chamber 210, to accommodate any suitable number of ice shapes.

[0029] First chamber 2101 and second chamber 2102 may be connected by a central channel 262. In detail, central channel may be a via or opening that fluidly connects first chamber 2101 and second chamber 2102, such that liquid supplied to first chamber 2101, for example, is subsequently supplied to second chamber 2102. Accordingly, each of first chamber 2101 and second chamber 2102 may be supplied with water via a single opening 212. Further, as shown in the figures, when the chambers are spherical, central channel 262 may be provided at or along a vertically central location within mold body 204. Additionally or alternatively, central channel 262 may be provided at or near a transversally central location within mold body 204.

[0030] Mold portions 206 and 208 may be constructed from a flexible or resilient material. In one exemplary aspect, one or both mold portions 206 and 208 are constructed from a silicone rubber. As mentioned above, the pleats may allow the size or diameter of opening 212 to increase as an ice shape 234 is ejected from mold body 204 as will be further explained. In another exemplary aspect, one or both mold portions 206 and 208 are constructed from a flexible and hydrophobic material such as e.g., silicone rubber. The hydrophobic property assists in precluding water from escaping (e.g., through the pleats or between the mold portions 206 and 208) during the filling and freezing processes. A unitary construction may also be used instead of mold portions 206 and 208 in other embodiments of the invention. For instance, upper mold portion 206 and lower mold portion 208 may be formed as a single piece, having one or more openings 212 defined therein.

[0031] According to at least one embodiment, upper mold portion 206 may include a first upper mold piece 2061 and a second upper mold piece 2062. As shown in FIG. 6, first upper mold piece 2061 may form a first upper quadrant of mold body 204. First upper mold piece 2061 may thus be referred to as a front upper mold piece. Accordingly, second upper mold piece 2062 may form a second upper quadrant of mold body 204. Second upper mold piece 2062 may thus be referred to as a rear upper mold piece. As described above, first and second upper mold pieces 2061 and 2062 may be constructed from a flexible and hydrophobic material, such as silicone rubber, for example. Thus, the hydrophobic property may assist in precluding water from escaping from mold body 204 between first and second upper mold piece 2061 and 2062.

[0032] For example, upper mold portion 206 may define a joint 264 extending, e.g., along the lateral direction L from a first lateral end of mold body 204 to a second lateral end of mold body 204. Joint 264 may be a connection point between first upper mold piece 2061 and second upper mold piece 2062. In detail, when mold body 204 is in a neutral or resting position, first upper mold piece 2061 and second upper mold piece 2062 may contact each other along joint 264. The hydrophobic property of upper mold portion 206 may assist in precluding water escaping via joint 264 (e.g., when mold body 204 is in the neutral position). Joint 264 may further assist in defining each of first chamber 2101 and second chamber 2102. For example, as shown most clearly in FIGS. 5 and 6, each of first chamber 2101 and second chamber 2102 may be predominantly spherical in shape. Joint 264 may be defined by one or more planar portions 266 on each of first upper mold piece 2061 and second upper mold piece 2062. For instance, a first planar portion 266 me be formed at the first lateral side of upper mold portion 206, a second planar portion 266 may be formed at the second lateral side of upper mold portion 206, and a third planar portion 266 may be formed at a center of upper mold portion 206 (e.g., along the lateral direction L).

[0033] First upper mold piece 2061 may be selectively coupled to second upper mold piece 2062. In detail, first and second upper mold pieces 2061 and 2062 may be coupled to each other at each of the first and second lateral ends. One or more fasteners 213 may penetrate first and second planar portions 266 (e.g., through each of first and second upper mold pieces 2061 and 2062).

Accordingly, upper mold portion 206 may be restrained at both lateral ends. Additionally or alternatively, upper mold portion 206 may be a single piece. For instance, each connection point defined at each lateral end of upper mold portion 206 may be formed as a unitary body. Upper mold portion 206 may thus be opened along joint 264. For instance, as will be explained in more detail below, during a harvesting operation, joint 264 may be split to create or define a single aperture 280 at the top of upper mold portion 206 (i.e., two or more openings 212 may be merged or joined to define aperture 280). Advantageously, the formed ice shapes 234 may be easily released from mold body 204.

[0034] Mold frame 260 (e.g., upper mold shell 207) may include a first support brace 270 provided at a first lateral end of upper mold shell 207 and a second support brace 272 provided at a second lateral end of upper mold shell 207. First and second support braces 270 and 272 may mirror each other about the transverse direction T. Accordingly, hereinafter, first support brace 270 will be described in detail with the understanding that the description applies to second support brace 272 as well.

[0035] As shown particularly in FIG 3., first support brace 270 may define a first groove 271 (i.e., second support brace 272 defines a second groove 273). First groove 271 may extend along the vertical direction V and the lateral direction L. For instance, first support brace 270 may include a plurality of walls that define first groove 271. First groove 270 may selectively receive a portion of upper mold portion 206 therein. According to at least one embodiment, planar portion 266 at the first lateral end of mold body 204 is received within first groove 271. Additionally or alternatively, planar portion 266 may be coupled to first support brace 270 via fastener 213. For instance, a first planar portion 266 may be defined as a first tab 282. First tab 282 may be selectively received within first groove 271. Similarly, a second planar portion 266 may be defined as a second tab 284. Second tab 284 may be selectively received within second groove 273. Accordingly, a first fastener 213 may penetrate first support brace 270 and first tab 282, and a second fastener 213 may penetrate second support brace 272 and second tab 284.

[0036] FIGS. 8 and 9 provide side section views of ice making assembly 200 in a first position and a second position, respectively. While only a single chamber 210 is shown, it should be understood that the descriptions apply to each of first and second chambers 2101 and 2102, for example. Accordingly, generic reference numerals will be used where appropriate for the sake of brevity and clarity. Mold body 204 (and mold frame 260) may be rotatable between a first position (FIG. 8) and a second position (FIG. 9). In the first position, mold body 204 may be filled with water (e.g., from a water dispenser 232). For example, a valve (not shown) may be activated by controller 134 as part of an ice making process to provide the appropriate amount of water to flow into mold body 204 when mold body 204 is in the upper (or first) position. As shown in FIG. 8, a first limit switch 226 may be contacted by lower mold shell 209 when mold body 204 is in the first position. First limit switch 226 may be connected with controller 134 (e.g., communicatively) for purposes of determining when mold body 204 is in the first position.

[0037] In the second position, ice shape 234 (or ice shapes) may be fully ejected from mold body 204. Ice shape 234 may be, e.g., ejected into ice bin 202 (e.g., via aperture 280). As shown in FIG. 9, a second limit switch 228 may be contacted by lower mold shell 209 when mold body 204 is in the second position. Second limit switch 228 may be connected with controller 134 (e.g., communicatively) for purposes of determining when mold body 204 is in the second position. Other configurations of limit switches may also be used to determine the position of mold body 204.

[0038] A motor 216 may be used to rotate mold body 204 (and mold frame 260) and an ejector 238 between the first and second positions. Motor 216 may be operated by controller 134. For example, motor 216 may drive gears 244 so as to rotate mold body 204 about axis of rotation A-A between the first and second positions as desired. The direction of rotation of, e.g., a shaft (not shown) from motor 216 may be used to control the direction of rotation of gears 244 and therefore mold 204 as determined by controller 134.

[0039] Ejector 238 may be positioned adjacent to mold body 204 and may be rotatable with mold body 204 between the first position and the second position. As will be explained, ejector 238 may be configured to push ice shape 234 out of chamber 210 (e.g., first chamber 2101 and second chamber 2102) through aperture 280 created by splitting open first upper mold piece 2061 and second upper mold piece 2062 during rotation between the first position and the second position. More particularly, ejector 238 configured to move between a retracted position (FIG. 8) and an extended position (FIG. 9). Ejector 238 may move from the retracted position to the extended position as mold body 204 is moved from the first position to the second position, respectively. While doing so, ejector may translate within a guide or channel 246 formed at least in part by lower mold shell 209.

[0040] Ejector 238 may include a first plunger 2381 and a second plunger 2382. For instance, as shown in FIG. 4, first plunger 2381 may be positioned beneath first chamber 2101 while second plunger 2382 is positioned beneath second chamber 2102 (e.g., along the vertical direction V when mold body 204 is in the first position). First and second plungers 2381 and 2382 may be connected by an axle bar 274. Axle bar 274 may connect a distal end 240 of first plunger 2381 with a distal end 240 of second plunger 2382. For instance, each of first plunger 2381 and second plunger 2382 may include a cam follower 242 (e.g., at the distal end 240 of each plunger, respectively). Axle bar 274 may connect the cam followers 242 to each other such that each of first and

second plunger 2381 and 2382 is rotated together, ensuring a smooth motion of the assembly 200.

[0041] For this exemplary embodiment, movement of ejector 238 (e.g., first plunger 2381 and second plunger 2382) is determined by a cam 218. More particularly, the distal end 240 of first plunger 2381 includes the cam follower or wheel 242 that rides in a slot 222 along an arcuate path 220 defined by cam 218. The slotted, arcuate path 220 may determine the position of ejector 238 as mold 204 and ejector 238 rotate together from the first position to the second position. Moreover, cam 218 may include a first slot 2221 and a second slot 2222. First slot 2221 may interact with first plunger 2381 while second slot 2222 interacts with second plunger 2382. Accordingly, each ejector 238 may be associated with a dedicated slot 222, ensuring smooth and unimpeded operation when moving between the first position and the second position.

[0042] An exemplary method of operating ice making assembly 200 will now be set forth using the described exemplary embodiment. One of skill in the art, using the teachings disclosed herein, will understand that other exemplary methods of operation may be use as well.

[0043] After chamber 210 has been filled with an appropriate amount of water as previously described, the water is allowed to freeze. During the filling and freezing process, mold body 204 is maintained in the first position as shown in FIG. 8 during which ejector 238 also remains in the retracted position. In one exemplary aspect of the disclosure, the water may be filtered to remove particulates and may be cooled along a controlled temperature and time profile to provide clearer ice. Temperature (as measured by sensor 215) may be monitored so that e.g., controller 134 may determine when the water has been converted into ice shape 234.

[0044] After a determination has been made that the water has frozen to form ice shape 234, controller 134 may activate motor 216 to begin rotation of mold body 204. As mold body 204 rotates about axis of rotation A-A, head 250 of ejector 238 is forced to press against external surface 214 of lower mold half 208. As mold body 204 rotates, ejector 238 may move through guide 246 along a direction perpendicular to axis of rotation A-A. Rotation forces ejector 238 to so move because cam follower 242 is riding on arcuate path 220. Referring to FIG. 10, a center C of a radius R defining arcuate path 220 is offset by a distance D from the axis of rotation A-A. As such, rotation shortens the distance between guide 246 and the arcuate path 220 of cam 218 - forcing ejector 238 to move therethrough.

[0045] While rotation of mold body 204 continues, ejector 238 moves out of a recess 252 formed in lower mold shell 209 and begins to deform flexible mold portions 206 and 208 as depicted in FIGS. 8 and 9. Continued rotation increases the movement of ejector 238 and the deformation of mold portions 206 and 208. Lower mold portion 208 may invert as it is pressed towards openings 205 and 212. Moreover, aperture 280 between first upper mold piece 2061 and second upper mold piece 2062 may begin to form as joint 264 is split apart by the movement of ejector 238 (or first and second ejectors 2381 and 2382). Ice shape 234 may be rotated but, more importantly, is forced to move in the same direction as ejector 238 by the pressing of head 250. This pressing action may force ice shape 234 through the formed aperture 280. The diameter or size of aperture 280 may increase due to the flexibility of upper mold portion 206 and joint 264 (e.g., including planar portions 266) in upper mold portion 206. In some embodiments, additional pleats may be added to upper mold portion 206 to provide further deflection ability. As mold body 204 reaches the second position shown in FIG. 9, ejector 238 reaches the extended position so as to force ice shape 234 to be fully ejected from mold body 204 via aperture 280 as shown by arrow E.

[0046] Upon reaching the second position, second limit switch 228 may be activated as shown in FIG. 12, which provides a signal to controller 134 to stop motor 216. Either immediately or after a delay, controller 134 may cause motor 216 to reverse direction so that mold body 204 is returned to the first position and ejector 238 is fully retracted. Upon reaching the first position, first limit switch 226 may be activated as shown in FIG. 11, which provides a signal to controller 134 to stop motor 216. Either immediately, or after a delay, controller 134 may repeat the process of refilling chamber 210 with water 236 using dispenser 232 so as to create another ice shape 234.

[0047] For the exemplary embodiment described above, mold body 204 and ejector 238 rotate 90 degrees between the first position and the second position. In other embodiments, a different degree of rotation may be used. Additionally or alternatively, gravity and/or the resiliency of lower mold portion 208 may be used to return ejector 238 to the retracted position. A spring that is compressed as ejector 238 is extended may also be used to urge ejector 238 back to its retracted position.

[0048] According to the disclosure, an ice making assembly for a refrigerator includes a multi-cavity or chamber ice mold capable of forming a plurality of ice shapes simultaneously. The mold may be formed from a flexible material, such as a silicon. A top portion of the mold may be restrained at either lateral end, forming a joint therebetween. In some embodiments, the top portion of the mold is formed from two separate pieces. The top portion may be at least partially restrained by a mold frame. The mold frame and mold together may be rotated, e.g., by a motor, after ice has formed within the multiple cavities. During rotation, one or more ejectors may press a bottom portion of the mold. Consequently, the formed ice shapes may press against the top portion of the mold, separating the joint between the restrained ends. Since an aperture is formed therebetween, a relatively large opening may be formed in the top portion of the mold. The ice shaped may then be easily ejected from the mold into an ice storage bin.

[0049] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they include structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

Claims

1. An ice making assembly for a refrigerated appliance, the ice making assembly defining a vertical direction, a lateral direction, and a transverse direction, the ice making assembly including:

a mold body including an upper portion and a lower portion, the mold body defining a plurality of cavities for the formation of ice shapes, wherein the upper portion defines a plurality of apertures into which water is supplied;
a mold frame at least partially surrounding the mold body, wherein the mold body is coupled together via the mold frame;
an ejector positioned adjacent to the mold body, the ejector being rotatable together with the mold body and the mold frame between a first position and a second position, wherein the ejector deflects the lower portion toward the upper portion, and wherein the upper portion is separated between the plurality of apertures to define a single aperture when in the second position; and
a motor for rotating the mold body, the mold frame, and the ejector between the first position and the second position.

2. The ice making assembly of claim 1, wherein the mold body includes a flexible material.

3. The ice making assembly of claim 1, wherein the upper portion includes a first upper mold piece and a second upper mold piece coupled to the first upper mold piece.

4. The ice making assembly of claim 3, wherein the first upper mold piece and the second upper mold piece are coupled to each other at a first end of the mold body and a second end of the mold body, respectively.

5. The ice making assembly of claim 1, wherein the mold frame includes:

a first support brace provided at a first end of the mold frame, the first support brace defining a first groove; and
a second support brace provided at a second end of the mold frame, the second support brace defining a second groove.

6. The ice making assembly of claim 5, wherein the upper portion includes:

a first tab selectively received within the first groove; and
a second tab selectively received within the second groove.

7. The ice making assembly of claim 6, further including:

a first fastener penetrating through the first support brace and the first tab; and
a second fastener penetrating through the second support brace and the second tab.

8. The ice making assembly of claim 1, wherein the plurality of cavities of the mold body defines a first ice shape volume and a second ice shape volume, the first and second ice shape volumes connected by a central channel.

9. The ice making assembly of claim 8, wherein liquid water is supplied to the first ice shape volume of the mold body and flows into the second ice shape volume of the mold body via the central channel.

10. The ice making assembly of claim 8, wherein the ejector includes:

a first plunger contacting an exterior surface of the lower portion adjacent to the first ice shape volume;
a second plunger contacting the exterior surface of the lower portion adjacent to the second ice shape volume; and
an axle bar connecting the first plunger to the second plunger.

11. The ice making assembly of claim 10, further including:
a cam in mechanical communication with the ejector, the cam defining an arcuate path along which a first end of the ejector moves when rotating between the first position and the second position.

12. The ice making assembly of claim 1, further including:

a first limit switch for stopping rotation of the mold frame and the ejector when the mold frame is moved into the first position; and
a second limit switch for stopping rotation of the mold frame and the ejector when the mold frame is moved into the second position.

13. The ice making assembly of claim 1, further including:
a plurality of heat exchanging fins in thermal communication with the lower portion, the plurality of heat exchanging fins being attached to the mold frame.

14. A refrigerator appliance defining a vertical direction, a lateral direction, and a transverse direction, the refrigerator appliance including:

a cabinet including a freezer chamber; and
an ice making assembly provided within the freezing chamber, the ice making assembly including:

a mold body including an upper portion and a lower portion, the mold body defining a plurality of cavities for the formation of ice shapes, wherein the upper portion defines a plurality of apertures into which water is supplied;
a mold frame at least partially surrounding the mold body, wherein the mold body is coupled together via the mold frame;
an ejector positioned adjacent to the mold body, the ejector being rotatable together with the mold body and the mold frame between a first position and a second position, wherein the ejector deflects the lower portion toward the upper portion, and wherein the upper portion is separated between the plurality of apertures to define a single aperture when in the second position; and
a motor for rotating the mold body, the mold frame, and the ejector between the first position and the second position.

15. The refrigerator appliance of claim 14, wherein the mold body includes a flexible material.

16. The refrigerator appliance of claim 14, wherein the upper portion includes a first upper mold piece and a second upper mold piece coupled to the first upper mold piece.

17. The refrigerator appliance of claim 16, wherein the first upper mold piece and the second upper mold piece are coupled to each other at a first end of the mold body and a second end of the mold body, respectively.

18. The refrigerator appliance of claim 14, wherein the mold frame includes:

a first support brace provided at a first end of the mold frame, the first support brace defining a first groove; and
a second support brace provided at a second end of the mold frame, the second support brace defining a second groove.

19. The refrigerator appliance of claim 18, wherein the upper portion includes:

a first tab selectively received within the first groove; and
a second tab selectively received within the second groove.

20. The refrigerator appliance 14 of claim wherein the plurality of cavities of the mold body defines a first ice shape volume and a second ice shape volume, the first and second ice shape volumes connected by a central channel.

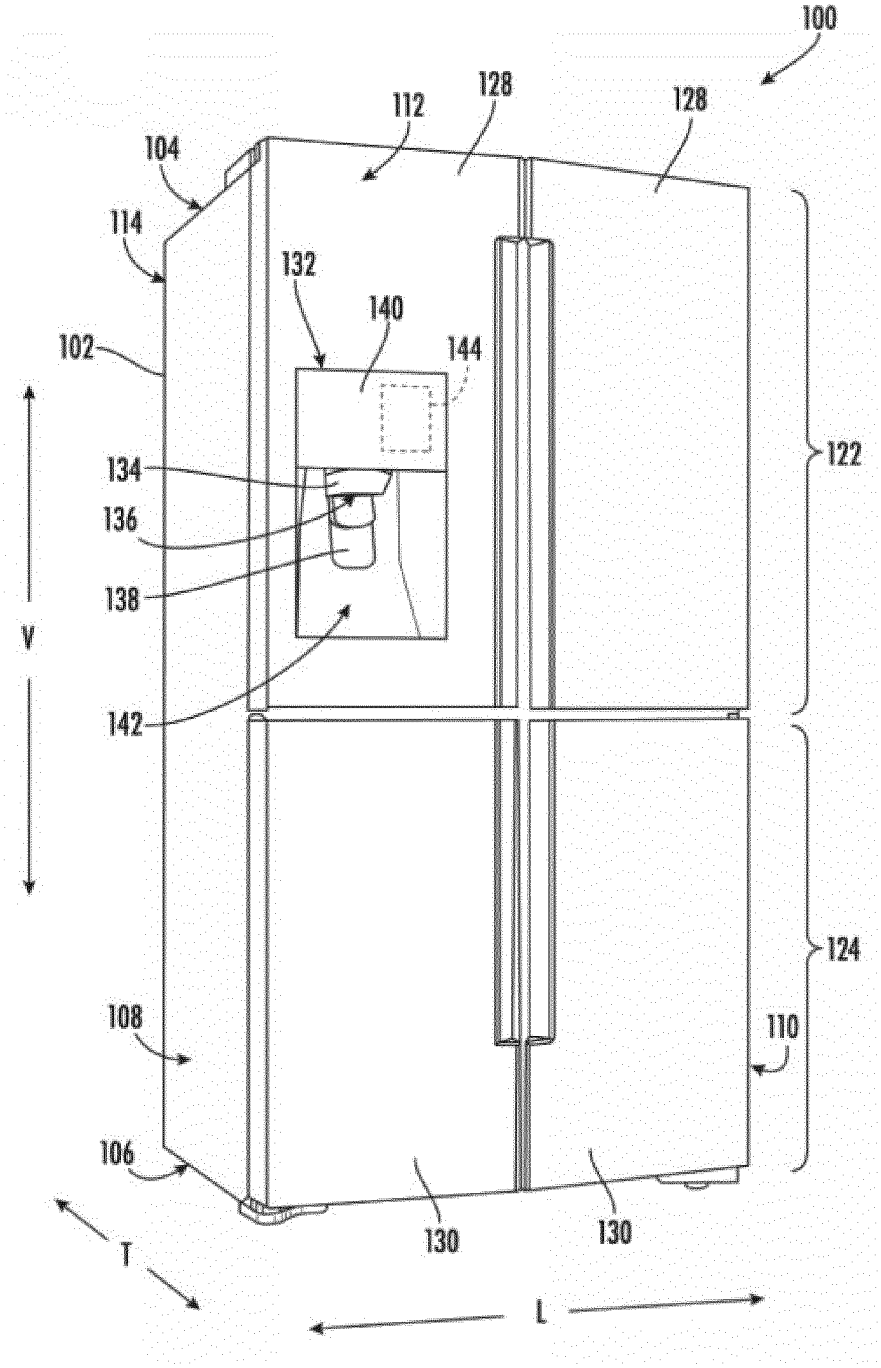
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Fig. 1

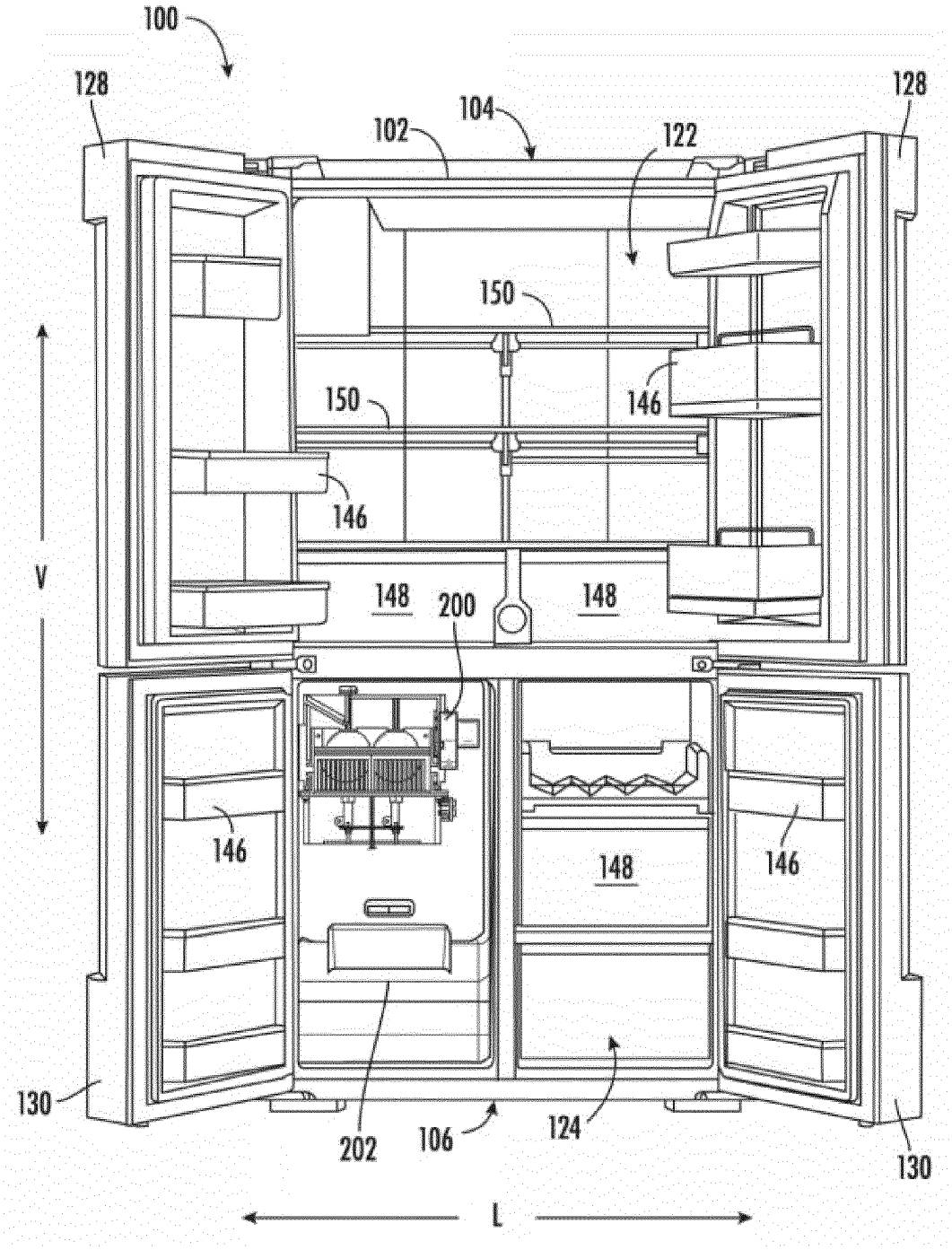
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Fig. 2

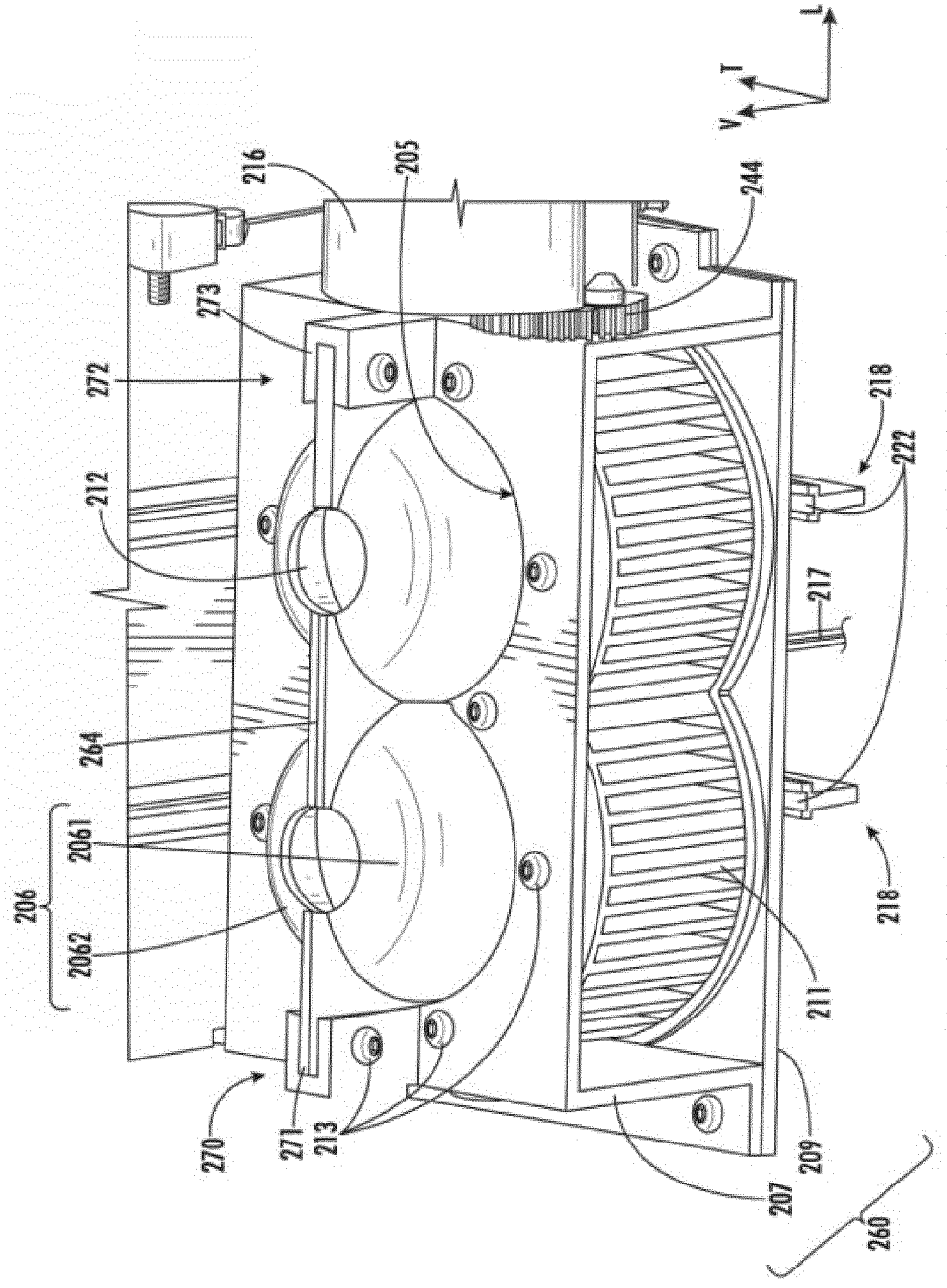
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Fig. 3

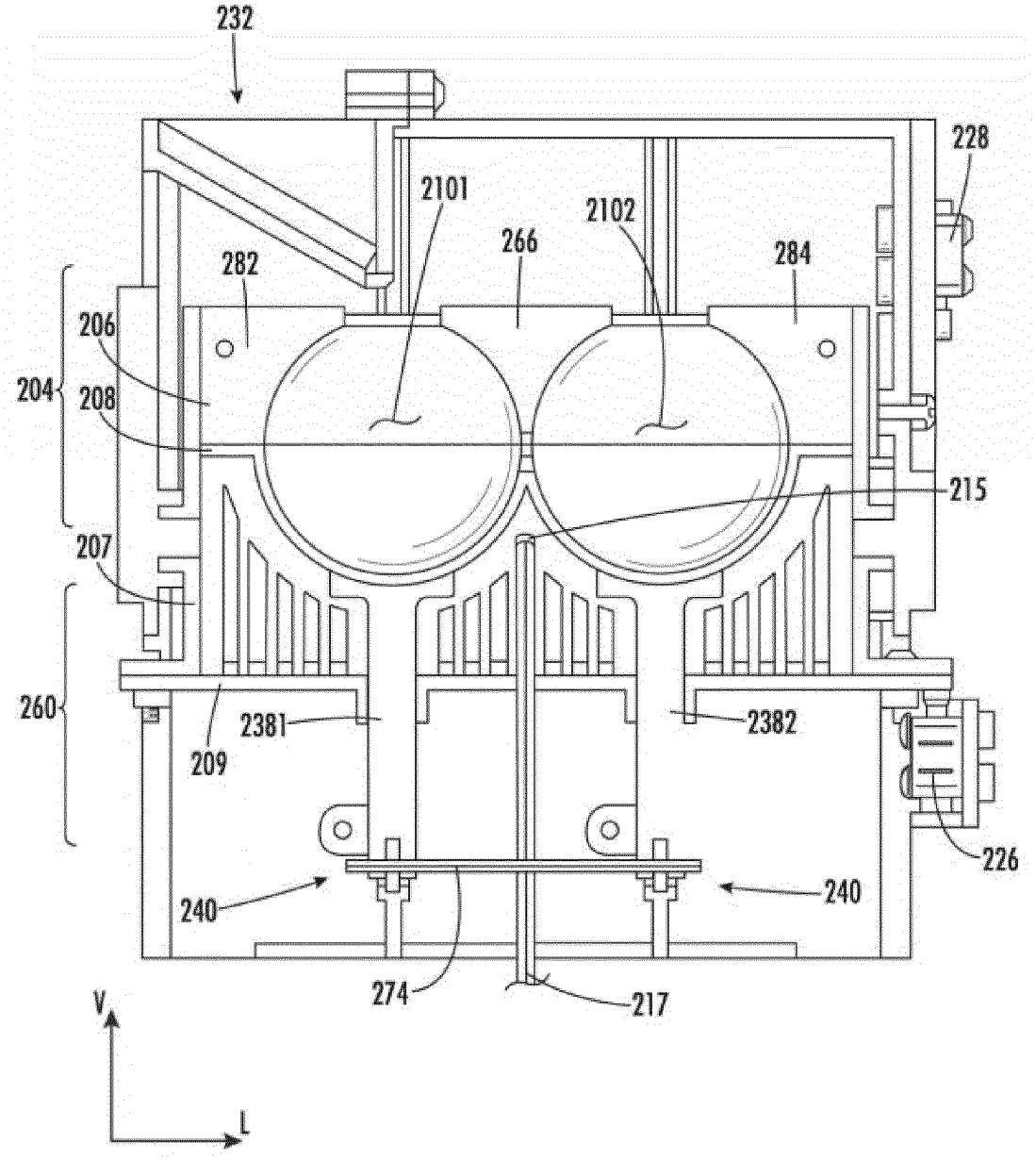
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Fig. 4

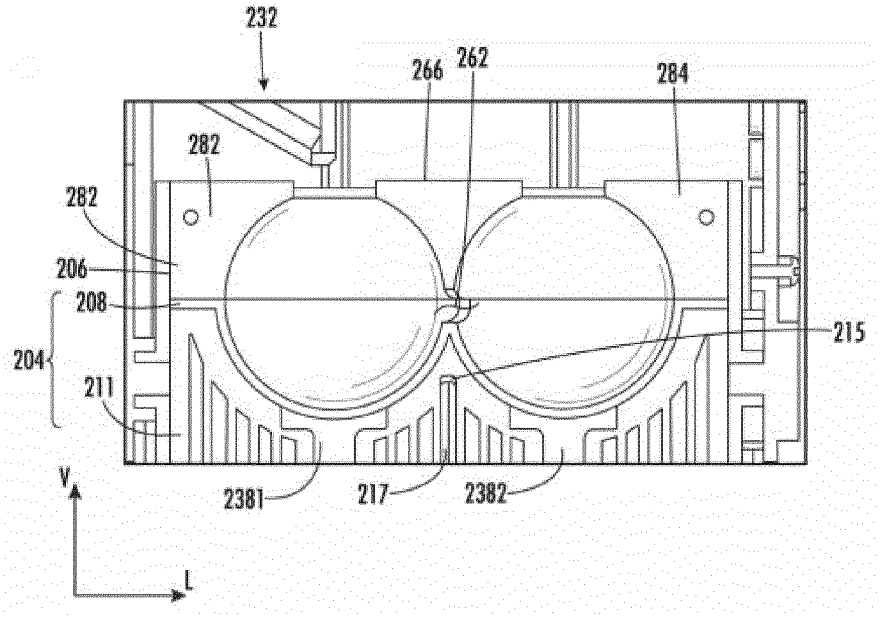
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Fig. 5

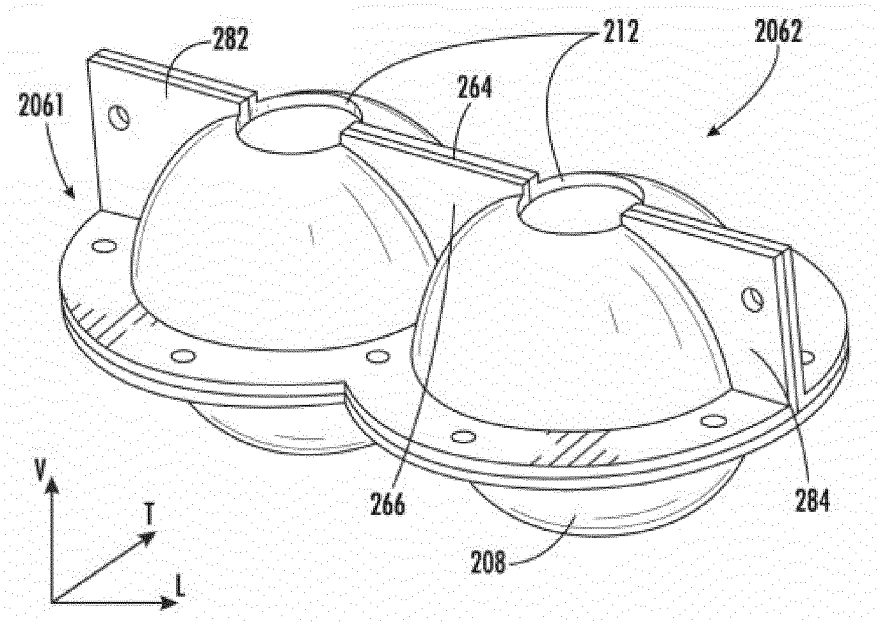
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Fig. 6

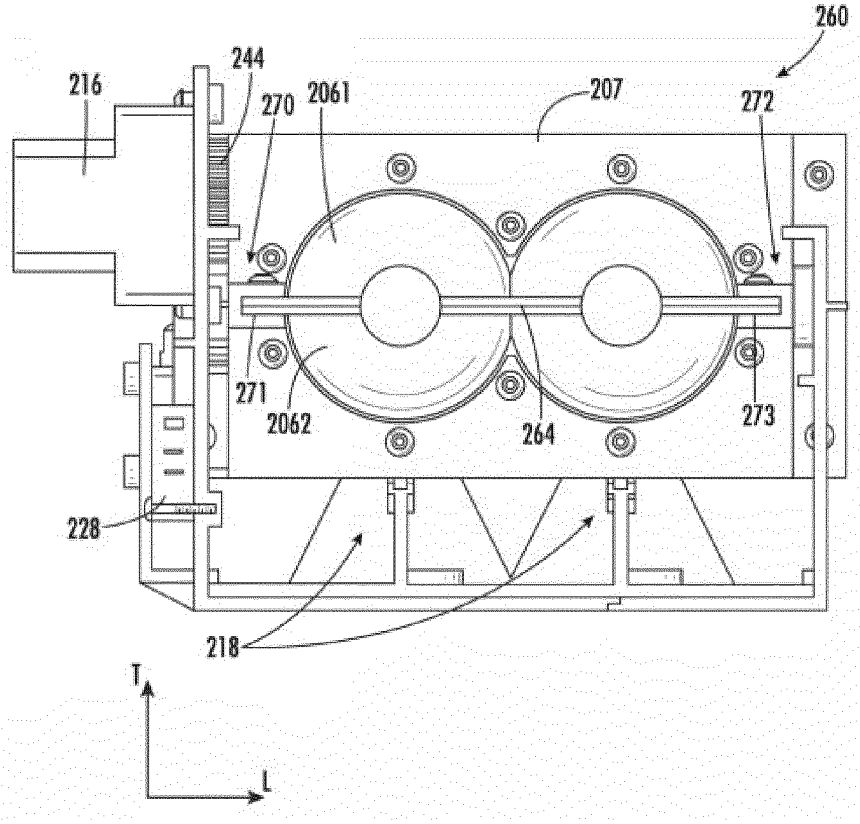

Fig. 7

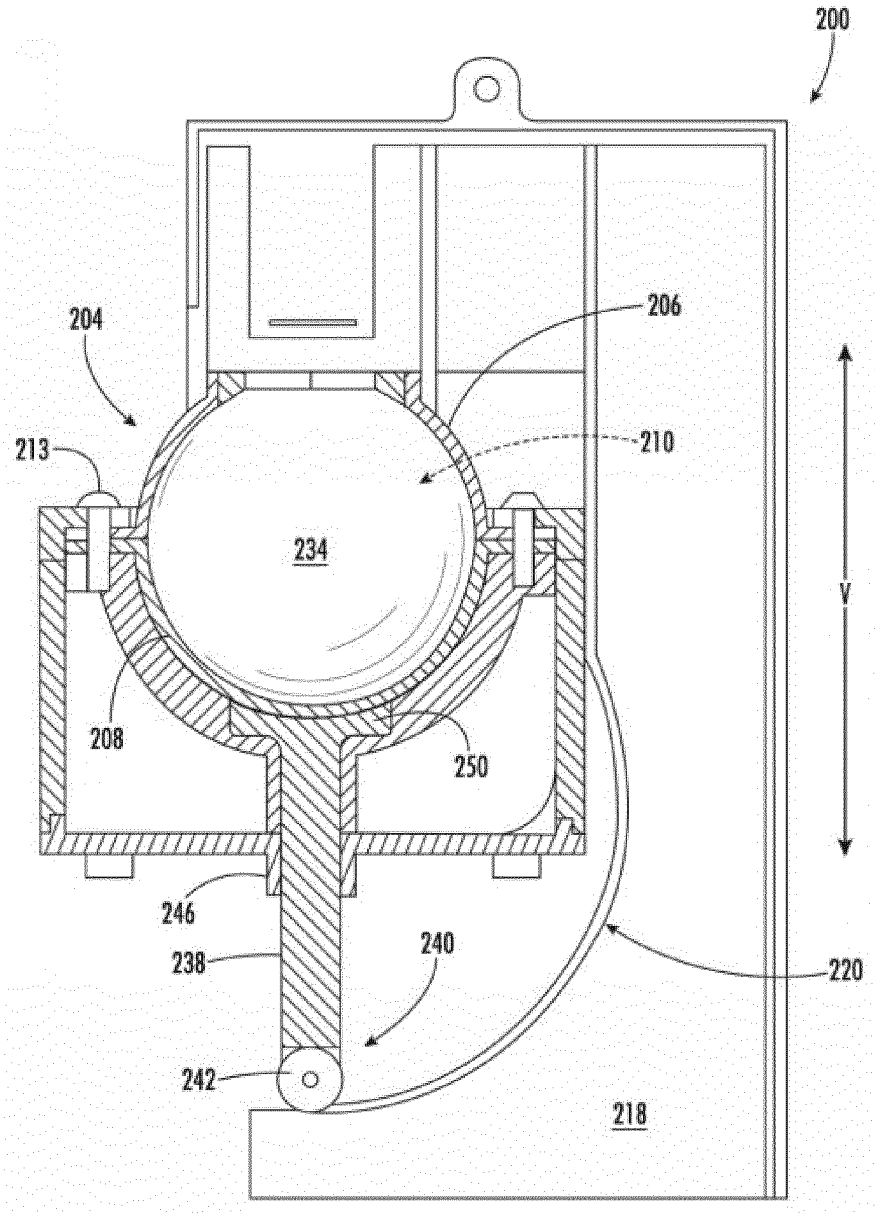

Fig. 8

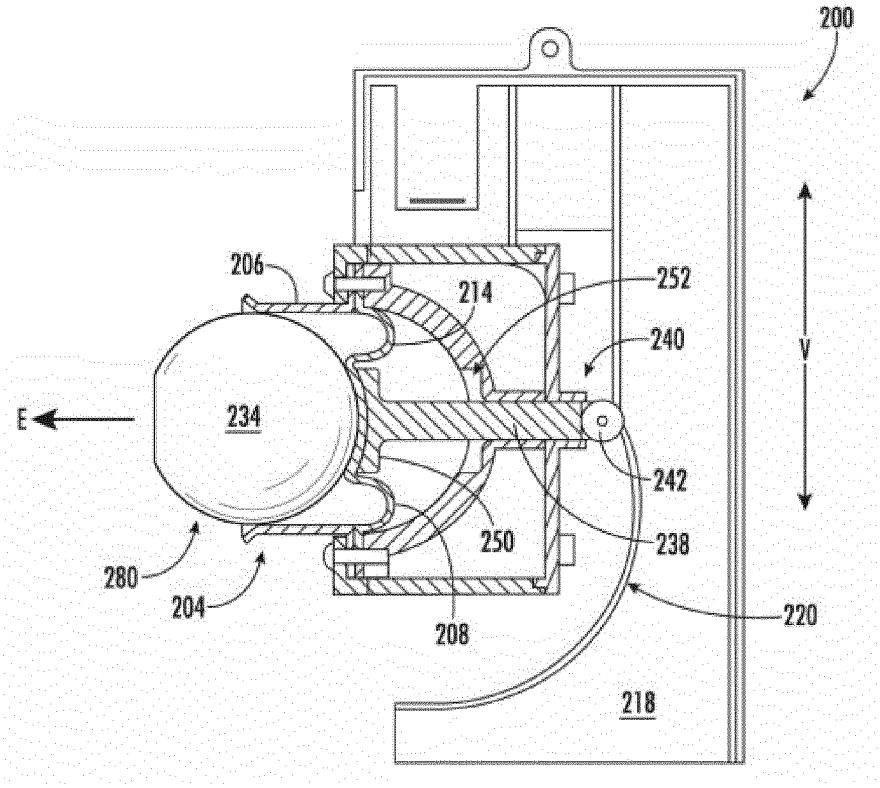
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Fig. 9

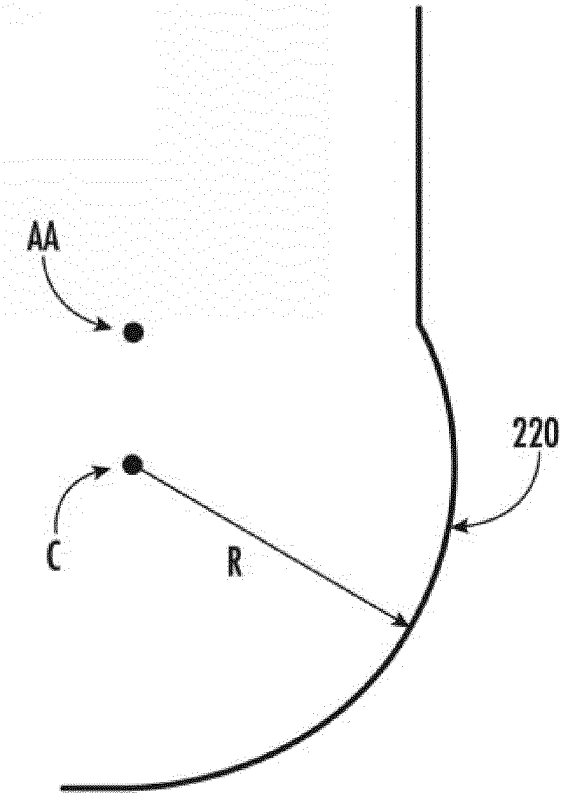
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Fig. 10

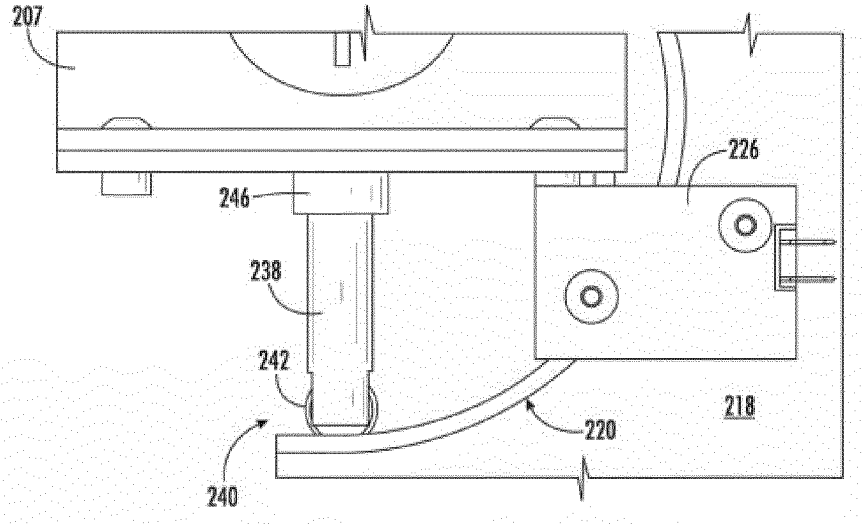

Fig. 11

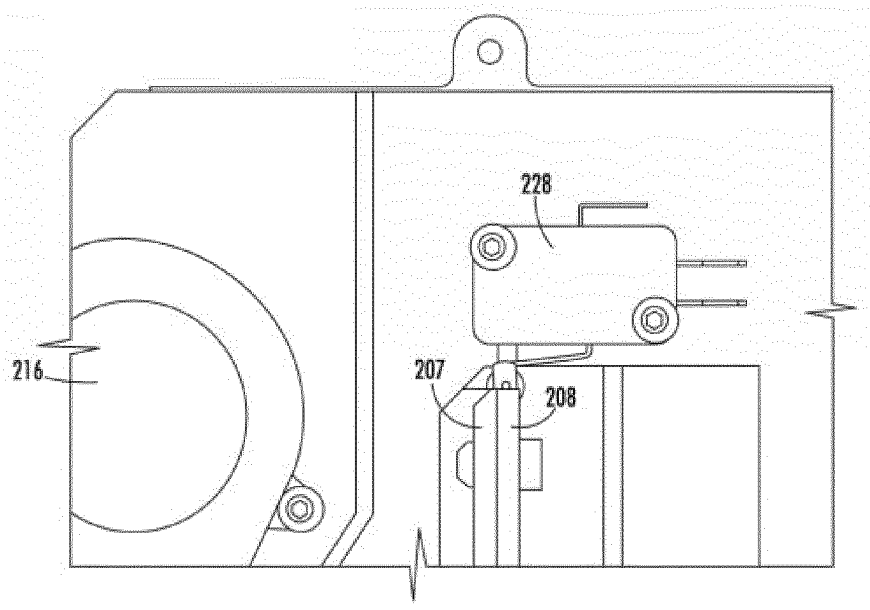

Fig. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/070496

A. CLASSIFICATION OF SUBJECT MATTER

F25C5/06(2006.01)i;F25C1/10(2006.01)i;F25D11/02(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F25C1, F25C5, F25D11

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNKI, CNTXT, CNABS, ENTXTC, ENTXT, WPABSC, WPABS, DWPI, VEN: 制冰, 球形, 旋转, 弹性, 柔性, 变形, 挤压, 排冰, 脱模, ice maker, ice machine, spherical, rotat+, rotary, elastic, flexible, deform, squeez+, demould+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	US 2022316782 A1 (HAIER US APPLIANCE SOLUTIONS, INC.) 06 October 2022 (2022-10-06) description, paragraphs 21-43, and figures 1-15	1-4, 8-17, 20
A	WO 2020071824 A1 (LG ELECTRONICS INC.) 09 April 2020 (2020-04-09) description, paragraphs 271-838, and figures 1-65	1-20
A	CN 113237284 A (HISENSE RONSHEN (GUANGDONG) REFRIGERATOR CO., LTD.) 10 August 2021 (2021-08-10) entire document	1-20
A	US 2006086134 A1 (VOGLEWEDE RONALD L et al.) 27 April 2006 (2006-04-27) entire document	1-20
A	EP 3653957 A1 (LG ELECTRONICS INC.) 20 May 2020 (2020-05-20) entire document	1-20
A	JP 2005326035 A (JAPAN SERVO CO., LTD.) 24 November 2005 (2005-11-24) entire document	1-20

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 April 2023	**16 May 2023**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/070496

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2020015707 A1 (QINGDAO HAIER REFRIGERATOR CO., LTD. et al.) 23 January 2020 (2020-01-23) entire document	1-20

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2023/070496

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
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				US	11543167	B2	03 January 2023
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				EP	3861262	A1	11 August 2021
				EP	3861262	A4	27 July 2022
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				US	10788252	B2	29 September 2020

Form PCT/ISA/210 (patent family annex) (July 2022)