(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 738 486 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
04.06.2014 Bulletin 2014/23

(21) Application number: **13188925.5**

(22) Date of filing: **16.10.2013**

(51) Int Cl.:
F25B 21/04 *(2006.01)* ***F25C 1/04*** *(2006.01)*
F25C 5/08 *(2006.01)* ***F25D 11/02*** *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **03.12.2012 US 201213691894**

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(54) Modular cooling and low energy ice

(57) A refrigerator (10) includes a refrigerator cabinet (12), an ice maker (32) disposed within the refrigerator cabinet, an ice mold (40) in the ice maker, and a thermo-electric device (46) positioned below the ice mold and configured to provide cooling liquid along a bottom side of the ice mold during freezing of water to make ice. The ice maker is further configured to warm the bottom side of the ice mold to facilitate harvesting of the ice. The ice maker may be disposed within a refrigeration compartment and may be configured to make clear ice. The ice mold may be fixed in place during the harvesting of the ice. The ice maker may be further configured to warm the bottom side of the ice mold to facilitate harvesting of the ice by providing warming liquid along the bottom side of the ice mold.

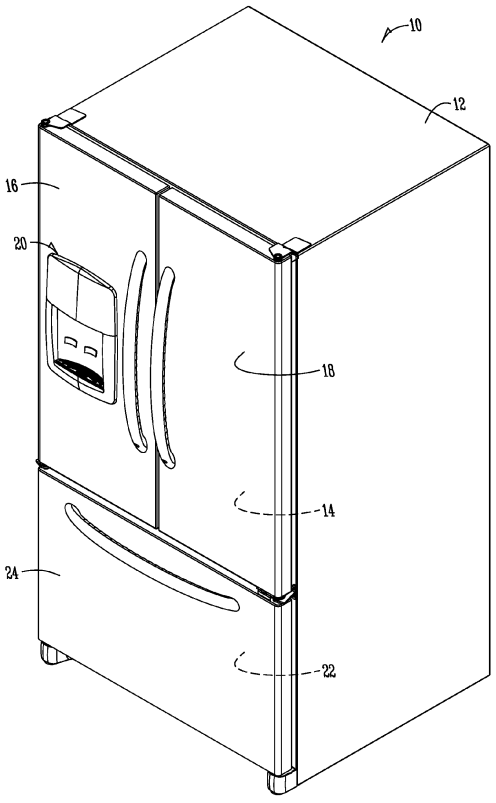

Fig. 1

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Description

[0001] The present invention relates to refrigerators. More particularly, but not exclusively, the present invention relates to a refrigerator which includes an ice maker with a fixed tray.

[0002] Refrigerators often include ice makers for making ice. The making of ice can be an energy intensive function which can reduce the energy efficiency of the refrigerator. In some refrigerators, ice is made in an ice tray and then the ice removed from the ice tray through a twisting motion applied to the ice tray. Using a motor to provide this twisting motion to the ice tray can be a significant expenditure of energy. One alternative is to use heaters to heat the ice mold in order to release the ice. This is another example of a method which uses high energy. What is needed is improved ways of making ice and removing ice from an ice mold.

[0003] Therefore, it is a primary object, feature, or advantage of the present invention to improve over the state of the art.

[0004] It is a further object, feature, or advantage of the present invention to provide for improved methods and apparatuses for making and removing ice from an ice mold of a refrigerator.

[0005] It is a further object, feature, or advantage of the present invention to provide for energy efficient removal of ice.

[0006] One or more of these and/or other objects, features, or advantages of the present invention will become apparent from the specification and claims that follow. No single embodiment need meet or provide each and every object, feature, or advantage. Different embodiments may have different objects, features, or advantages. The present invention is not to be limited by or to these objects, features, or advantages.

[0007] According to one aspect, a refrigerator is provided. The refrigerator includes a refrigerator cabinet, an ice maker disposed within the refrigerator cabinet, an ice mold in the ice maker, and a thermoelectric device positioned below the ice mold and configured to provide cooling liquid along a bottom side of the ice mold during freezing of water to make ice. The ice maker is further configured to warm the bottom side of the ice mold to facilitate harvesting of the ice. The ice maker may be disposed within a refrigeration compartment and may be configured to make clear ice. The ice mold may be fixed in place during the harvesting of the ice. The ice maker may be further configured to warm the bottom side of the ice mold to facilitate harvesting of the ice by providing warming liquid along the bottom side of the ice mold.

[0008] According to another aspect, a refrigerator is provided. The refrigerator includes a refrigerator cabinet, a freezer compartment disposed within the refrigerator compartment, a refrigeration compartment disposed within the refrigerator cabinet, an ice maker disposed within the refrigerator cabinet, and an ice mold in the ice maker having a bottom side. The ice maker is configured to receive cooling liquid along the bottom side of the ice mold during freezing of water to make ice. The ice maker is further configured to warm the bottom side of the ice mold to facilitate harvesting of the ice. The ice maker is disposed within the refrigeration compartment of the refrigerator. The ice mold may be fixed in place during the harvesting of the ice. The refrigeration compartment may maintain a temperature of above freezing during the freezing of water to make ice by the ice maker. The ice maker may be configured to make clear ice. The refrigerator may further include a thermoelectric cooler (TEC) associated with the ice maker. The TEC may be adapted to cool the liquid along the bottom side of the ice mold during the freezing of the water to make ice. The ice maker may be further configured to warm the bottom side of the ice mold to facilitate harvesting of the ice using liquid warmed by the TEC or otherwise configured to warm the bottom side of the ice mold to facilitate harvesting of the ice using the TEC.

[0009] According to another aspect, a refrigerator includes a refrigerator cabinet, a freezer compartment disposed within the refrigerator compartment, a refrigeration compartment disposed within the refrigerator cabinet, an ice maker disposed within the refrigerator cabinet, an ice mold in the ice maker having a bottom side, and a thermoelectric cooler positioned below the ice mold. The ice maker is configured to cool the bottom side of the ice mold during freezing of water to make ice using the thermoelectric cooler. The ice maker may be further configured to warm the bottom side of the ice mold to facilitate harvesting of the ice. The ice mold may be fixed in place during the harvesting of the ice. The ice maker may be disposed within the refrigeration compartment of the refrigerator. The thermoelectric cooler may be configured to provide heating used to warm the bottom side of the ice mold to facilitate harvesting of the ice and configured to provide cooling to cool the bottom side of the ice mold during freezing of the water to make ice.

[0010] The present invention will be further described by way of example with reference to the accompanying drawings:-

FIG. 1 is a perspective view of one example of a refrigerator of the present invention.

FIG. 2 is a perspective view of the refrigerator of FIG. 1 with the French doors in an open position.

FIG. 3 is a perspective view of one example of an ice maker of the present invention.

FIG. 4 is an end view of the ice maker of FIG. 3.

FIG. 5 is a side view of the ice maker of FIG. 3.

[0011] FIG. 1 illustrates one embodiment of a refrigerator of the present invention. In FIG. 1 a refrigerator 10 has a bottom mount freezer with French doors. It is should be understood that the present invention may be used in other configurations including side-by-side refrigerator configurations and other types of configurations, especially where an ice maker and/or ice storage is on a door

providing access to a fresh food compartment. The refrigerator 10 has a refrigerator cabinet 12. One or more compartments are disposed within the refrigerator cabinet 12. As shown in FIG. 1, an example of a refrigerator 10 has a fresh food compartment 14 is shown with French doors 16, 18 providing access to the fresh food compartment 14. Mounted on the door 16 is a water and ice dispenser 20. Below the fresh food compartment 14 is a freezer compartment 22 which may be accessed by pulling drawer 24 outwardly.

[0012] FIG. 2 illustrates the refrigerator 10 of FIG. 1 with French doors 16, 18 in an open position. Mounted on the French door 16 is an ice making compartment 30 in which an ice maker 32 and an ice storage bucket 34 may be disposed. Note the ice making compartment as shown in FIG. 2 is within the refrigeration or fresh food compartment 14.

[0013] FIG. 3 illustrates one example of an ice maker 32 where a liquid cooled system is used for freezing water into ice. An ice mold 40 is positioned above a thermoelectric cooler (TEC). The ice mold 40 is preferably fixed in place during harvesting of the ice. FIG. 4 illustrates an end view of the ice maker showing the thermoelectric cooler 46 with electrical inputs 42, 44 shown. Fluid is shown in fluid line 48 which is in contact with a bottom side 50 of the thermoelectric cooler 46. Thus, in operation fluid within the fluid line 48 can remove heat from the thermoelectric cooler 46. FIG. 5 provides another illustration where one or more thermo electric coolers 46 are used to remove heat from an ice maker using liquid cooling. During harvest, heat may be provided to the ice mold 40. The heat may be provided through the thermoelectric cooler 46 or through warm fluid through the fluid line 48.

[0014] Thus, the present invention provides for liquid cooling to be used in making ice. Cooling may be performed by the thermoelectric cooler and fluid on a bottom side of an ice mold. Harvest may be accomplished by warm fluid across the bottom of the ice mold and/or heat from the thermoelectric cooler. The ice maker may reside in the refrigeration compartment at an above freezing temperature, particularly where clear ice is desired. Alternatively, the ice maker may reside in the freezer compartment for normal ice. Note that because the ice mold may be fixed in place during the harvesting of the ice, less energy is needed then in configurations of ice makers where twisting motions are applied to the ice mold during harvesting.

[0015] Therefore, a refrigerator which provides for modular cooling and low energy ice in a refrigerator is provided. The present invention contemplates numerous variations including the number and placement of thermoelectric coolers where used, the manner in which the bottom of a mold of an ice maker is cooled, the placement of the ice maker, and other options, variations, and alternatives. In general, the present invention is only intended to be limited by the scope of the following claims.

Claims

1. A refrigerator comprising:

   a refrigerator cabinet;
   an ice maker disposed within the refrigerator cabinet;
   an ice mold in the ice maker;
   the ice maker configured to cool a bottom side of the ice mold during freezing of water to make ice;
   the ice maker further configured to warm the bottom side of the ice mold to facilitate harvesting of the ice.

2. A refrigerator according to claim 1 further comprising a thermoelectric device positioned below the ice mold and configured to provide cooling liquid along a bottom side of ice mold during freezing of water to make ice.

3. The refrigerator of claim 1 or 2 wherein the ice maker is disposed within a refrigeration compartment.

4. The refrigerator of claim 1, 2 or 3 wherein the ice maker is configured to make clear ice.

5. The refrigerator according to any one of the preceding claims wherein the ice mold is fixed in place during the harvesting of the ice.

6. The refrigerator according to any one of the preceding claims wherein the ice maker is further configured to warm the bottom side of the ice mold to facilitate harvesting of the ice by providing warming liquid along the bottom side of the ice mold.

7. The refrigerator according to any one of the preceding claims wherein the ice mold is fixed in place.

8. A refrigerator according to any one of the preceding claims comprising:

   a freezer compartment disposed within the refrigerator compartment;
   a refrigeration compartment disposed within the refrigerator cabinet;
   wherein the ice maker is configured to receive cooling liquid along the bottom side of the ice mold during freezing of water to make ice; and
   wherein the ice maker is disposed within the refrigeration compartment of the refrigerator.

9. The refrigerator of claim 8 wherein the refrigeration compartment maintains a temperature of above freezing during the freezing of water to make ice by the ice maker.

10. The refrigerator of claim 8 or 9 further comprising a thermoelectric cooler (TEC) associated with the ice maker.

11. The refrigerator of claim 10 wherein the TEC is adapted to cool the liquid along the bottom side of the ice mold during the freezing of the water to make ice.

12. The refrigerator of claim 11 wherein the ice maker is further configured to warm the bottom side of the ice mold to facilitate harvesting of the ice using liquid warmed by the TEC.

13. The refrigerator of claim 10 wherein the ice maker is further configured to warm the bottom side of the ice mold to facilitate harvesting of the ice using the TEC.

14. A refrigerator according to claim 1, further comprising:

a freezer compartment disposed within the refrigerator compartment;
a refrigeration compartment disposed within the refrigerator cabinet;
a thermoelectric cooler positioned below the ice mold to cool the bottom side of the ice mold during freezing of water to make ice using the thermoelectric cooler; and
wherein the ice mold is fixed in place during the harvesting of the ice.

15. The refrigerator of claim 14 wherein the thermoelectric cooler is configured to provide heating used to warm the bottom side of the ice mold to facilitate harvesting of the ice and configured to provide cooling to cool the bottom side of the ice mold during freezing of the water to make ice.

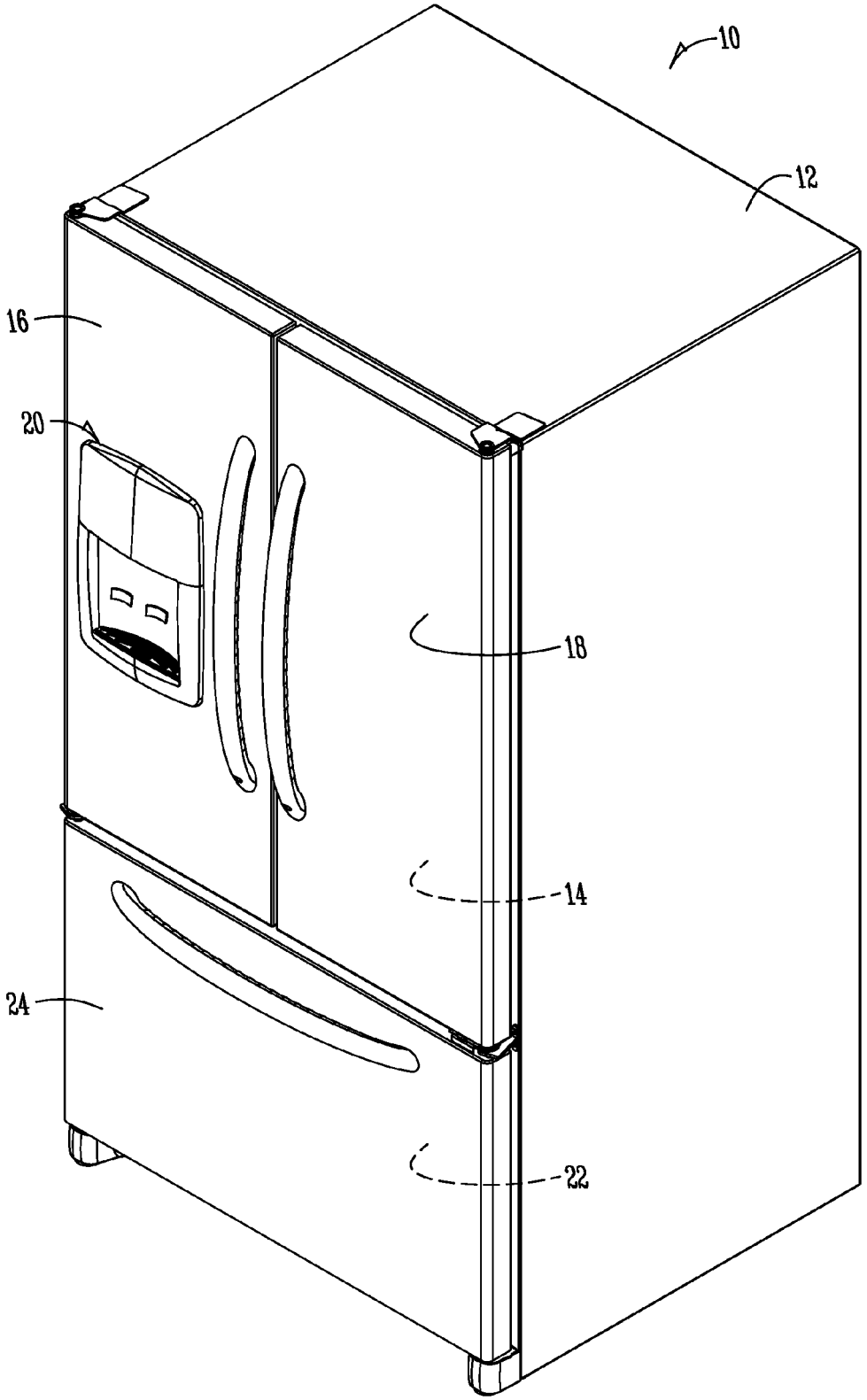

Fig. 1

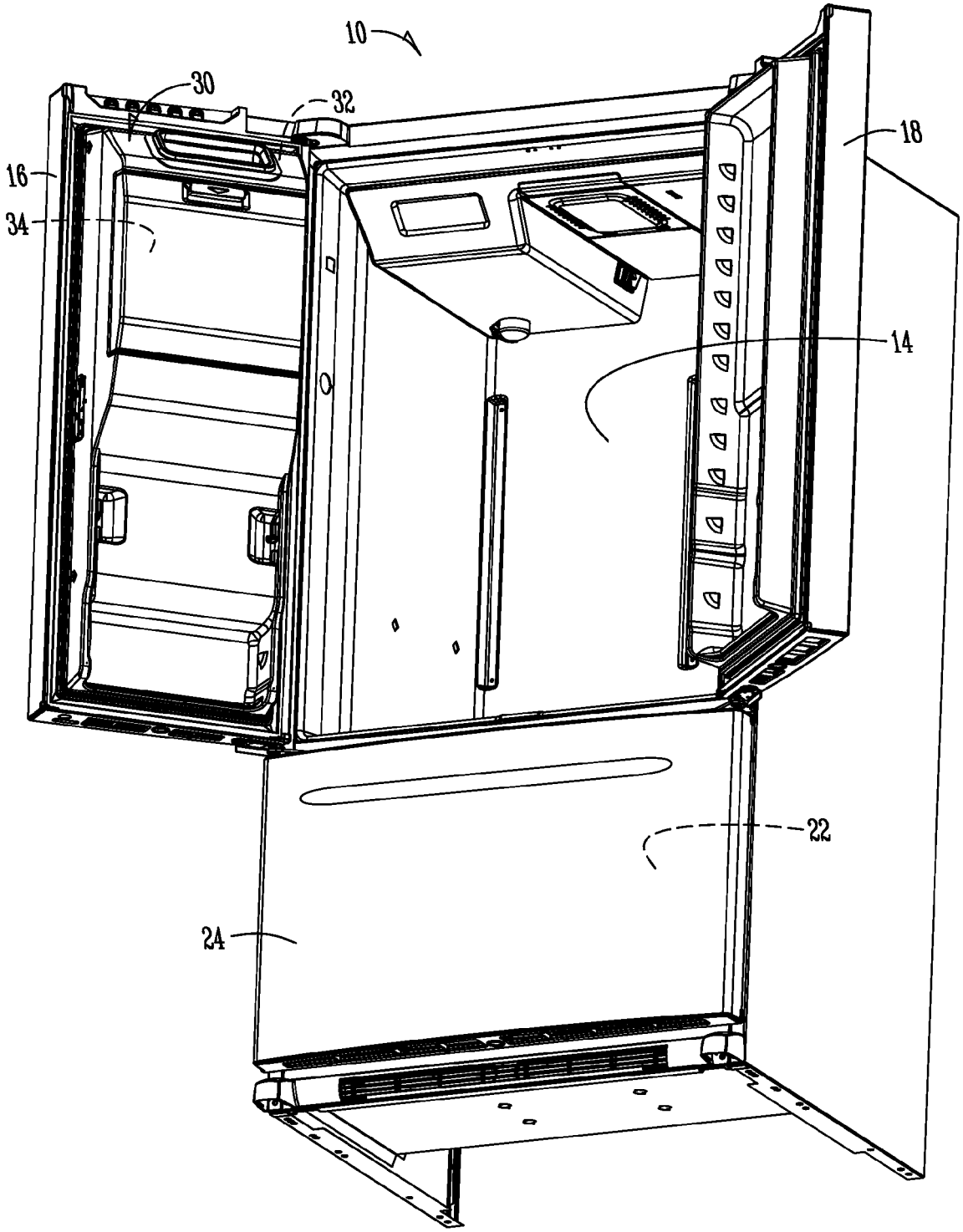

Fig.2

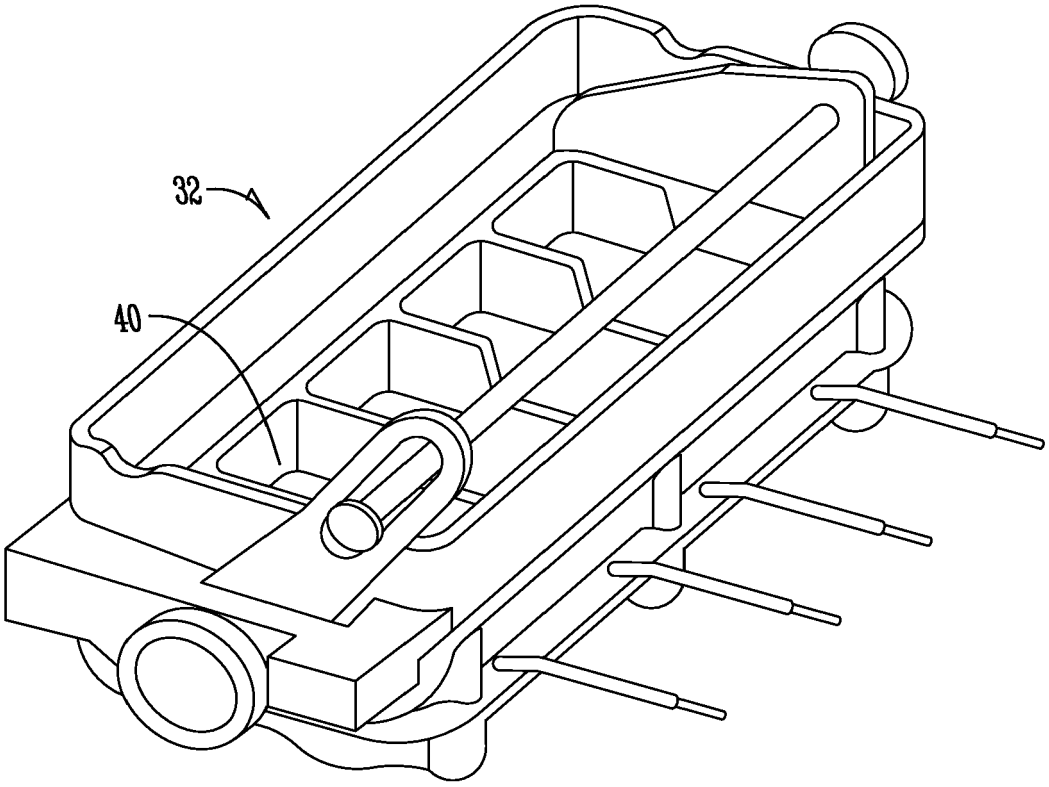

Fig. 3

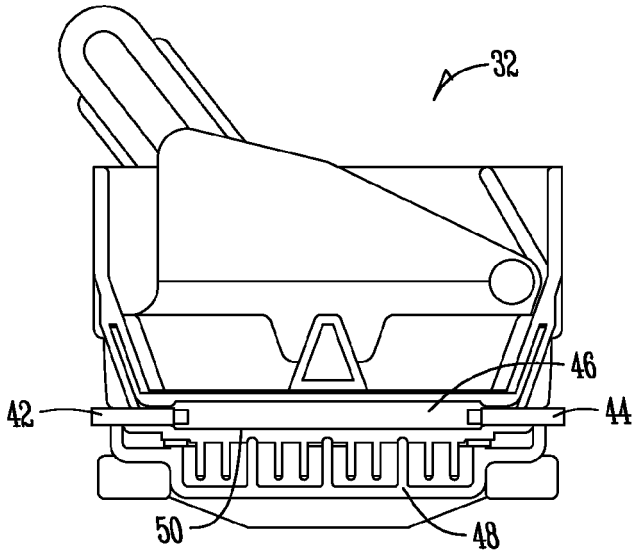

Fig. 4

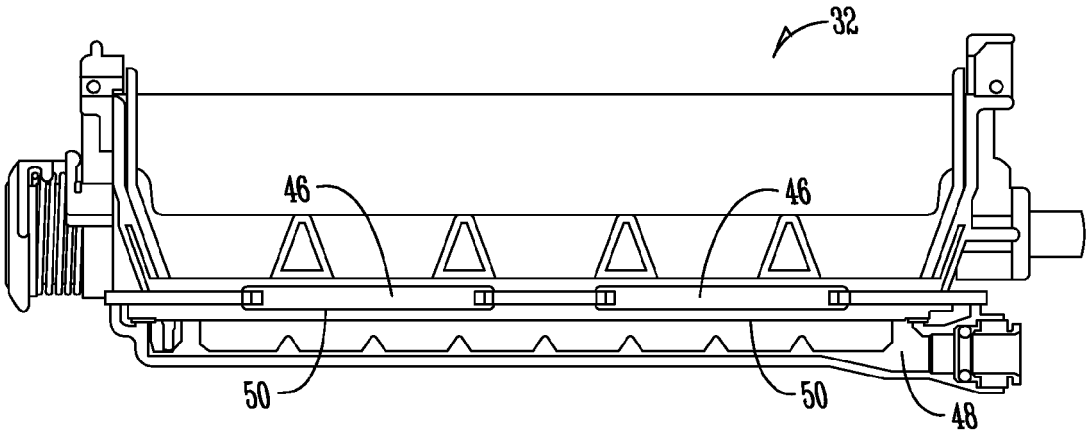

Fig. 5