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(54) **PULSE ELECTROTHERMAL MOLD  
RELEASE ICEMAKER FOR REFRIGERATOR  
HAVING INTERLOCK CLOSURE AND  
BAFFLE FOR SAFETY**

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application No. 10/939,289, filed on Sep. 9, 2004, now Pat. No. 7,034,257, which is a division of application No. 10/364,438, filed on Feb. 11, 2003, now Pat. No. 6,870,139, said application No. PCT/US2007/069478 is a continuation-in-part of application No. PCT/US2006/002283, filed on Jan. 24, 2006, which is a continuation-in-part of application No. 11/571,231, filed on Apr. 23, 2009, filed as application No. PCT/US05/22035 on Jun. 22, 2005.

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(52) **U.S. Cl.** ..... **62/351; 62/449**  
(57) **ABSTRACT**

The present document relates to an icemaker having a pulse electrothermal ice release system for separating ice bodies from an ice mold. The pulse electrothermal ice release system operates by applying an electric current through the ice mold through two wires. Safety apparatus for preventing electric shock to users of the icemaker is described. A refrigerator having the icemaker, and an operating method of the icemaker are disclosed. In an embodiment, the safety apparatus interrupts current flow through both wires.

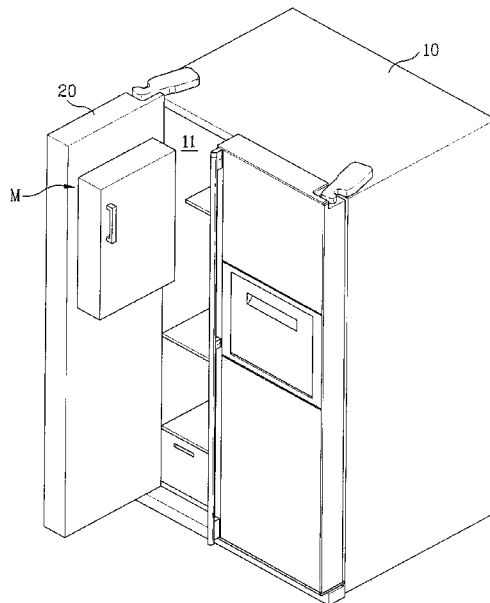


FIG. 1

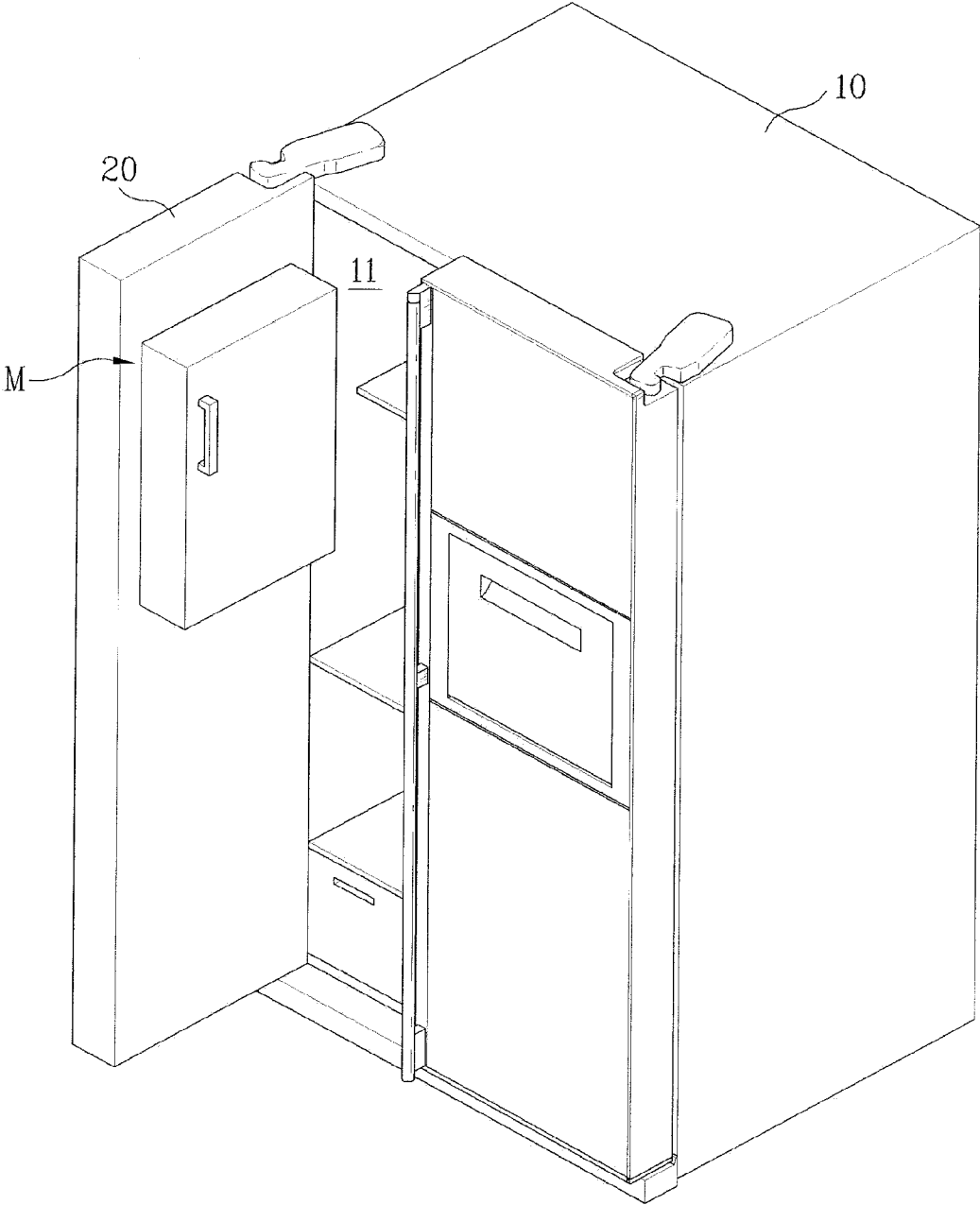


FIG. 2

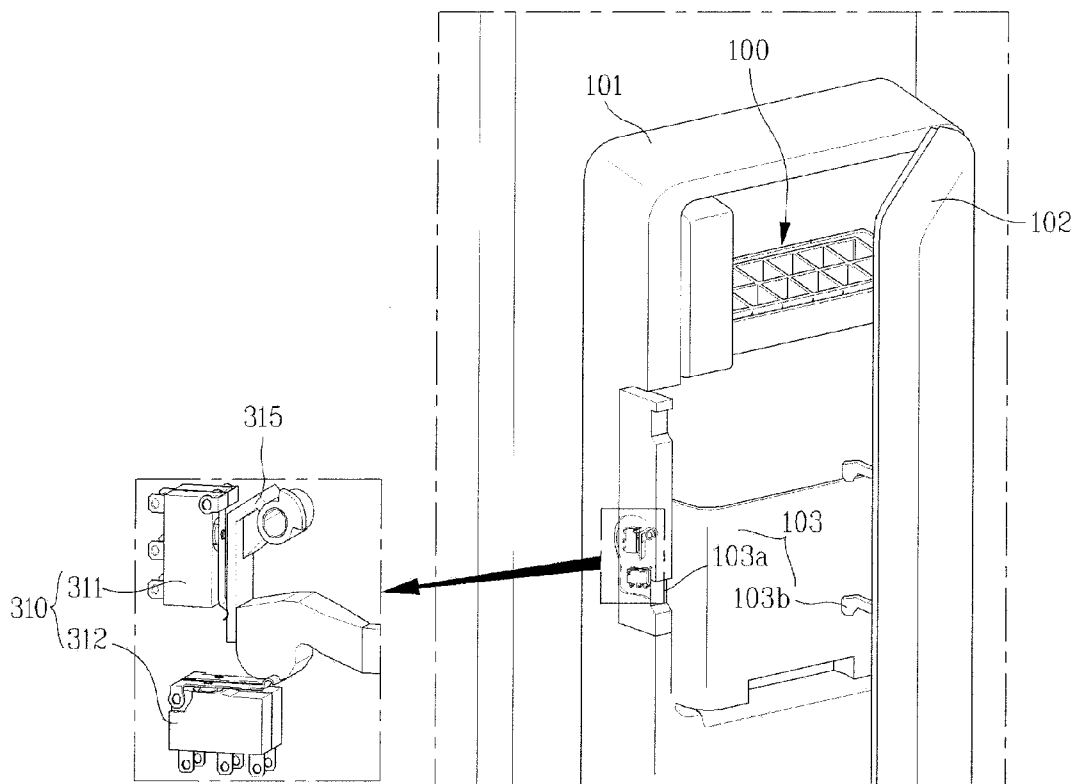


FIG. 3

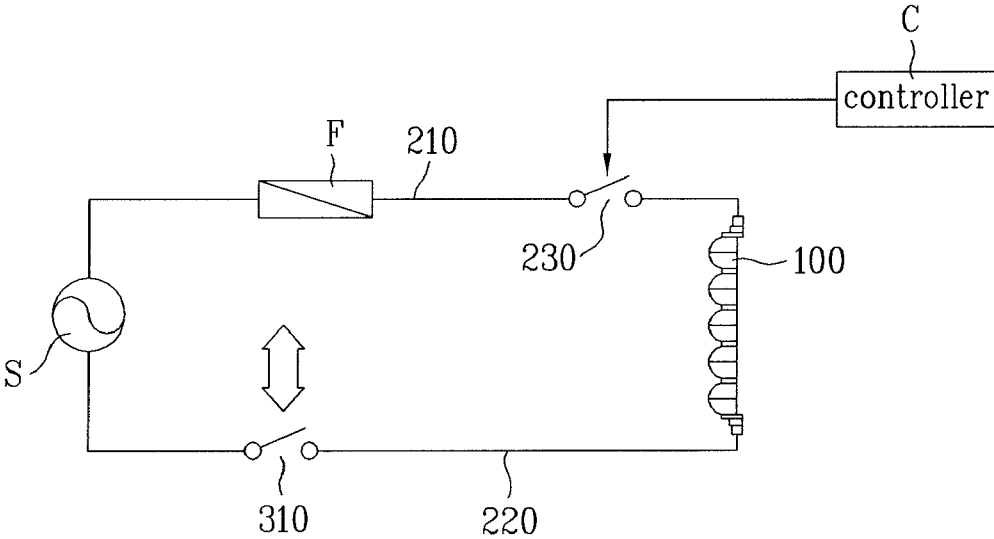


FIG. 4

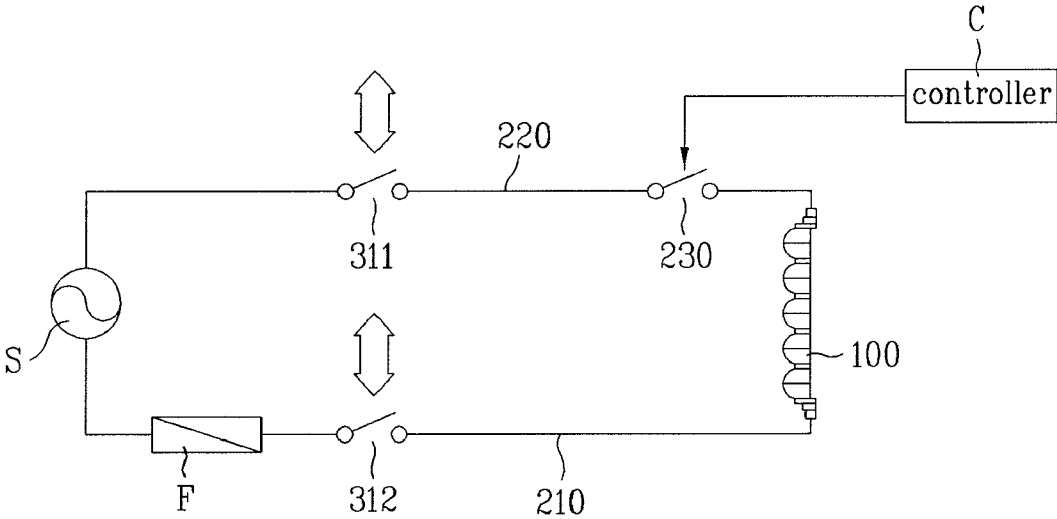


FIG. 5

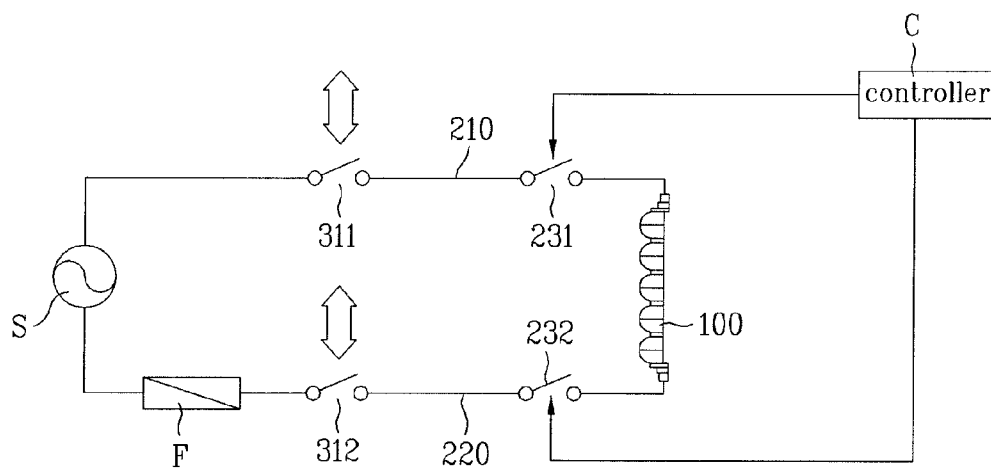


FIG. 6

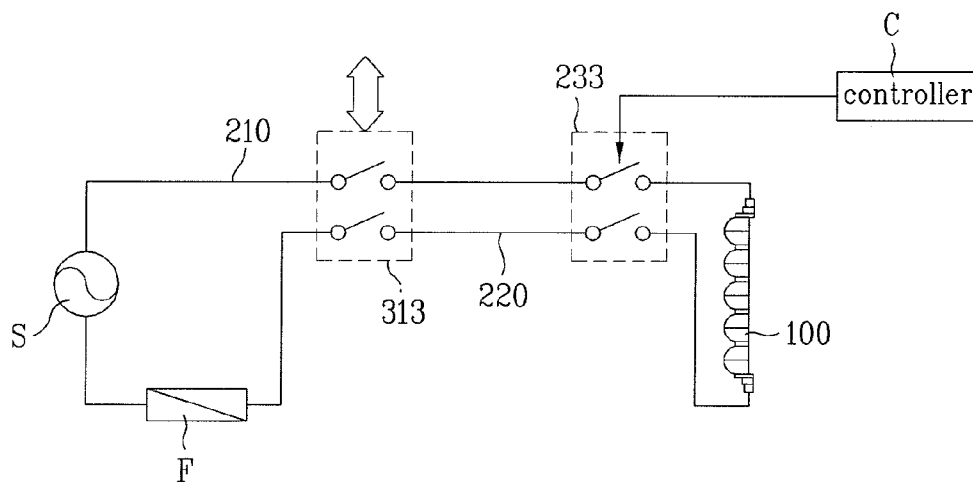


FIG. 7

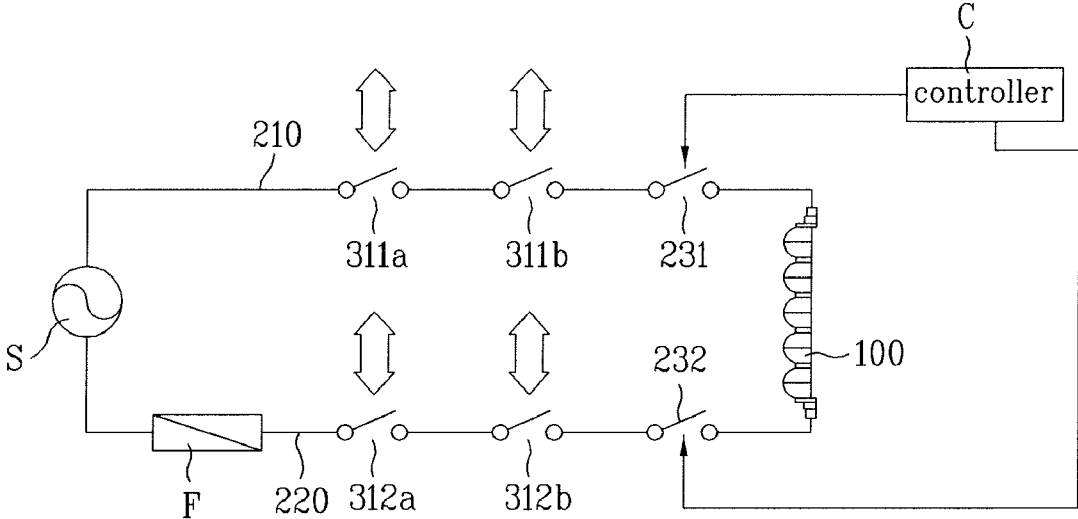


FIG. 8

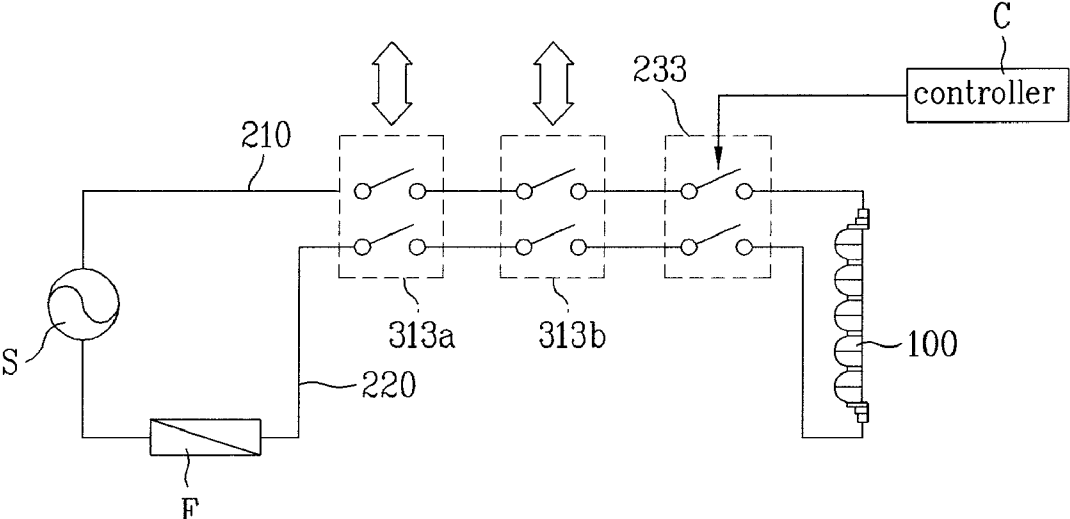


FIG. 9

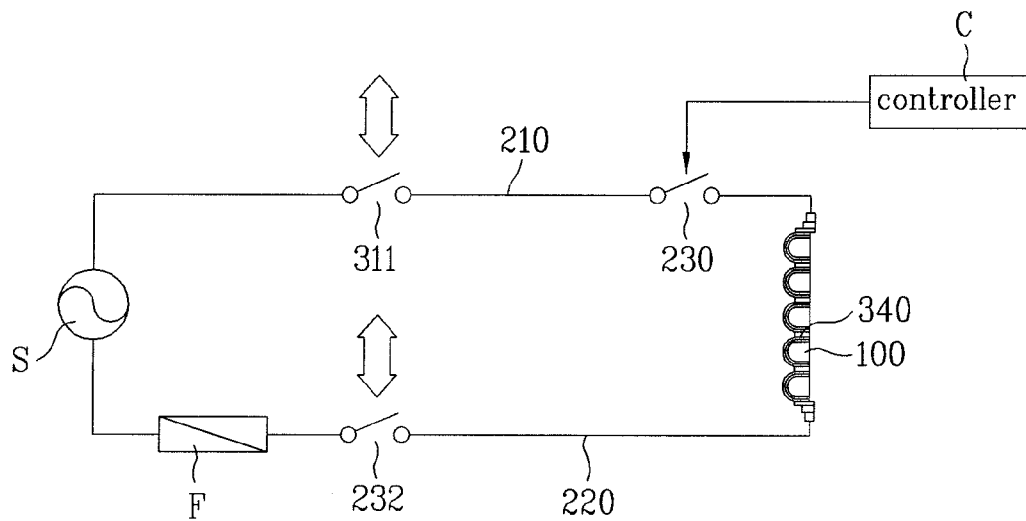


FIG. 10

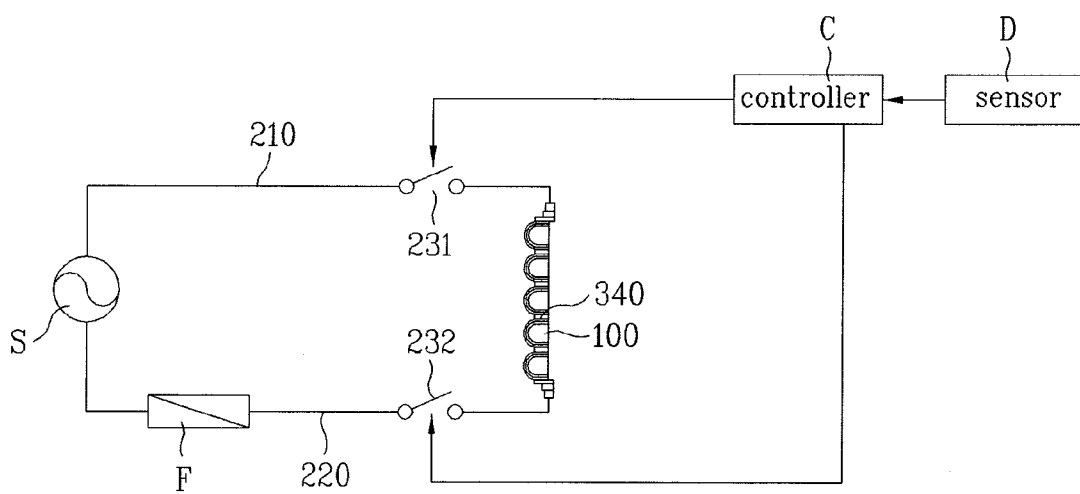


FIG. 11

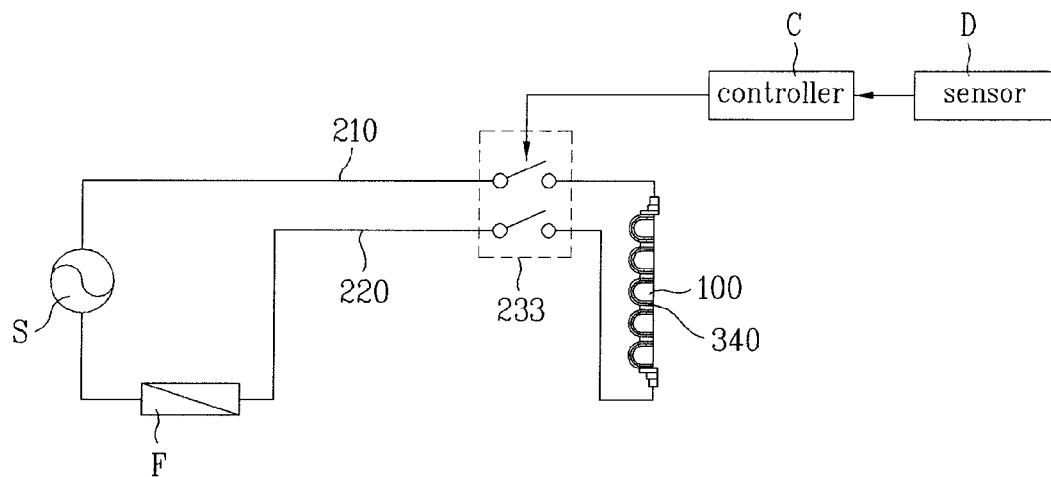


FIG. 12

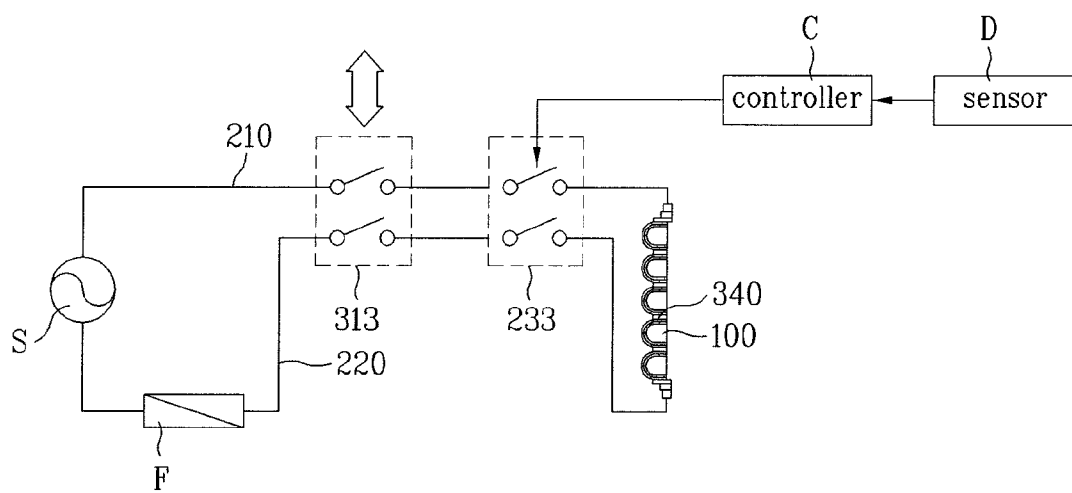




FIG. 13

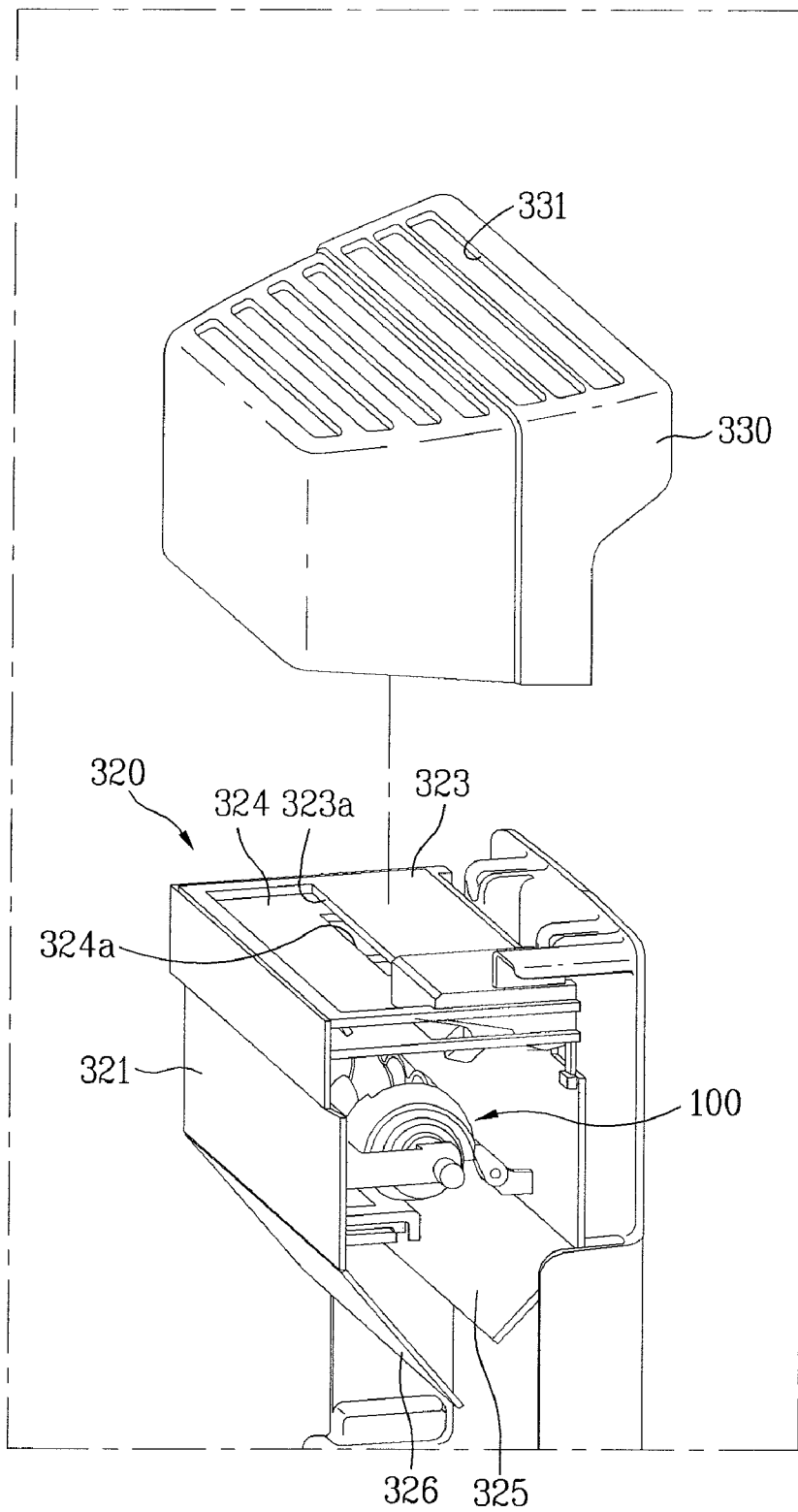


FIG. 14

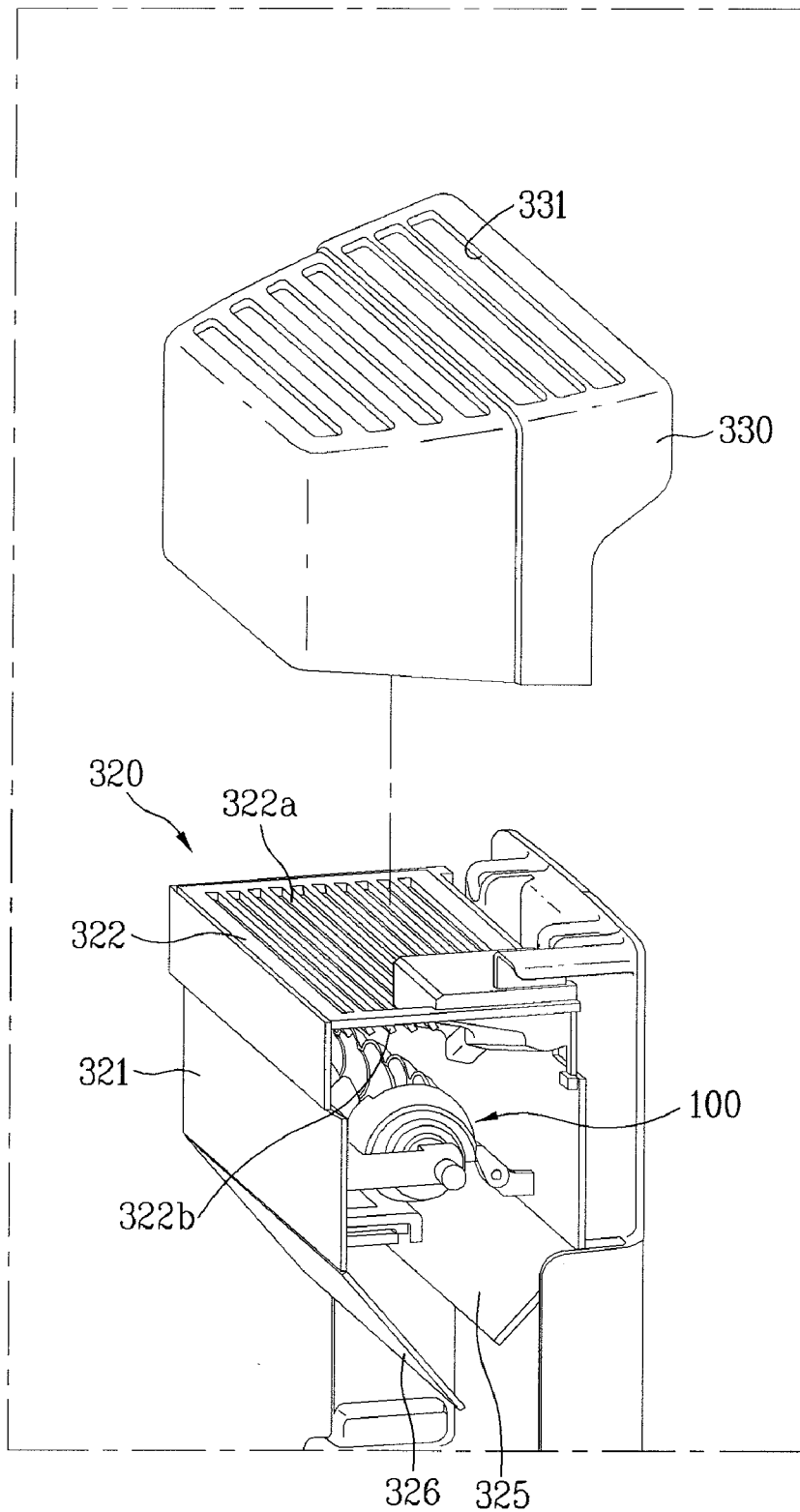


FIG. 15

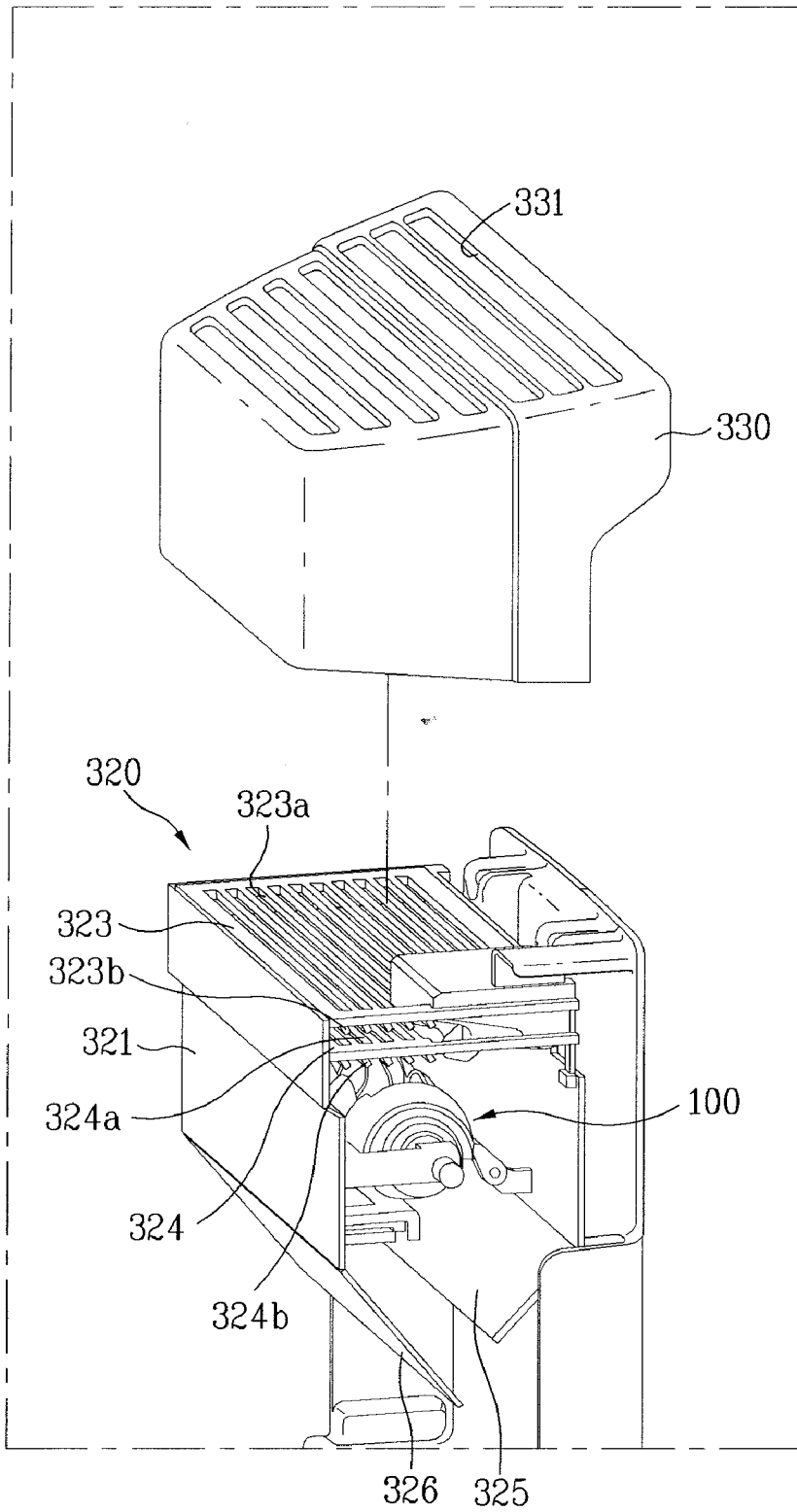


FIG. 16

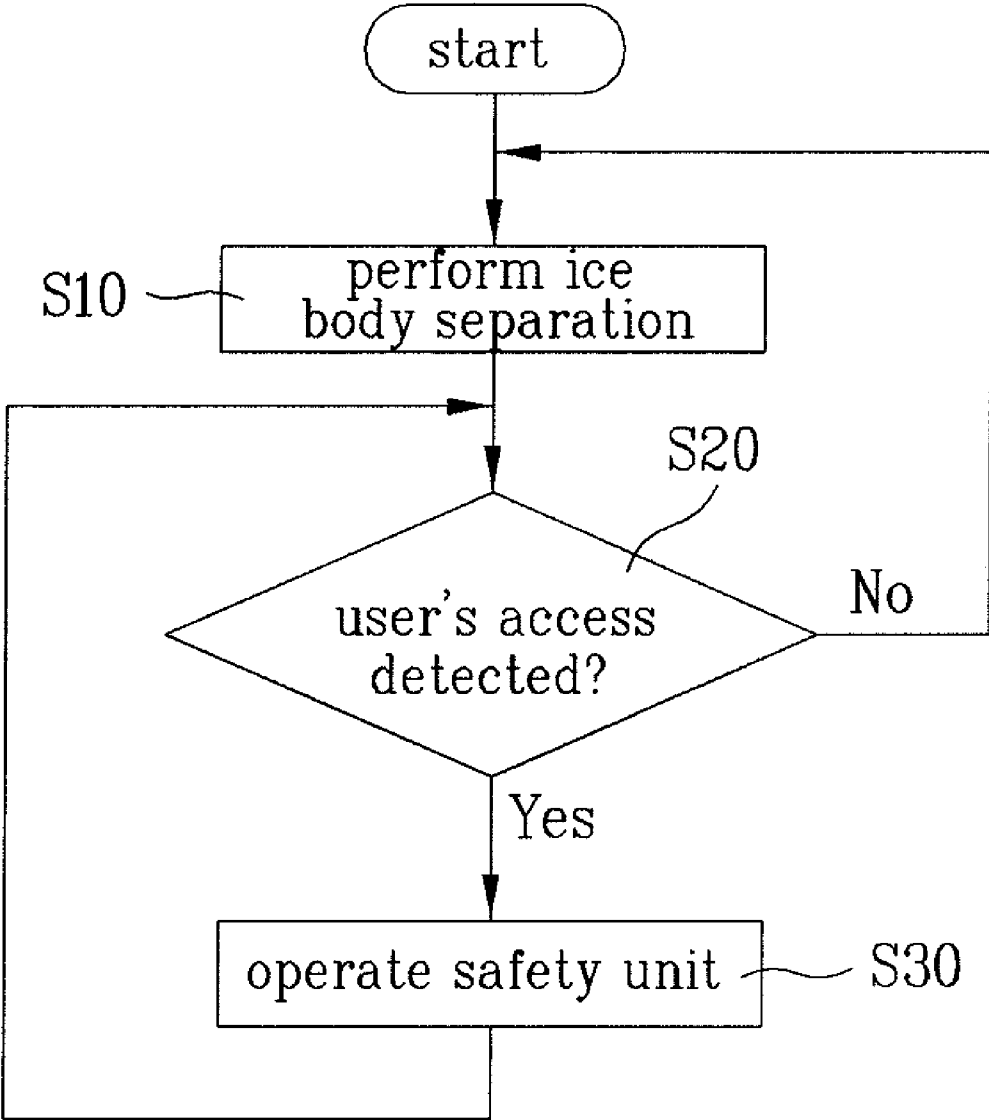
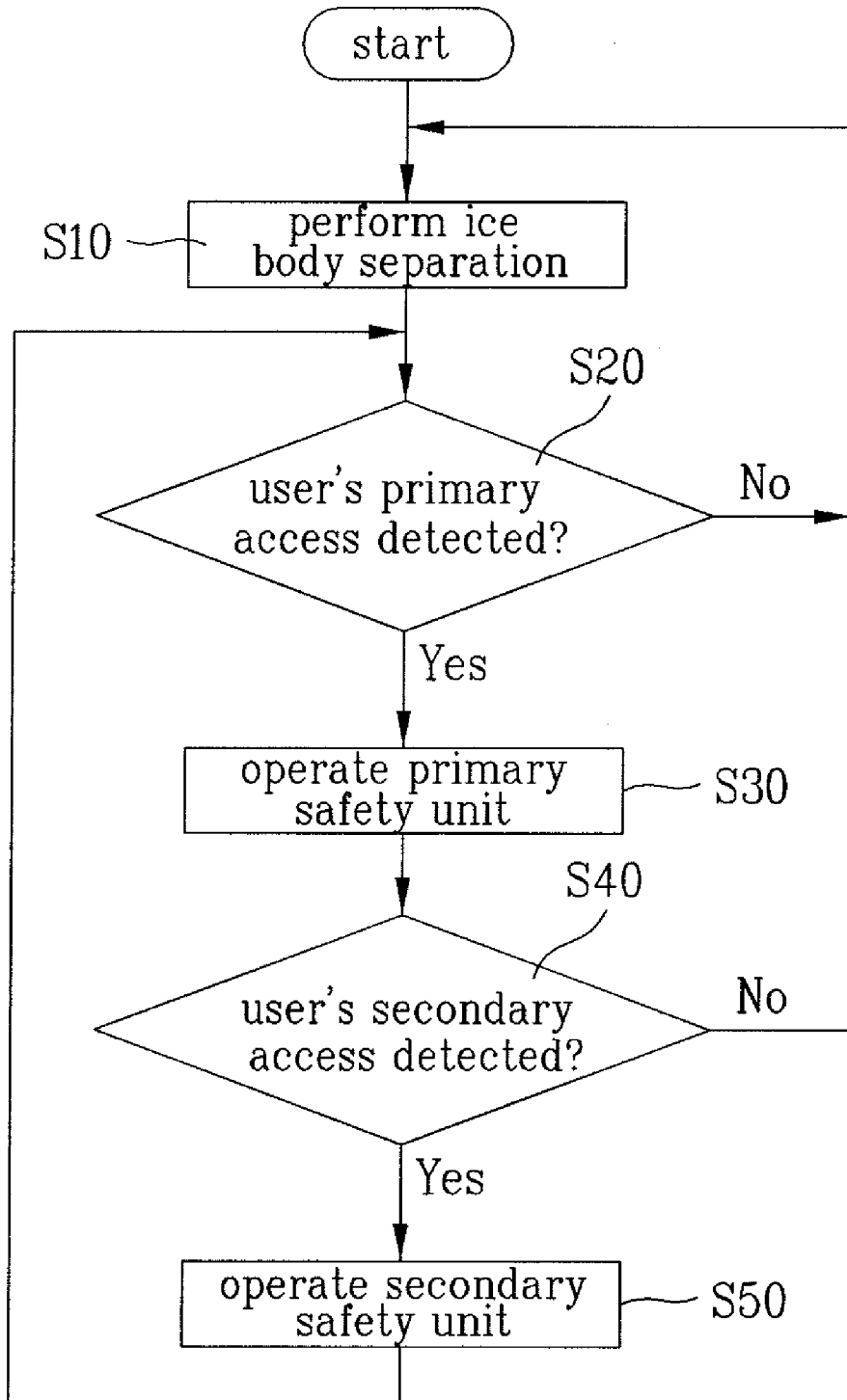


FIG. 17



**PULSE ELECTROTHERMAL MOLD  
RELEASE ICEMAKER FOR REFRIGERATOR  
HAVING INTERLOCK CLOSURE AND  
BAFFLE FOR SAFETY**

**CLAIM TO PRIORITY**

**[0001]** This application is a continuation-in-part of commonly-owned and copending U.S. patent application Ser. No. 11/338,239 filed 24 Jan. 2006, which claims the benefit of priority to U.S. Provisional Patent Applications Nos. 60/646,394, filed 24 Jan. 2005, 60/646,932, filed 25 Jan. 2005, and 60/739,506, filed 23 Nov. 2005. U.S. patent application Ser. No. 11/338,239 is also a continuation-in-part of commonly-owned PCT Application No. PCT/US2005/22035 filed 22 Jun. 2005, which claims the benefit of priority to U.S. Provisional Patent Applications Nos. 60/581,912, filed 22 Jun. 2004, 60/646,394, filed 24 Jan. 2005, and 60/646,932, filed 25 Jan. 2005. U.S. patent application Ser. No. 11/338,239 is also a continuation-in-part of commonly-owned and copending U.S. patent application Ser. No. 10/939,289 filed 10 Sep. 2004, now U.S. Pat. No. 7,034,257, which is a divisional application that claims the benefit of priority to U.S. patent application Ser. No. 10/364,438, filed 11 Feb. 2003, now U.S. Pat. No. 6,870,139, which claims the benefit of priority to U.S. Provisional Patent Applications Nos. 60/356,476, filed 11 Feb. 2002, 60/398,004, filed 23 Jul. 2002, and 60/404,872, filed 21 Aug. 2002.

**[0002]** This application is also a continuation in part of PCT Application No. PCT/US2007/069478, filed May 22, 2007, which claims benefit of priority to commonly-owned U.S. Provisional Patent Application No. 60/802,407, filed 22 May 2006. PCT Application No. PCT/US2007/069478 is also a continuation-in-part of commonly-owned PCT/US2006/002283, filed 24 Jan. 2006, which claims the benefit of priority to U.S. Provisional Patent Applications Nos. 60/646,394, filed 24 Jan. 2005, 60/646,932, filed 25 Jan. 2005, and 60/739,506, filed 23 Nov. 2005. PCT Application No. PCT/US2007/069478 is also a continuation-in-part of commonly-owned and copending U.S. patent application Ser. No. 11/571,231, filed 22 Dec. 2006, which claims the benefit of priority to PCT/US2005/022035, filed 22 Jun. 2005, which claims the benefit of priority to U.S. Provisional Patent Applications Nos. 60/581,912, filed 22 Jun. 2004, 60/646,394, filed 24 Jan. 2005, and 60/646,932, filed 25 Jan. 2005. PCT Application Serial No. PCT/US07/069,478 is also a continuation-in-part of commonly-owned and copending U.S. patent application Ser. No. 11/338,239, filed 24 Jan. 2006, which claims the benefit of priority to U.S. Provisional Patent Applications Nos. 60/646,394, filed 24 Jan. 2005, 60/646,932, filed 25 Jan. 2005, and 60/739,506, filed 23 Nov. 2005. U.S. patent application Ser. No. 11/338,239 is also a continuation-in-part of commonly-owned and copending U.S. patent application Ser. No. 10/939,289, now U.S. Pat. No. 7,034,257, filed 10 Sep. 2004, which is a divisional application that claims the benefit of priority to U.S. patent application Ser. No. 10/364,438, now U.S. Pat. No. 6,870,139, filed 11 Feb. 2003, which claims the benefit of priority to U.S. Provisional Patent Applications Nos. 60/356,

476, filed 11 Feb. 2002, 60/398,004, filed 23 Jul. 2002, and 60/404,872, filed 21 Aug. 2002.

**[0003]** All of the above-identified patent applications are incorporated herein by reference.

**FIELD OF THE INVENTION**

**[0004]** The present document relates to an icemaker having a pulse electrothermal ice release system for separating ice bodies from an ice mold. In particular, the present document describes safety apparatus for preventing electric shock to users.

**BACKGROUND**

**[0005]** Refrigerators, water purifiers, vending machines, and similar devices often have icemakers. Ice makers include apparatus for cooling water contained in a specific ice mold to a temperature below the freezing point to make ice bodies.

**[0006]** However, ice bodies made by the icemaker do not easily separate from the ice mold in which they are formed because the ice bodies stick to the bottom of the ice mold.

**[0007]** The separation of ice bodies from the ice mold may be carried out according to various methods. For example, the ice mold may be twisted to separate the ice bodies from the ice mold, a heating device, such as a sheath heater, embedded in the ice mold may apply heat to the ice bodies such that the surfaces of the ice bodies in contact with the ice mold are melted allowing the ice bodies to separate from the ice mold, or the ice bodies may be picked out of the ice mold by a mechanical device.

**[0008]** Conventional methods for separating ice bodies have problems in that some methods generate a large amount of water during ice body separation, the ice mold may be torn or damaged during ice body separation, or the shape of the ice bodies is extremely restricted.

**SUMMARY**

**[0009]** The present invention is related generally to an icemaker, and a refrigerator having an icemaker, where the icemaker makes use of pulse electrothermal separation of ice bodies from the ice mold. The icemaker has provisions that protect users from electric shock, thereby enhancing safety and reliability of products.

**[0010]** Additional advantages, objects, and features of the invention will be set forth in part in the description that follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

**[0011]** An ice maker according to an embodiment of the present invention has at least one ice mold for receiving water to be frozen. The ice mold is made of a material that generates heat when electric current flows through the material to perform an ice body separation. A control unit is provided for controlling the supply of electric current to the ice mold to perform the ice body separation, also provided is a safety unit for protecting a user from electric shock when the user tries to touch the ice mold.

**[0012]** In an embodiment, the ice mold is manufactured by injection molding an electrically conductive plastic material.

**[0013]** In an embodiment, the control unit includes a first line for connecting a power supply unit to one end of the ice mold and a second line for connecting the power supply unit to the other end of the ice mold, and a power interruption unit of the safety unit includes at least one switch mounted on the first line for allowing or stopping the flow of electric current and at least one counter switch mounted on the second line for allowing or stopping the flow of electric current together with the at least one switch.

**[0014]** In another embodiment, the control unit includes a first line for connecting a power supply unit to one end of the ice mold and a second line for connecting the power supply unit to the other end of the ice mold, and the power interruption unit includes at least one switching device connected to each of the first line and the second line for allowing or stopping the flow of electric current along the lines.

**[0015]** An ice maker according to another embodiment of the present invention includes a case having a predetermined inner chamber defined therein, a case door for opening and closing the chamber of the case, a locking unit for locking the case door to the case, an ice mold within the case a control unit for controlling electric current to the ice mold to perform ice body separation, and a safety unit for protecting users from electric shock when users try to access the ice mold. The ice mold is made of a material that generates heat when electric current flows through it to perform ice body separation.

**[0016]** The safety unit may include a power interruption unit coupled to the control unit for interrupting the supply of the electric current to the ice mold when a user opens the case door.

**[0017]** The locking unit can include a locking groove formed at one side of the case or one side of the case door, and a locking hook formed at one side of the case door or one side of the case, the locking hook engaged into the locking groove to lock the case door.

**[0018]** In an embodiment, the control unit includes a first line for connecting a power supply unit to one end of the ice mold and a second line for connecting the power supply unit to the other end of the ice mold. The power interruption unit includes at least one first switch in the first line for allowing or stopping the flow of electric current and at least one additional switch mounted in the second line for allowing or stopping the flow of electric current together with the first switch. The first switch and the additional switch have actuators in the locking groove operable by the locking hook to allow or stop the flow of electric current to the ice mold according to the open or closed state of the case door.

**[0019]** In another embodiment, the control unit includes a first line for connecting a power supply unit to one end of the ice mold and a second line for connecting the power supply unit to another end of the ice mold. The power interruption unit includes at least one switching device in the first line and another switching device in the second line for allowing or stopping the flow of electric current along the first line and the second line. The switching devices have actuators in the locking groove such that the locking hook operates the switching devices to allow or stop the flow of electric current to the ice mold according to the open or closed state of the case door.

**[0020]** The safety unit can include a button switch connected to the control unit for allowing or stopping the flow of electric current to the ice mold by operation of the case door releasing or pressing on the button switch.

**[0021]** Also, the safety unit can include a shield member surrounding the ice mold for preventing a user from accessing the ice mold while allowing cool air to be supplied to the ice mold for ice making.

**[0022]** The shield member can include a shield case for surrounding the ice mold, the shield member being provided at the bottom thereof with a discharge port through which cool air circulates and ice bodies, separated from the ice mold, are discharged. The shield member has a shield cover covering the top of the shield case for preventing the user from accessing the ice mold while allowing the cool air to be supplied to the ice mold.

**[0023]** Also, the shield cover includes a first shield cover for covering top of the shield case, the first shield cover being provided at one side thereof with an opening through which cool air circulates, and a second shield cover disposed below the first shield cover, such that the second shield cover is spaced a predetermined distance from the first shield cover, the second shield cover being provided at one side thereof with an opening which is formed at a position substantially not overlapping with the position where the opening of the first shield cover is formed such that cool air circulates through the opening of the second shield cover but the user is prevented from accessing the ice mold through the openings.

**[0024]** Also, the shield cover can include a plurality of circulation holes for communicating the inside and outside of the shield cover with each other such that cool air is supplied to the ice mold, the circulation holes having a small size enough to prevent fingers of the user from reaching the ice mold.

**[0025]** Also, the shield cover includes a first shield cover for covering the top of the shield case, the first shield cover having a plurality of circulation holes for communicating the inside and outside of the shield cover with each other such that cool air is supplied to the ice mold, the circulation holes having a small size enough to prevent a hand of the user from reaching the ice mold, and a second shield cover disposed below the first shield cover, such that the second shield cover is spaced a predetermined distance from the first shield cover, the second shield cover having a plurality of communication holes for communicating the inside and outside of the shield cover with each other such that cool air circulates through the communication holes.

**[0026]** Also, the shield cover can further include louvers mounted at top and/or bottom of the circulation holes for guiding the flow of the cool air to the ice mold.

**[0027]** Also, the shield cover can further include louvers mounted at top or bottom of the circulation holes and/or the communication holes for guiding the flow of the cool air to the ice mold.

**[0028]** The icemaker can further include a shield box surrounding the shield member for further preventing the user from accessing the ice mold, the shield box having a ventilation hole, through which cool air is supplied into the shield member.

**[0029]** The safety unit can include an insulation part coated on the outer surface of the ice mold with an electrically insulating material as at least one insulation layer, for protecting a user from electric shock even when the user touches the ice mold.

**[0030]** A refrigerator according to an embodiment of the present invention includes a refrigerator body having a cold chamber defined therein, a door for opening and closing the

cold chamber, and an icemaker placed in the cold chamber. The icemaker can be mounted on inside surface of the door.

**[0031]** The ice maker has an ice mold for receiving water to be frozen, the ice mold is made of a material that generates heat when electric current flows therethrough to perform ice body separation, a control unit for controlling the supply of electric current to the ice mold to control the separation of ice bodies from the ice mold, and a safety unit for protecting a user from electric shock when the user tries to access the ice mold.

**[0032]** The cold chamber may be a freezer compartment of a refrigerator.

**[0033]** An embodiment of a refrigerator according to the present invention includes a refrigerator body having a cold chamber, a door for accessing the cold chamber, and an icemaker.

**[0034]** The ice maker can include a case mounted in the cold chamber or inside the door, the case having an inner chamber defined therein and an opening part, a case door, a locking unit for locking the case door, an ice mold mounted in the case for receiving water to be frozen, the ice mold being made of a material that generates heat when electric current flows therein to perform an ice body separation, a control unit for controlling electric current to the ice mold, and a safety unit for protecting users from electric shock when the users try to access the ice mold.

**[0035]** An embodiment of an operating method of an icemaker includes supplying electric current to an ice mold to perform an ice body separation, detecting a user's attempted access to the ice mold, and operating a safety unit.

**[0036]** Another embodiment of an operating method of an icemaker includes performing an ice body separation, detecting a user's access to the ice mold with a primary switch and operating a primary safety unit, and detecting a user's access to the ice mold with a secondary switch and operating a secondary safety unit.

**[0037]** It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0038]** FIG. 1 is a view illustrating a refrigerator according to an embodiment of the present invention;

**[0039]** FIG. 2 is a view illustrating an ice maker according to an embodiment of the present invention;

**[0040]** FIGS. 3 to 12 are views schematically illustrating the structures of ice makers according to various embodiments of the present invention;

**[0041]** FIG. 13 is a view illustrating an ice maker according to another embodiment of the present invention;

**[0042]** FIG. 14 is a view illustrating an ice maker according to another embodiment of the present invention;

**[0043]** FIG. 15 is a view illustrating an ice maker according to a further embodiment of the present invention;

**[0044]** FIG. 16 is a flow chart illustrating an operating method of an ice maker according to an embodiment of the present invention; and

**[0045]** FIG. 17 is a flow chart illustrating an operating method of an icemaker according to another embodiment of the present invention.

#### DETAILED DESCRIPTION OF THE EMBODIMENTS

**[0046]** Reference will now be made in detail to embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

**[0047]** As shown in FIG. 1, a refrigerator includes a refrigerator body **10** having a cold chamber **11** defined therein, a door **20** for opening and closing the cold chamber **11**, and an icemaker **M**.

**[0048]** FIG. 1 illustrates that the icemaker **M** is installed at the inside of the door **20**. However, the present invention is not limited to the illustrated example. For example, it is possible to install the icemaker **M** in the cold chamber **11**.

**[0049]** The icemaker **M** is provided to make ice bodies. Consequently, it is preferred to set the temperature of the cold chamber **11** below the freezing point of water, and therefore, the cold chamber **11** is preferably constructed using a freezer compartment. However, the cold chamber **11** is not necessarily constructed using the freezer compartment. It is also possible to construct the cold chamber **11** using a refrigerator compartment.

**[0050]** Hereinafter, an icemaker according to an embodiment of the present invention will be described in detail with reference to FIG. 2.

**[0051]** As shown in FIG. 2, the ice maker according to this embodiment of the present invention includes a case **101** having a predetermined chamber defined therein, an ice mold **100** mounted in the case **101**, a control unit for controlling the ice mold **100**, and a safety unit.

**[0052]** The ice mold **100** has a plurality of predetermined sized cavities for receiving water. The water, received in the respective cavities, is frozen, by cool air in the cold chamber **11**, into ice bodies.

**[0053]** The ice bodies frozen in the ice mold **100** are separated from the ice mold **100** and are then supplied to a predetermined sized ice tank disposed below the ice mold **100**. At this time, electric current flows along the surface of the ice mold **100**, with the result that heat is generated from the ice mold **100**. The surfaces of the ice bodies are slightly melted, and therefore, the ice bodies are easily separated from the respective cavities of the ice mold **100**.

**[0054]** The control unit controls the ice body separation by allowing electric current to flow in the ice mold **100** or stopping the flow of electric current in the ice mold **100**.

**[0055]** During the ice body separation, electric current flows along the surface of the ice mold **100**. Consequently, when a user accesses the ice mold **100**, during the ice body separation, the user may be injured by an electric shock. The safety unit is provided to prevent the occurrence of the electric shock, i.e., to protect the user from the ice mold **100**.

**[0056]** The safety unit may be constructed in a structure that is capable of fundamentally preventing the user from accessing the ice mold. Alternatively, the safety unit may be constructed such that the user may access the ice mold but with great difficulty.

**[0057]** Also, the safety unit may be constructed such that, when the user tries to access the ice mold, the supply of power to the ice mold is interrupted, and therefore, no electric cur-



rent flows in the ice mold. This may be accomplished by the provision of an additional mechanical device that is capable of interrupting the supply of power to the ice mold when the user tries to open a case door of the icemaker or take off the case of the icemaker in order to access the ice mold. Alternatively, the safety unit may be constructed in an electronic fashion such that the user's access to the ice mold is detected to interrupt the supply of power to the ice mold.

[0058] The safety unit will be described in more detail through various embodiments thereof, which will be described below with reference to the corresponding drawings.

[0059] Meanwhile, the icemaker according to this embodiment of the present invention, shown in FIG. 2, further includes a case door 102 for opening and closing an opening part formed at one side of the case 101.

[0060] Also, the icemaker according to this embodiment of the present invention further includes a locking unit 103 for selectively coupling the case and the case door 102.

[0061] The locking unit 103 includes a locking groove 103a and a locking hook 103b configured to be caught and locked in the locking groove 103a.

[0062] The locking groove 103a may be formed at the case 101 or the case door 102. Correspondingly, the locking hook 103b may be formed at the case door 102 or the case 101.

[0063] FIG. 2 illustrates an example in which the locking groove 103a is formed at the case 101, and the locking hook 103b is formed at the case door 102.

[0064] Meanwhile, a power interruption unit 310, as an example of the safety unit, is mounted in the locking groove 103a.

[0065] As shown in FIG. 2, the power interruption unit 310 includes a switch 311 and a counter switch 312.

[0066] While the case door 102 closes the opening part of the case 101, the locking hook 103b keeps pushing the switch 311 and the counter switch 312, with the result that electric current flows in the ice mold 100.

[0067] The switch 311 and the counter switch 312 are mounted perpendicular to each other such that the switch 311 is disposed in tight contact with the tip end of the locking hook 103b, and the counter switch 312 is disposed in tight contact with the bottom point of the tip end of the locking hook 103b.

[0068] In addition, a press part 315 is rotatably mounted to assist the locking hook 103b to press against the switch 311.

[0069] When a user opens the case door 102, the locking hook 103b is separated from the locking groove 103a. As a result, the switch 311 and the counter switch 312 are released from their pressed states, and therefore, the supply of electric current to the ice mold 100 is interrupted.

[0070] Hereinafter, various embodiments of the power interruption unit will be described with reference to FIGS. 3 to 12.

[0071] Referring to FIG. 3, an icemaker according to an embodiment of the present invention includes an ice mold 100, a power supply unit S for supplying electric current to the ice mold 100, a control unit, and a safety unit.

[0072] The control unit includes a controller C, a relay 230, a first line 210 for connecting the power supply unit S and one end of the ice mold 100, and a second line 220 for connecting the power supply unit S and the other end of the ice mold 100.

[0073] The relay 230 is mounted on the first line 210. A power interruption unit 310, as an example of the safety unit,

is mounted on the second line 220. Reference numeral F indicates a fuse for preventing overcurrent.

[0074] The relay 230 is controlled by the controller C. The relay 230 is a component for controlling the flow of electric current to the ice mold 200 such that the electric current can flow to the ice mold 100 only during the ice body separation.

[0075] Specifically, the relay 230 is opened while the ice making is carried out, and, when the ice making is completed and the ice body separation is to be carried out, the relay 230 is closed, according to an instruction of the controller C, such that electric current can flow to the ice mold 100.

[0076] Meanwhile, the power interruption unit 310 is constructed by an additional mechanical or electronic device for interrupting the supply of power to the ice mold 100, when a user tries to access the ice mold 100, irrespective of whether the instruction of the controller C exists.

[0077] Specifically, the power interruption unit 310 remains closed, and, when a user tries to access the ice mold 100, the power interruption unit 310 is opened, by the operation of the mechanical or electronic device, to interrupt the supply of power to the ice mold 100.

[0078] Next, an icemaker according to another embodiment of the present invention will be described with reference to FIG. 4.

[0079] As shown in FIG. 4, the icemaker according to this embodiment of the present invention includes an ice mold 100, a power supply unit S, a control unit, and a safety unit. The control unit includes a controller C, a relay 230, a first line 210, and a second line 220.

[0080] The details of the control unit are similar to the previous embodiment shown in FIG. 3, and therefore, a detailed description thereof will not be given.

[0081] In the embodiment shown in FIG. 4, a switch 311 is mounted on the first line 210, and a counter switch 312 is mounted on the second line 220.

[0082] The switch 311 and the counter switch 312 may be constructed in connection with the locking unit 103 (see FIG. 2), as shown in FIG. 2. Alternatively, the switch 311 and the counter switch 312 may be constructed by another mechanical device or may be electronically constructed by an additional control device.

[0083] For example, when the case is installed inside of the door, the switch 311 and the counter switch 312 may be mounted at one side of the inside of the door such that one side of the case presses the switch and the counter switch, and, when a user separates the case from the door, the pressed states of the switch and the counter switch are released.

[0084] Alternatively, an additional control device, for example a sensor, may be installed such that, when a user's access to the ice mold is detected, the pressed states of the switch and the counter switch are released.

[0085] Next, an icemaker according to another embodiment of the present invention will be described with reference to FIG. 5.

[0086] As shown in FIG. 5, the icemaker according to this embodiment of the present invention includes an ice mold 100, a power supply unit S, a control unit, and a safety unit. The control unit includes a controller C, a first relay 231, a second relay 232, a first line 210, and a second line 220.

[0087] The first relay 231 is mounted on the first line 210, and the second relay 232 is mounted on the second line 220. Both the first relay 231 and the second relay 232 are controlled by the controller C.

[0088] Specifically, the controller C controls the first relay 231 and the second relay 232 to remain opened. During the ice body separation, the controller C controls the first relay 231 and the second relay 232 to be closed such that electric current can flow to the ice mold 100.

[0089] In the embodiment shown in FIG. 5, a switch 311 is mounted on the first line 210, and a counter switch 312 is mounted on the second line 220. The details of the switch 311 and the counter switch 312 resemble the previous embodiment shown in FIG. 4, and therefore, a detailed description thereof will not be given.

[0090] Next, an icemaker according to another embodiment of the present invention will be described with reference to FIG. 6.

[0091] As shown in FIG. 6, the icemaker according to this embodiment of the present invention includes an ice mold 100, a power supply unit S, a control unit, and a safety unit.

[0092] The control unit includes a controller C, a relay device 233, a first line 210, and a second line 220.

[0093] The safety unit includes a switching device 313 mounted on the first line 210 and the second line 220.

[0094] The switching device 313 is a device provided to simultaneously achieve the connection or disconnection between the first line 210 and the second line 220 by a single switching operation. The switching device 313 may be, for example, a double-pole switch.

[0095] Consequently, the controller C controls the relay device 233 to remain open, and, when the ice making is completed and the ice body separation is to be carried out, the controller C controls relay device 233 to be closed such that electric current can flow to the ice mold 100. At this time, the switching device 313 is closed.

[0096] When a user tries to access the ice mold 100, the switching device 313 disconnects the first line 210 and the second line 220, such that electric current cannot flow to the ice mold 100, by the operation of the mechanical or electronic device.

[0097] Next, an icemaker according to another embodiment of the present invention will be described with reference to FIG. 7.

[0098] As shown in FIG. 7, the icemaker according to this embodiment of the present invention includes an ice mold 100, a power supply unit S, a control unit, and a safety unit. The control unit includes a controller C, a first relay 231, a second relay 232, a first line 210, and a second line 220.

[0099] The first relay 231 is mounted on the first line 210, and the second relay 232 is mounted on the second line 220. Both the first relay 231 and the second relay 232 are controlled by the controller C.

[0100] Specifically, the controller C controls the first relay 231 and the second relay 232 to remain opened. During the ice body separation, the controller C controls the first relay 231 and the second relay 232 to be closed such that electric current can flow to the ice mold 100.

[0101] Meanwhile, the safety unit includes a first switch 311a and a second switch 311b mounted on the first line 210 and a first counter switch 312a and a second counter switch 312b mounted on the second line 220.

[0102] The respective switches 311a and 311b and the respective counter switches 312a and 312b may be constructed to be separately operable by other different mechanical or electronic devices. Alternatively, the respective switches 311a and 311b and the respective counter switches

312a and 312b may be constructed to be simultaneously operable by a single mechanical or electronic device.

[0103] Since the switches and the counter switches are constructed in a dual structure, as described above, it is possible to interrupt the supply of power to the ice mold even though a pair of devices (a switch and a counter switch) are not operated, and therefore, it is possible to more safely operate the icemaker.

[0104] Next, an icemaker according to another embodiment of the present invention will be described with reference to FIG. 8.

[0105] As shown in FIG. 8, the icemaker according to this embodiment of the present invention includes an ice mold 100, a power supply unit S, a control unit, and a safety unit.

[0106] The control unit includes a controller C, a relay device 233, a first line 210, and a second line 220.

[0107] The safety unit includes a first switching device 313a mounted on the first line 210 and the second line 220 and a second switching device 313b mounted on the first line 210 and the second line 220.

[0108] The first switching device 313a and the second switching device 313b are devices provided to simultaneously achieve the connection or disconnection between the first line 210 and the second line 220 by a single switching operation. The first switching device 313a and the second switching device 313b may be, for example, double-pole switches.

[0109] Since the first switching device 313a and the second switching device 313b are constructed in a dual safety structure, as described above, it is possible to interrupt the supply of power to the ice mold, even though any one of the switching devices is out of order, thereby further securing safety.

[0110] Next, an icemaker according to another embodiment of the present invention will be described with reference to FIG. 9.

[0111] As shown in FIG. 9, the icemaker according to this embodiment of the present invention includes an ice mold 100, a power supply unit S, a control unit, and a safety unit.

[0112] The control unit includes a controller C, a relay 230 controlled by the controller C, a first line 210, and a second line 220.

[0113] The safety unit includes a switch 311 mounted on the first line 210, a counter switch 312 mounted on the second line 220, and an insulation part 340 for surrounding the ice mold 100. The insulation part 340 is made of an insulating material.

[0114] The switch 311 and the counter switch 312 are substantially identical in construction and operation to the previous embodiments shown in FIGS. 4 and 5, and therefore, a detailed description thereof will not be given.

[0115] In the embodiment shown in FIG. 9, the insulation part 340, formed on the ice mold 100, serves as a dual safety unit together with the power interruption unit, which includes the switch 311 and the counter switch 312.

[0116] When a user tries to access the ice mold 100, the switch 311 and the counter switch 312 interrupt the supply of power, such that electric current cannot flow to the ice mold 100, by the operation of an additional mechanical or electronic device. In addition, the insulation part 340, formed on the ice mold 100, serves to protect the user from electric shock irrespective of the power interrupting operation of the switch 311 and the counter switch 312. Consequently, this embodiment protects the user through the provision of the dual safety unit.

[0117] Next, an icemaker according to another embodiment of the present invention will be described with reference to FIG. 10.

[0118] As shown in FIG. 10, the icemaker according to this embodiment of the present invention includes an ice mold 100, a power supply unit S, a control unit, and a safety unit.

[0119] The control unit includes a controller C, a first relay 231 and a second relay 232 controlled by the controller C, a first line 210, and a second line 220. The first relay 231 is mounted on the first line 210, and the second relay 232 is mounted on the second line 220.

[0120] The safety unit includes an insulation part 340 formed on the ice mold 100 such that the insulation part 340 surrounds the ice mold 100, a sensor D, and the relays 231 and 232. The sensor D and the relays 231 and 232 constitute an electronic safety unit.

[0121] Specifically, when a user's access to the ice mold is detected by the sensor D, the sensor D transmits the detected information to the controller C, which opens the first relay 231 and the second relay 232, such that the supply of power to the ice mold is interrupted. Consequently, the sensor D and the relays 231 and 232 function as a safety unit.

[0122] In addition, the insulation part 340 protects a user from electric shock when the user accesses the ice mold 100. Consequently, the insulation part 340 functions as another safety unit.

[0123] Another embodiment of the present invention shown in FIG. 11 is different from the previous embodiment of the present invention shown in FIG. 10 in that the relays 231 and 231 are replaced by a relay device 233.

[0124] Specifically, this embodiment is characterized by a single switch device simultaneously connected in the first line 210 and the second line 220. The switch device may be, for example, a double-pole switch.

[0125] Consequently, when a user's access to the ice mold is detected by the sensor D, the sensor D controls the relay device 233 to interrupt the supply of power to the ice mold. In this way, the sensor D and the relay device 233 function as a safety unit. In addition, the insulation part 340 functions as another safety unit.

[0126] Another embodiment of the present invention shown in FIG. 12 is characterized in that this embodiment further includes a switching device 313, as an additional safety unit, in addition to the components of the previous embodiment of the present invention shown in FIG. 11.

[0127] Specifically, the ice maker according to this embodiment of the present invention as shown in FIG. 12 includes a safety unit, constituted by the insulation part 340 for surrounding the ice mold 100, another safety unit, constituted by the sensor D, which detects a user's access to the ice mold, and the relay device 233, which are operated by the controller C to interrupt the supply of power to the ice mold, and a further safety unit, constituted by the switching device 313. The switching device 313 may be a mechanical or electronic device.

[0128] Hereinafter, other embodiments of the present invention will be described in detail with reference to FIGS. 13 to 15.

[0129] Referring to FIG. 13, the icemaker according to this embodiment includes an ice mold 100, a power supply unit (not shown), a control unit (not shown), and a safety unit.

[0130] The power supply unit supplies electric current to the ice mold. The control unit includes a controller and a relay for controlling the supply of electric current to the ice mold

100. The controller, the relay, and the power supply unit of this embodiment are substantially identical in construction and operation to those shown FIGS. 3 to 12, and a detailed description thereof will not be given.

[0131] As shown in FIG. 13, on the other hand, the safety unit includes a shield member 320 for surrounding the ice mold 100 and a shield box 330 for surrounding the shield member 320.

[0132] The shield member 320 includes a shield case 321 and a shield cover. In the embodiment shown in FIG. 13, the shield cover includes a first shield cover 323 and a second shield cover 324.

[0133] That is, the shield cover shown in FIG. 13 is constructed in a dual cover structure. However, the present invention is not limited to the dual cover structure. For example, the shield cover may be constructed in a single cover structure or a triple cover structure.

[0134] It is preferred to construct the shield cover in a structure in which cool air circulates, such that the cool air from the cold chamber can be supplied to the ice mold 100. Also, it is preferred to construct the shield cover in a structure in which a user's access to the ice mold is not possible.

[0135] The shield case 321 shown in FIG. 13 surrounds the ice mold 100. The shield case 321 is provided at lower ends thereof with guide parts 325 and 326. Between the guide parts 325 and 326 is defined an opening part through which ice bodies, separated from the ice mold 100, are discharged into an ice tank (not shown).

[0136] The shield covers 323 and 324 are coupled to or integrally formed with the top of the shield case 321. The shield covers 323 and 324 include the first shield cover 323 and the second shield cover 324. The first shield cover 323 has a predetermined sized circulation hole 323a, through which cool air is supplied to the ice mold 100.

[0137] The second shield cover 324 has a communication hole 324a, through which cool air is supplied to the ice mold 100. As shown in FIG. 13, the circulation hole 323a of the first shield cover 323 and the communication hole 324a of the second shield cover 324 are located such that the circulation hole 323a of the first shield cover 323 and the communication hole 324a of the second shield cover 324 deviate from each other. Consequently, a user is prevented from coming into contact with the ice mold 100 through the circulation hole 323a and the communication hole 324a.

[0138] In the icemaker according to the embodiment shown in FIG. 13, the shield box 330 is provided to surround the shield member 320.

[0139] The shield box 330 is provided at the top thereof with a ventilation hole 331 (Alternatively, the ventilation hole 331 may be formed at the side of the shield box 330.), through which cool air is supplied to the ice mold 100 via the circulation hole 323a and the communication hole 324a.

[0140] Either the shield member 320 or the shield box 330 may be used in the icemaker according to this embodiment. Also, the shield member 320 and the shield box 330 may be applied to the previous embodiments of the present invention shown in FIGS. 3 to 12.

[0141] Next, an icemaker according to another embodiment of the present invention will be described with reference to FIG. 14.

[0142] As shown in FIG. 14, the icemaker according to this embodiment of the present invention includes an ice mold 100, a power supply unit (not shown), a control unit (not shown), and a safety unit.

[0143] The ice mold 100, the power supply unit, and the control unit of this embodiment are substantially identical in construction and operation to those of the previous embodiment shown in FIG. 13, and a detailed description thereof will not be given.

[0144] In the embodiment shown in FIG. 14, the safety unit includes a shield member 320 and a shield box 330.

[0145] The shield member 320 includes a shield case 321 and a shield cover 322. As shown in FIG. 14, the shield case 321 surrounds the ice mold 100. The shield case 321 is provided at lower ends thereof with guide parts 325 and 326. Between the guide parts 325 and 326 is defined an opening part through which ice bodies, separated from the ice mold 100, are discharged into an ice tank (not shown).

[0146] The shield cover 322 is coupled to or integrally formed with the top of the shield case 321. The shield cover 322 shown in FIG. 14 is constructed in a single cover structure. Also, the shield cover 322 is provided with a plurality of communication holes 322a and a plurality of louvers 322b for guiding the introduction of cool air to the ice mold 100.

[0147] The communication holes 322a are preferably small enough to prevent a user from accessing the ice mold 100 through them.

[0148] The shield box 330 is provided at the top thereof with at least one ventilation hole 331 (Alternatively, the ventilation hole 331 may be formed at the side of the shield box 330), through which cool air is supplied to the ice mold 100 via the communication hole 322a.

[0149] Either the shield member 320 or the shield box 330 may be used in the icemaker according to this embodiment. Also, the shield member 320 and the shield box 330 may be applied to the previous embodiments of the present invention shown in FIGS. 3 to 12.

[0150] Next, an icemaker according to a further embodiment of the present invention will be described with reference to FIG. 15.

[0151] As shown in FIG. 15, the icemaker according to this embodiment of the present invention includes an ice mold 100, a power supply unit (not shown), a control unit (not shown), and a safety unit.

[0152] The ice mold 100, the power supply unit, and the control unit of this embodiment resemble those of the previous embodiment shown FIG. 13, and a detailed description thereof will not be given.

[0153] In the embodiment shown in FIG. 15, the safety unit includes a shield member 320 and a shield box 330.

[0154] The shield member 320 includes a shield case 321 and a shield cover. As shown in FIG. 15, the shield case 321 surrounds the ice mold 100. The shield case 321 is provided at lower ends thereof with guide parts 325 and 326. Between the guide parts 325 and 326 is defined an opening part through which ice bodies, separated from the ice mold 100, are discharged into an ice tank (not shown).

[0155] The shield cover includes a first shield cover 323 and a second shield cover 324. The first shield cover 323 has a plurality of predetermined sized circulation holes 323a, through which cool air is supplied to the ice mold 100. The first shield cover 323 also has a plurality of first louvers 323b.

[0156] The second shield cover 324 has a plurality of communication holes 324a through which cool air is supplied to the ice mold 100. The second shield cover 324 also has a plurality of second louvers 324b.

[0157] The first louvers 323b and the second louvers 324b serve to guide the introduction of cool air to the ice mold 100.

The circulation holes 323a and the communication holes 324a are preferably small enough to effectively prevent a user from accessing the ice mold 100 through them.

[0158] The shield box 330 is provided at the top thereof with a ventilation hole 331 (Alternatively, the ventilation hole 331 may be formed at the side of the shield box 330.), through which cool air is supplied to the ice mold 100 via the circulation holes 323a and the communication holes 324a.

[0159] Either the shield member 320 or the shield box 330 may be used in the icemaker according to this embodiment. Also, the shield member 320 and the shield box 330 may be applied to the previous embodiments of the present invention shown in FIGS. 3 to 12.

[0160] Meanwhile, the shield box 330 may be easily separated from the remaining parts of the icemaker by a user. Consequently, the shield box 330 may be linked to the switch and the counter switch or the switching device as shown in FIGS. 3 to 12. Alternatively, the shield box 330 may be linked to the relay.

[0161] Specifically, when the user separates the shield box 330 from the remaining parts of the icemaker, the switch and the counter switch or the switching device as shown in FIGS. 3 to 12 may interrupt the supply of electric current to the ice mold. Alternatively, the controller may detect whether the shield box 330 has been separated from the remaining parts of the icemaker and control the relay to interrupt the supply of electric current to the ice mold. The same construction may be applied to the shield member 320.

[0162] Hereinafter, an operating method of an icemaker according to an embodiment of the present invention will be described with reference to FIGS. 16 and 17.

[0163] As shown in FIG. 16, the operating method of the icemaker according to this embodiment of the present invention includes performing an ice body separating operation (S10), determining whether a user has accessed an ice mold (S20), and operating a safety unit when it is determined that the user has accessed the ice mold (S30).

[0164] At Step S20, it is determined, for example, whether a user tries to open the case door in the embodiment shown in FIG. 2 or whether a user tries to separate the shield box or the shield member from the remaining parts of the icemaker in the embodiments shown in FIGS. 13 to 15.

[0165] The step of operating the safety unit (S30) may be carried out by controlling the switch and the counter switch or the switching device through the additional mechanical or electronic device as shown in FIGS. 3 to 12 or controlling the relay through the controller.

[0166] Specifically, Step S30 is a step of interrupting the supply of electric current to the ice mold to protect the user from electric shock.

[0167] The operating method of the icemaker shown in FIG. 16 may be carried out simultaneously with the use of various mechanical safety units. For example, the operating method of the icemaker shown in FIG. 16 may be applied to the icemaker constructed in a structure in which the insulation part is formed on the ice mold. Alternatively, the operating method of the icemaker according to the present invention may be applied to the icemaker including the shield member or the shield box.

[0168] FIG. 17 is a flow chart illustrating an operating method of an icemaker according to another embodiment of the present invention. Referring to FIG. 17, the operating method of the icemaker according to this embodiment of the present invention includes performing an ice body separating

operation (S10), determining whether a user has accessed an ice mold (S20) with a primary sensor, operating a primary safety unit when the primary sensor determines that the user has primarily accessed the ice mold (S30), determining whether the user has accessed the ice mold (S40) with a secondary sensor, and operating a secondary safety unit when the secondary sensor determines that the user has accessed the ice mold (S50).

[0169] The secondary sensor is a second, independent, sensor that either detects opening of the icemaker by removal or opening of a different member than the primary sensor; or may detect opening of the same part as the primary sensor with an independent detector in case the primary detector fails due to icing. For example, the secondary sensor may detect that the user separates the shield member from the remaining parts of the icemaker after the user separated the shield box. Alternatively, the secondary sensor may detect that the user separates the shield member from the remaining parts of the ice maker after the user opened the case door in a structure in which both the case and the case door as shown in FIG. 2 and the shield member as shown in FIGS. 13 to 15 are included in the ice maker.

[0170] Step S30 and Step S50 may be carried out by controlling the switch and the counter switch or the switching device through the additional mechanical or electronic device as shown in FIGS. 3 to 12 or controlling the relay through the controller.

[0171] Specifically, Step S30 and Step S50 are steps of interrupting the supply of electric current to the ice mold to protect the user from electric shock.

[0172] The operating method of the icemaker shown in FIG. 17 may be carried out simultaneously with the use of various mechanical safety units.

[0173] As apparent from the above description, the ice maker, the refrigerator having the same, and the operating method of the same have the effect of preventing electric current flowing in the ice mold from being transmitted to a user when the user access the ice mold, thereby protecting the user and improving the safety and reliability of the products.

[0174] 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 spirit or scope of the inventions. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. An icemaker comprising:
  - a case having an open chamber;
  - a case door mounted to the case to open and close the open chamber;
  - a locking unit to lock the case door to the case;
  - an ice mold disposed within the case, the ice mold made of a material that generates heat when electric current flows through the material to perform an ice body separation;
  - apparatus for dispensing water into the ice mold;
  - a control unit to control a supply of electric current to the ice mold to perform the ice body separation; and
  - a safety unit to interrupt the supply of the electric current to the ice mold when the case door is opened.
2. The icemaker according to claim 1, wherein the safety unit includes a power interruption unit mounted to the case, the power interruption unit configured to switch off the supply of the current when the locking unit is unlocked.

3. The icemaker according to claim 2, wherein the locking unit includes a locking hook mounted to the case door, and the power interruption unit includes a switch and a counter switch, both switches released off by being depressed by the locking hook.

4. The ice maker according to claim 2, wherein the control unit includes a first line to electrically connect one end of the ice mold to a power supply unit and a second line to connect another end of the ice mold to the power supply unit, and

the power interruption unit includes at least one switch to control a flow of current through the first line and at least one counter switch to control a flow of current through the second line, and

the locking unit includes a locking hook mounted on the case door to switch on the at least one switch and the at least one counter switch when the case door is closed.

5. The ice maker according to claim 2, wherein the control unit includes a first line to electrically connect one end of the ice mold to a power supply unit and a second line to connect another end of the ice mold to the power supply unit, and

the power interruption unit includes at least one switching device to switch on and off both current through the first line and the second line, and

the locking unit includes a locking hook mounted on the case door to switch on the switching device when the case door is closed.

6. The icemaker according to claim 1, wherein the safety unit includes a button switch mounted on the case to switch on and off a flow of electric current to the ice mold by being pushed and released when the case door is closed and opened.

7. An icemaker comprising:

- an ice mold placed in a case, the ice mold made of a material that generates heat, when electric current flows through the material, to perform an ice body separation;
- a control unit to control a supply of electric current to the ice mold to perform the ice body separation; and

A shield member surrounding the ice mold to prevent a user from touching the ice mold, the shield member configured to allow air to flow through.

8. The icemaker according to claim 7, wherein the shield member includes

- a shield case to surround the ice mold, the shield case having a discharge port through which cool air flows and ice bodies, separated from the ice mold, are discharged, and

- a shield cover for covering a top of the shield case to prevent the user from touching the ice mold, the shield cover configured to allow air to flow through.

9. The icemaker according to claim 8, wherein the shield cover includes:

- a first shield cover to cover the top of the shield case, the first shield cover provided at one side thereof with an opening, through which cool air circulates, and

- a second shield cover disposed below the first shield cover with a predetermined distance, the second shield cover provided at one side thereof with an opening that is formed at a position substantially not overlapping with the opening of the first shield cover.

10. The icemaker according to claim 8, wherein the shield cover includes a plurality of holes, the holes small enough to prevent the user from touching the ice mold.

11. The icemaker according to claim 8, wherein the shield cover includes:

- a first shield cover to cover top of the shield case, the first shield cover having a plurality of holes small enough to prevent the user from touching the ice mold; and
- a second shield cover disposed below the first shield cover with a predetermined distance, the second shield cover having a plurality of holes.

12. The icemaker according to claim 10, wherein the shield cover further includes louvers mounted to guide a flow of the cool air to the ice mold.

13. The icemaker according to claim 11, wherein the shield cover further includes louvers mounted to guide a flow of the cool air to the ice mold.

14. The icemaker according to claim 8, further comprising:
- a shield box surrounding the shield member to further prevent the user from touching the ice mold, the shield box having at least one hole through which cool air flows.

15. An icemaker comprising:
- an ice mold placed in a case, the ice mold made of a material that generates heat, when electric current flows through, to perform an ice body separation;
  - a control unit to control a supply of electric current to the ice mold to perform the ice body separation; and
  - an insulation layer of an electrically insulating material coated on the ice mold.

16. The icemaker according to claim 1, further comprising: a shield member surrounding the ice mold to prevent a user from touching the ice mold, the shield member configured to allow air to flow through.

17. The icemaker according to claim 1, further comprising: a shield box to surround the ice mold to prevent a user from touching the ice mold, the shield box having at least one hole through which cool air flows.

18. The icemaker according to claim 1, further comprising: an insulation layer of an electrically insulating material coated on the ice mold.

19. The icemaker according to claim 7, further comprising: a power interruption unit connected to the control unit to interrupt a supply of the electric current to the ice mold.

20. The icemaker according to claim 7, further comprising: an insulation layer of an electrically insulating material coated on the ice mold.

21. A refrigerator comprising:
- a refrigerator body having a cold chamber;
  - a door to open and close the cold chamber; and
  - an icemaker placed in the cold chamber, wherein the icemaker comprises:
    - an ice mold made of a material that generates heat, when electric current flows through the material, to perform an ice body separation;
    - a control unit to control a supply of electric current to the ice mold to control the separation of ice bodies from the ice mold; and
    - at least one of a power interruption unit to interrupt the supply of the electric current to the ice mold, a shield member surrounding the ice mold to prevent a user from touching the ice mold, and an insulation layer of an electrically insulating material coated on the ice mold.

22. A refrigerator comprising:
- a refrigerator body having a cold chamber;
  - a door to open and close the cold chamber; and
  - an icemaker placed in the cold chamber, wherein the icemaker comprises:
    - a case having an open chamber;
    - a case door mounted to the case to open and close the open chamber;
    - a locking unit to lock the case door to the case;
    - an ice mold place in the case, the ice mold made of a material that generates heat, when electric current flows through the material, to perform an ice body separation;
    - a control unit to control a supply of electric current to the ice mold to perform the ice body separation; and
    - a safety unit to interrupt the supply of the electric current to the ice mold when the case door is opened.

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