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(71) Applicants:
- **Haier Smart Home Co., Ltd.**
  Qingdao, Shandong 266101 (CN)
- **Qingdao Haier Refrigerator Co., Ltd.**
  Laoshan District
  Qingdao
  Shandong 266101 (CN)
- **Aqua Co., Ltd.**
  Tokyo 103-0012 (JP)

(72) Inventor: **KURATANI, Toshiharu**
Tokyo 103--0012 (JP)

(74) Representative: **Winter, Brandl - Partnerschaft mbB**
Alois-Steinecker-Straße 22
85354 Freising (DE)

(54) LIQUID SUPPLY DEVICE AND REFRIGERATOR COMPRISING LIQUID SUPPLY DEVICE

(57) A liquid supply apparatus and a refrigerator including the liquid supply apparatus. The liquid supply apparatus includes a liquid storage container (4);a liquid storage region (10) provided inside the liquid storage container (4) for storing liquid to be supplied to an ice mold (5);a secondary liquid storage region (20) provided inside the liquid storage container (4) above the liquid storage region (10); a liquid supply pump (30), which is configured as a non-positive displacement pump, for supplying the liquid stored in the liquid storage region (10) to the secondary liquid storage region (20); and a liquid supply conduit (40), an inlet opening of the liquid supply conduit is provided inside the secondary liquid storage region (20) and an outlet opening of the liquid supply conduit is provided above the ice mold (50); the secondary liquid storage region (20) is provided above the ice mold, the liquid supplied from the liquid storage region (10) to the secondary liquid storage region (20) by the liquid supply pump (30) flows downward within the liquid supply conduit (40) under the action of gravity, thereby supplying liquid to the ice mold (50). With this arrangement, a device is provided that can supply liquid to the ice mold in a clean state even when using a pump that cannot rotate in reverse as the liquid supply pump.

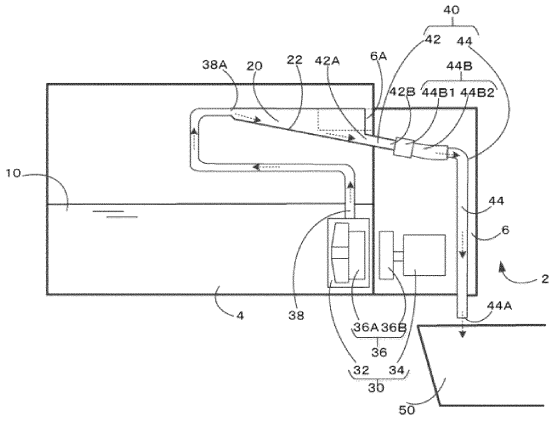

Fig.3

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Description

TECHNICAL FIELD

[0001] The present application relates to the field of refrigeration appliances, particularly to a liquid supply apparatus for supplying liquid to an ice mold and a refrigerator including such a liquid supply apparatus.

BACKGROUND

[0002] Liquid supply apparatuses for supplying liquid to ice molds in refrigerators are known. In such liquid supply apparatuses, liquid stored in a liquid storage region is typically supplied to the ice mold through a liquid supply pump. In this case, to suppress the proliferation of mildew or miscellaneous bacteria in the flow path connecting the liquid storage region and the ice mold, it is preferable to connect a liquid storage container and the ice mold with a closed flow path that is isolated from external gas. However, when liquid remains in the closed flow path, there is a problem of liquid backflow due to the siphon phenomenon.

[0003] To address this problem, a liquid supply apparatus has been proposed that uses a positive displacement pump, such as a gear pump, capable of forward and reverse rotation as the liquid supply pump in a liquid supply apparatus with a closed flow path connecting the liquid storage container and the ice mold (for example, refer to Patent Document 1 - Japanese Patent Application Publication No. H07-260306). In the ice-making apparatus described in Patent Document 1, the liquid supply pump, which is a positive displacement pump, is rotated in reverse to collect the liquid remaining in the closed flow path back into the liquid supply container, preventing backflow caused by the siphon phenomenon.

[0004] However, considering factors such as manufacturing cost and maintainability of the liquid supply pump, it is more preferable to use widely used non-positive displacement pumps rather than positive displacement pumps. However, when a non-positive displacement pump is used in the closed flow path connecting the liquid storage container and the ice mold, it is not possible to remove the liquid remaining in the flow path because non-positive displacement pumps cannot rotate in reverse.

[0005] If an opening for introducing external gas is provided on the piping forming the flow path to prevent the occurrence of the siphon phenomenon, mildew and miscellaneous bacteria may proliferate in the flow path due to the opening.

SUMMARY

[0006] The object of the present application is to provide a liquid supply apparatus and a refrigerator including the liquid supply apparatus. The liquid supply apparatus is capable of suppling liquid stored in a liquid storage region to an ice mold in a clean state even when using a pump that cannot rotate in reverse as the liquid supply pump.

[0007] To achieve the above object, one embodiment of the present application provides a liquid supply apparatus comprising:

a liquid storage container;
a liquid storage region provided inside the liquid storage container for storing liquid to be supplied to an ice mold;
a secondary liquid storage region provided inside the liquid storage container above the liquid storage region;
a liquid supply pump, which is configured as a non-positive displacement pump, for supplying the liquid stored in the liquid storage region to the secondary liquid storage region; and
a liquid supply conduit, an inlet opening of the liquid supply conduit is provided inside the secondary liquid storage region and an outlet opening of the liquid supply conduit is provided above the ice mold;
wherein the secondary liquid storage region is provided above the ice mold,
and the liquid supplied from the liquid storage region to the secondary liquid storage region by the liquid supply pump flows downward within the liquid supply conduit under the action of gravity, thereby supplying liquid to the ice mold.

[0008] According to the present application, the liquid supplied to the secondary liquid storage region flows downward within the liquid supply conduit under the action of gravity, thereby supplying liquid to the ice mold. As a result, when the liquid supply pump is stopped and the liquid supply to the ice mold is terminated, the liquid connection from the liquid storage region to the ice mold is interrupted at the secondary liquid storage region, and all the liquid in the liquid supply conduit flows out to the ice mold. Thus, even when using a non-positive displacement pump that cannot rotate in reverse as the liquid supply pump, and without providing an opening for introducing external gas into the liquid supply conduit, backflow due to the siphon phenomenon can be prevented. Furthermore, since the secondary liquid storage region, which is isolated to prevent the siphon phenomenon, is provided inside the liquid storage container like the liquid storage region, it is not subject to contamination from the external environment.

[0009] As described above, according to the present application, it is possible to provide a liquid supply apparatus with a pump that cannot rotate in reverse as the liquid supply pump, the liquid supply apparatus is capable of suppling liquid stored in the liquid storage region to the ice mold in a clean state even in such a case .

[0010] Furthermore, in one embodiment of the present application, in the liquid supply apparatus of the present application, the secondary liquid storage region has an inclined bottom surface, a supply opening for supplying

liquid from the liquid storage region is provided on the upper inclined side of the bottom surface, and the inlet opening of the liquid supply conduit is provided on the lower inclined side of the bottom surface.

[0011] According to the present application, the supply opening for supplying liquid from the liquid storage region is provided on the upper inclined side of the inclined bottom surface of the secondary liquid storage region, and the inlet opening of the liquid supply conduit is provided on the lower inclined side. In this way, when the liquid supply pump is stopped and the liquid supply to the ice mold is terminated, all the liquid in the secondary liquid storage region can be supplied to the ice mold via the liquid supply conduit. As a result, liquid does not remain in the secondary liquid storage region, thereby maintaining the cleanliness of the secondary liquid storage region.

[0012] Furthermore, in one embodiment of the present application, in the liquid supply apparatus of the present application, the liquid supply conduit is formed as:

a first pipe having the inlet opening and extending outward from the liquid storage container; and
a second pipe having the outlet opening and provided inside a piping housing;
a pump body of the liquid supply pump provided inside the liquid storage container is driven in a non-contact manner via magnetic coupling by a drive part of the liquid supply pump provided inside the piping housing,
in a state where the piping housing, which is detachable relative to the liquid storage container, is installed on the liquid storage container, a first connection part on the side opposite to the inlet opening of the first pipe and a second connection part on the side opposite to the outlet opening of the second pipe are engaged with each other,
and the magnetic coupling is in a drive transmission state.

[0013] According to the present application, the liquid storage container with the liquid storage region, the pump body of the liquid supply pump, the secondary liquid storage region, and the first pipe, and the piping housing with the drive part of the liquid supply pump and the second pipe are constituted in a detachable manner, thus enabling easy maintenance and cleaning of the liquid supply apparatus. In particular, by dividing the liquid supply conduit into the first pipe and the second pipe and adopting magnetic coupling for the liquid supply pump, the liquid storage container and the piping housing can be easily assembled and disassembled.

[0014] Furthermore, in one embodiment of the present application, in the liquid supply apparatus of the present application, the first pipe extends diagonally downward from the liquid storage container,

the second connection part of the second pipe has elasticity,
when the detached piping housing is moved approximately horizontally to approach the liquid storage container for installation on the liquid storage container,
the elastically deformed second connection part advances along the extension direction of the first pipe in a manner to cover the outer surface of the first connection part, to become an engaged state,
and a drive part side portion of the magnetic coupling advances in a manner to approach a pump body side portion, to become a drive transmission state.

[0015] To prevent liquid from remaining in the first pipe when the liquid supply pump is stopped, the first pipe extends diagonally downward from the liquid storage container. On the other hand, for the pump body side portion and the drive part side portion of the magnetic coupling to be arranged in a manner capable of transmitting drive, the piping housing needs to move approximately horizontally to approach the liquid storage container. At this time, due to the elastic deformation of the second connection part, even if the piping housing moves approximately horizontally, the second connection part can advance along the extension direction of the first pipe in a manner to cover the outer surface of the first connection part.

[0016] In this way, by simply moving the piping housing approximately horizontally, the first pipe and the second pipe can be accurately engaged, while the pump body side portion and the drive part side portion of the magnetic coupling can be arranged to be capable of transmitting drive.

[0017] To achieve the above object of the application, one embodiment of the present application provides a refrigerator including the liquid supply apparatus according to any of the above embodiments. A refrigerator including the above liquid supply apparatus can also achieve various effects of the above liquid supply apparatus.

[0018] As described above, the present application can provide a liquid supply apparatus with a pump that cannot rotate in reverse as the liquid supply pump and a refrigerator including the liquid supply apparatus, the liquid supply apparatus is capable of suppling liquid stored in a liquid storage region to an ice mold in a clean state even in such a case.

BRIEF DESCRIPTION OF DRAWINGS

[0019] The specific embodiments of the present application will be further explained in detail with reference to the accompanying drawings, wherein:

Figure 1A is a side sectional view of a liquid supply apparatus according to one embodiment of the present application, showing the state where the liquid storage container is separated from the piping hous-

ing;

Figure 1B is a side sectional view of the liquid supply apparatus for suppling liquid to the ice mold according to one embodiment of the present application, showing the state during the installation of the piping housing onto the liquid storage container;

Figure 1C is a side sectional view of the liquid supply apparatus for suppling liquid to the ice mold according to one embodiment of the present application, showing the state where the piping housing is installed on the liquid storage container;

Figure 2 is a side sectional view of the structure of the magnetic coupling connecting the pump body and the drive part of the liquid supply pump according to one embodiment of the present application;

Figure 3 is a side sectional view showing the situation of supplying liquid from the liquid storage region to the ice mold in the liquid supply apparatus according to one embodiment of the present application;

Figure 4 is a side sectional view showing the state where the supply of liquid from the liquid storage region to the ice mold has been stopped in the liquid supply apparatus according to one embodiment of the present application;

Figure 5 is a side sectional view of a refrigerator including the liquid supply apparatus according to one embodiment of the present application.

DETAILED DESCRIPTION OF EMBODIMENTS

[0020] The embodiments for implementing the present application will now be explained with reference to the drawings. Furthermore, the refrigerator described below is a product for embodying the technical concept of the present application, and unless specifically stated, the present application is not limited to the following content. To make the explanation clearer, there may be cases where the size and positional relationships of the components shown in each figure are exaggerated. In the following description and drawings, the vertical direction is shown assuming the case where the refrigerator is placed on a horizontal plane.

(Liquid Supply Apparatus According to One Embodiment of the Present application)

[0021] Figures 1A to 1C are schematic side sectional views showing the liquid supply apparatus 2 according to one embodiment of the present application. Figure 1A shows the state where the liquid storage container 4 is separated from the piping housing 6, Figure 1B shows the state during the installation of the piping housing 6 onto the liquid storage container 4, and Figure 1C shows the state where the piping housing 6 is installed on the liquid storage container 4. Figure 2 is a schematic side sectional view showing the structure of the magnetic coupling 36 connecting the pump body 32 and the drive part 34 of the liquid supply pump 30.

[0022] First, the structure of the liquid supply apparatus 2 according to one embodiment of the present application will be explained with reference to Figures 1A to 2. The liquid supply apparatus 2 according to one embodiment of the present application includes a liquid storage container 4 and a piping housing 6. The liquid storage container 4 and the piping housing 6 can be assembled and disassembled from each other.

<Liquid Storage Container>

[0023] A liquid storage region 10 for storing liquid to be supplied to the ice mold 50 is provided in the lower part inside the liquid storage container 4. Any liquid, such as drinking water, can be used as the liquid to be supplied to the ice mold 50. A secondary liquid storage region 20 is provided at a position above the liquid storage region 10 inside the liquid storage container 4.

[0024] Inside the liquid storage container 4, a pump body 32 of the liquid supply pump 30 is also provided for supplying liquid stored in the liquid storage region 10 to the secondary liquid storage region 20. A pump body side portion 36A of the magnetic coupling 36 is mounted on the rotation shaft of a impeller 32A of the pump body 32. As described later, the impeller 32A of the pump body 32 is driven via the magnetic coupling 36 by a drive part 34 provided in the piping housing 6.

[0025] The pump body 32 is located within the liquid storage region 10, an inlet of the pump body 32 leads into the liquid stored in the liquid storage region 10. A discharge port of the pump body 32 is connected to a pump outlet pipe 38. The outlet end of the pump outlet pipe 38 opens into the secondary liquid storage region 20, forming a liquid supply opening 38A for supplying liquid stored in the liquid storage region 10 to the secondary liquid storage region 20.

[0026] The secondary liquid storage region 20 has an inclined bottom surface 22, with a supply opening 38Aprovided on the upper inclined side of the bottom surface 22. On the other hand, a first pipe 42 with an inlet opening 42A is connected to the lower inclined side of the bottom surface 22. The inlet opening 42Ais the upstream end opening of the first pipe 42 and becomes the upstream end opening of the liquid supply conduit 40 for supplying liquid from the secondary liquid storage region 20 to the ice mold 50. As shown in Figure 1A, the first pipe 42 extends diagonally downward along the inclination of the bottom surface 22 and terminates at a specified length. Thus, the first pipe 42 is formed to extend outward from the liquid storage container 4. Furthermore, the downstream end region of the first pipe 42 on the side opposite to the inlet opening 42A is called the first connection part 42B.

<Piping Housing>

[0027] Inside the piping housing 6, a second pipe 44 is provided, which together with the aforementioned first

pipe 42 forms the liquid supply conduit 40. The downstream end opening of the second pipe 44 becomes an outlet opening 44A provided above the ice mold 50. The upstream end region of the second pipe 44 on the side opposite to the outlet opening 44A is called a second connection part 44B. The second pipe 44 extends approximately vertically from the outlet opening 44A, curves approximately 90 degrees at the upper side of the second pipe 44, forming the second connection part 44B. As shown in Figure 1A, when the piping housing 6 is not installed on the liquid storage container 4, the second connection part 44B extends in an approximately horizontal direction.

[0028] When the piping housing 6 is installed on the liquid storage container 4, the first connection part 42B of the first pipe 42 and the second connection part 44B of the second pipe 44 become engaged with each other. The second connection part 44B includes a tip part 44B 1 that engages with the first connection part 42B and an elastic part 44B2. Thus, the second connection part 44B has elasticity. The elastic part 44B2 is preferably formed of a flexible resin material including silicone. When installing the piping housing 6 onto the liquid storage container 4, the second connection part 44B tilts through the elastic deformation of the elastic part 44B2, allowing it to smoothly engage with the first connection part 42B that extends diagonally downward.

[0029] In the lower part inside the piping housing 6, the drive part 34 of the liquid supply pump 30, which is an electric motor, is provided. A drive part side portion 36B of the magnetic coupling 36 is mounted on the drive shaft of the drive part 34. When the piping housing 6 is installed on the liquid storage container 4, the drive shaft of the drive part 34 and the rotation shaft of the impeller 32A of the pump body 32 are arranged coaxially.

<Magnetic Coupling>

[0030] Figure 2 shows the state where the piping housing 6 is installed on the liquid storage container 4 and the pump body side portion 36A and the drive part side portion 36B of the magnetic coupling 36 are in a drive transmission state. The pump body side portion 36A of the magnetic coupling 36 mounted on the rotation shaft of the impeller 32A of the pump body 32 has magnetism. The drive part side portion 36B of the magnetic coupling 36 mounted on the drive shaft of the drive part 34 has magnetism with polarity opposite to the north and south poles of the pump body side portion 36A. In this way, the driving force of the drive part 34 is transmitted to the rotation shaft of the impeller 32A of the pump body 32 in a non-contact state, utilizing the magnetic force between the pump body side portion 36A and the drive part side portion 36B.

[0031] By moving the liquid storage container 4 approximately horizontally in the direction away from the piping housing 6 (to the left in the figure) from the state shown in Figure 2, the liquid storage container 4 can be detached from the piping housing 6, simultaneously separating the pump body side portion 36A and the drive part side portion 36B that constitute the magnetic coupling 36. On the other hand, by moving the detached liquid storage container 4 approximately horizontally in the direction approaching the piping housing 6 (to the right in the figure), the liquid storage container 4 can be installed on the piping housing 6, simultaneously setting the magnetic coupling 36 to the drive transmission state.

<Assembly of Liquid Storage Container and Piping Housing>

[0032] The process of installing the detached piping housing 6 onto the liquid storage container 4 will now be explained in sequence with reference to Figures 1A to 1C. Starting from the state shown in Figure 1A, the piping housing 6 is moved approximately horizontally in the direction approaching the liquid storage container 4 (refer to arrow A), and the insertion part 6A on the upper side of the piping housing 6 is inserted into the guide hole of the liquid storage container 4. As the position is guided through the guide hole, when the piping housing 6 further approaches the liquid storage container 4, the tip of the second connection part 44B of the second pipe 44 provided in the piping housing 6 comes into contact with the tip of the first connection part 42B of the first pipe 42 provided in the liquid storage container 4.

[0033] Figure 1B shows the situation when the piping housing 6 is pushed closer to the liquid storage container 4 from the state where the tips of the first connection part 42B and the second connection part 44B are in contact. As shown by arrow A in Figure 1B, when pushing the piping housing 6 approximately horizontally, the drive part side portion 36B of the magnetic coupling 36 advances in the direction of arrow A, thus approaching the pump body side portion 36A. Then, as shown in Figure 1C, when the contact surface 6B of the piping housing 6 reaches the position where it contacts the contact surface 4B of the liquid storage container 4, the magnetic coupling 36 enters the drive force transmission state.

[0034] As shown by arrow A in Figure 1B, when the piping housing 6 is pushed approximately horizontally from the state where the tips of the first connection part 42B and the second connection part 44B are in contact, the elastic part 42B2 of the second connection part 44B elastically deforms. Then, as shown by arrow B in Figure 1B, the tip part 42B 1 of the second connection part 44B advances along the extension direction of the first pipe 42, which extends diagonally downward, in a manner to cover the outer surface of the first connection part 42B. Then, as shown in Figure 1C, when the contact surface 6B of the piping housing 6 reaches the position where it contacts the contact surface 4B of the liquid storage container 4, the first connection part 42B of the first pipe 42 and the second connection part 44B of the second pipe 44 become fully engaged.

[0035] In this way, the piping housing 6 is installed on

the liquid storage container 4, bringing the magnetic coupling 36 of the liquid supply pump 30 into the drive force transmission state, and engaging the first pipe 42 with the second pipe 44, making the liquid supply conduit 30 an integrated state. As a result, the liquid supply apparatus 2 of this embodiment becomes operational.

[0036] In this embodiment, from the perspective of preventing liquid leakage at the liquid supply conduit 40, the downstream second connection part 44B engages with the upstream first connection part 42B in a manner to cover an outer surface of the upstream first connection part 42B. However, this is not limited to this arrangement. As long as the sealing between the first connection part 42B and the second connection part 44B can be ensured, it is also possible for the first connection part 42B to engage with the second connection part 44B in a manner to cover an outer surface of the second connection part 44B, or for the ends of the first connection part 42B and the second connection part 44B to connect with each other in an abutting manner. In any case, because the second connection part 44B has elasticity, it can smoothly engage and join with the first connection part 42B that extends diagonally downward, even if the piping housing 6 moves approximately horizontally.

[0037] As described above, in the liquid supply apparatus 2 of this embodiment, the liquid supply conduit 40 is formed by the first pipe 42 having the inlet opening 42A and extending outward from the liquid storage container 4, and the second pipe 44 having the outlet opening 44A and provided inside the piping housing 6. The pump body 32 of the liquid supply pump 30 provided inside the liquid storage container 4 is driven in a non-contact manner via the magnetic coupling 36 by the drive part 34 of the liquid supply pump 30 provided inside the piping housing 6. In the state where the piping housing 6, which is detachable relative to the liquid storage container 4, is installed on the liquid storage container 4, the first connection part 42B on the side opposite to the inlet opening 42A of the first pipe 42 and the second connection part 44B on the side opposite to the outlet opening 44A of the second pipe 44 are engaged with each other, and the magnetic coupling 36 is in the drive transmission state.

[0038] According to this embodiment, the liquid storage container 4 having the liquid storage region 10, the pump body 32 of the liquid supply pump 30, the secondary liquid storage region 20, and the first pipe 42, and the piping housing 6 having the drive part 34 of the liquid supply pump 30 and the second pipe 44 are configured in a detachable manner, thus enabling easy maintenance and cleaning of the liquid supply apparatus 2. In particular, by dividing the liquid supply conduit 40 into the first pipe 42 and the second pipe 44 and adopting the magnetic coupling 36 for the liquid supply pump 30, the liquid storage container 4 and the piping housing 6 can be easily assembled and disassembled.

[0039] Furthermore, the first pipe 42 extends diagonally downward from the liquid storage container 4, and the second connection part 44B of the second pipe 44 has elasticity. When the detached piping housing 6 is moved approximately horizontally to approach the liquid storage container 4 for installation, the elastically deformed second connection part 44B advances along the extension direction of the first pipe 42 in a manner to cover the outer surface of the first connection part 42B, becoming engaged, and the drive part side portion 36B of the magnetic coupling 36 advances to approach the pump body side portion 36A, entering the drive transmission state.

[0040] To prevent liquid from remaining in the first pipe 42 when the liquid supply pump 30 is stopped, the first pipe 42 extends diagonally downward from the liquid storage container 4. On the other hand, for the pump body side portion 36A and the drive part side portion 36B of the magnetic coupling 36 to be arranged in a manner capable of transmitting drive, the piping housing 6 needs to move approximately horizontally to approach the liquid storage container 4. At this time, due to the elastic deformation of the second connection part 44B, even if the piping housing 6 moves approximately horizontally, the second connection part 44B can advance along the extension direction of the first pipe 42 in a manner to cover the outer surface of the first connection part 42B.

[0041] In this way, by simply moving the piping housing 6 approximately horizontally, the first pipe 42 and the second pipe 44 can be accurately engaged, while the pump body side portion 36A and the drive part side portion 36B of the magnetic coupling 36 can be arranged to be capable of transmitting drive.

(Liquid Flow in the Liquid Supply Apparatus)

[0042] Figure 3 is a schematic side sectional view showing the situation of supplying liquid from the liquid storage region 10 to the ice mold 50 in the liquid supply apparatus 2 according to one embodiment of the present application. Figure 4 is a schematic side sectional view showing the state where the supply of liquid from the liquid storage region 10 to the ice mold 50 has been stopped in the liquid supply apparatus 2 according to one embodiment of the present application. The liquid flow in the liquid supply apparatus 2 will now be explained with reference to Figures 3 and 4.

[0043] As shown in Figure 3, when the liquid supply pump 30 is operating, liquid stored in the liquid storage region 10 is supplied to the secondary liquid storage region 20 located above. Anon-positive displacement pump, which is low-cost and easy to maintain, is used as the liquid supply pump 30. More specifically, a centrifugal pump represented by a vortex pump or a helical pump represented by an axial flow pump can be used. The liquid supplied to the secondary liquid storage region 20 flows along the inclined bottom surface 22 under the action of gravity and enters the liquid supply conduit 40 through the inlet opening 42A. Then, the liquid flows downward within the liquid supply conduit 40 and is supplied to the ice mold 50 from the outlet opening 44A.

[0044] Since the cross-sectional area of the liquid

supply conduit 40 is smaller than the cross-sectional area of the secondary liquid storage region 20 in the direction perpendicular to the flow, the liquid stagnates to some extent in the secondary liquid storage region 20. The volume of liquid stagnating in the secondary liquid storage region 20 is determined by factors such as the discharge volume of the liquid supply pump 30, the volume of the secondary liquid storage region 20, and the inner diameter (cross-sectional area) of the liquid supply conduit 40. It is preferable to determine the discharge volume of the liquid supply pump 30, the volume of the secondary liquid storage region 20, and the inner diameter (cross-sectional area) of the liquid supply conduit 40 to achieve an appropriate volume. As an example, the volume of liquid stagnating in the secondary liquid storage region 20 can range from 50cc to 200cc.

[0045] The bottom surface 22 of the secondary liquid storage region 20 is inclined, and the first pipe 42 of the liquid supply conduit 40 connected to the secondary liquid storage region 20 extends diagonally downward along the inclination of the bottom surface 22, thus allowing the liquid supplied to the secondary liquid storage region 20 to flow effectively and be supplied to the ice mold 50. As an example, the inclination angle of the bottom surface 22 relative to the horizontal plane can range from 10 degrees to 30 degrees. Not only can the inclination angle of the first pipe 42 be the same as the inclination angle of the bottom surface 22, but it can also be smaller or larger than that of the bottom surface 22. In any case, it is preferable for the first pipe 42 to extend diagonally downward rather than horizontally or vertically.

[0046] After supplying a specified amount of liquid to the ice mold 50, the operation of the liquid supply pump 30 is stopped. Since the bottom surface 22 of the secondary liquid storage region 20 is inclined, the first pipe 42 extends diagonally downward, and the more downstream second pipe 44 extends approximately vertically, almost all of the liquid supplied to the secondary liquid storage region 20 flows towards and falls into the ice mold 50. As a result, as shown in Figure 4, the liquid from the liquid storage region 10 fills up to the position indicated by arrow C in the pump outlet pipe 38 through the pump body 32, without remaining in the secondary liquid storage region 20 or the liquid supply conduit 40. This way, the cleanliness of the secondary liquid storage region 20 and the liquid supply conduit 40 can be maintained.

[0047] As described above, the liquid supply apparatus 2 of this embodiment includes: a liquid storage container 4; a liquid storage region 10 provided inside the liquid storage container 4 for storing liquid to be supplied to the ice mold 50; a secondary liquid storage region 20 provided inside the liquid storage container 4 above the liquid storage region 10; a liquid supply pump 30, which is a non-positive displacement pump, for supplying the liquid stored in the liquid storage region 10 to the secondary liquid storage region 20; and a liquid supply conduit 40, the inlet opening 42A of the liquid supply conduit 40 is provided inside the secondary liquid storage region 20 and the outlet opening 44A of the liquid supply conduit 40 is provided above the ice mold 50; the secondary liquid storage region 20 is provided above the ice mold 50, and the liquid supplied from the liquid storage region 10 to the secondary liquid storage region 20 by the liquid supply pump 30 flows downward within the liquid supply conduit 40 under the action of gravity, thereby supplying liquid to the ice mold 50.

[0048] The liquid supplied to the secondary liquid storage region 20 flows downward within the liquid supply conduit 40 under the action of gravity, thereby supplying liquid to the ice mold 50. As a result, when the liquid supply pump 30 is stopped and the liquid supply to the ice mold 50 is terminated, the liquid connection from the liquid storage region 10 to the ice mold is interrupted at the secondary liquid storage region 20, and all the liquid in the liquid supply conduit 40 flows out to the ice mold 50. Thus, even when using a non-positive displacement pump that cannot rotate in reverse as the liquid supply pump 30, and without providing an opening for introducing external gas into the liquid supply conduit 40, backflow due to the siphon phenomenon can be prevented. Furthermore, since the secondary liquid storage region 20, which is isolated to prevent the siphon phenomenon, is provided inside the liquid storage container 4 like the liquid storage region 10, it is not subject to contamination from the external environment.

[0049] As a result, in the liquid supply apparatus 2 of this embodiment, even when using a pump that cannot rotate in reverse as the liquid supply pump 30, it is possible to supply liquid stored in the liquid storage region 10 to the ice mold 50 in a clean state.

[0050] Particularly, in the liquid supply apparatus 2 of this embodiment, the secondary liquid storage region 20 has an inclined bottom surface 22, a supply opening 38A for supplying liquid from the liquid storage region 10 is provided on the upper inclined side of the bottom surface 22, and the inlet opening 42A of the liquid supply conduit 40 is provided on the lower inclined side of the bottom surface 22.

[0051] In this way, when the liquid supply pump 30 is stopped and the liquid supply to the ice mold 50 is terminated, all the liquid in the secondary liquid storage region 20 can be supplied to the ice mold 50 via the liquid supply conduit 40. As a result, liquid does not remain in the secondary liquid storage region 20, thereby maintaining the cleanliness of the secondary liquid storage region 20.

(Refrigerator Including the Liquid Supply Apparatus According to One Embodiment of the Present application)

[0052] Figure 5 is a schematic side sectional view showing a refrigerator 100 including the liquid supply apparatus 2 according to one embodiment of the present application. The refrigerator 100 includes a freezing

compartment 102 and a refrigerating compartment 104, with the liquid supply apparatus 2 provided in the refrigerating compartment 104, and the ice mold 50 provided inside the freezing compartment 102. The gas inside the refrigerator circulates through a fan 108, and the cold air cooled by passing through an evaporator 106 flows into the freezing compartment 102. The liquid supplied to the ice mold 50 by the liquid supply apparatus 2 is cooled and frozen by this cold air, thereby producing ice.

[0053] The refrigerator 100 including this liquid supply apparatus 2 can also achieve the various effects of the aforementioned liquid supply apparatus.

[0054] Although embodiments and implementations of the present application have been described, the disclosed content may vary in structural details, and combinations or sequences of elements in the embodiments and implementations may be changed, without departing from the scope and spirit of the claimed application.

Claims

1. A liquid supply apparatus, **characterized in that**, the liquid supply apparatus comprising:

   a liquid storage container;
   a liquid storage region provided inside the liquid storage container for storing liquid to be supplied to an ice mold;
   a secondary liquid storage region provided inside the liquid storage container above the liquid storage region;
   a liquid supply pump, which is configured as a non-positive displacement pump, for supplying the liquid stored in the liquid storage region to the secondary liquid storage region; and
   a liquid supply conduit, an inlet opening of the liquid supply conduit is provided inside the secondary liquid storage region and an outlet opening of the liquid supply conduit is provided above the ice mold;
   wherein the secondary liquid storage region is provided above the ice mold,
   and the liquid supplied from the liquid storage region to the secondary liquid storage region by the liquid supply pump flows downward within the liquid supply conduit under the action of gravity, thereby supplying liquid to the ice mold.

2. The liquid supply apparatus according to claim 1, **characterized in that** the secondary liquid storage region has an inclined bottom surface, a supply opening for supplying liquid from the liquid storage region is provided on the upper inclined side of the bottom surface, and the inlet opening of the liquid supply conduit is provided on the lower inclined side of the bottom surface.

3. The liquid supply apparatus according to claim 2, **characterized in that**:
   the liquid supply conduit is formed by:

   a first pipe having the inlet opening and extending outward from the liquid storage container; and
   a second pipe having the outlet opening and provided inside a piping housing;
   a pump body of the liquid supply pump provided inside the liquid storage container is driven in a non-contact manner via magnetic coupling by a drive part of the liquid supply pump provided inside the piping housing,
   in a state where the piping housing, which is detachable relative to the liquid storage container, is installed on the liquid storage container, a first connection part on the side opposite to the inlet opening of the first pipe and a second connection part on the side opposite to the outlet opening of the second pipe are engaged with each other,
   and the magnetic coupling is in a drive transmission state.

4. The liquid supply apparatus according to claim 3, **characterized in that**:

   the first pipe extends diagonally downward from the liquid storage container,
   the second connection part of the second pipe has elasticity,
   when the detached piping housing is moved approximately horizontally to approach the liquid storage container for installation on the liquid storage container,
   the elastically deformed second connection part advances along the extension direction of the first pipe in a manner to cover the outer surface of the first connection part, to become an engaged state,
   and a drive part side portion of the magnetic coupling advances in a manner to approach a pump body side portion, to become a drive transmission state.

5. The liquid supply apparatus according to claim 4, **characterized in that** the cross-sectional area of the liquid supply conduit is smaller than the cross-sectional area of the secondary liquid storage region in the flow direction, liquid stagnates in the secondary liquid storage region, and the volume of liquid stagnating in the secondary liquid storage region is in the range of 50 cc or more and 200 cc or less.

6. A refrigerator, **characterized in that**, the refrigerator comprising a liquid supply apparatus, the liquid supply apparatus comprises:

a liquid storage container;
a liquid storage region provided inside the liquid storage container for storing liquid to be supplied to an ice mold;
a secondary liquid storage region provided inside the liquid storage container above the liquid storage region;
a liquid supply pump, which is configured as a non-positive displacement pump, for supplying the liquid stored in the liquid storage region to the secondary liquid storage region; and
a liquid supply conduit, an inlet opening of the liquid supply conduit is provided inside the secondary liquid storage region and an outlet opening of the liquid supply conduit is provided above the ice mold;
wherein the secondary liquid storage region is provided above the ice mold,
and the liquid supplied from the liquid storage region to the secondary liquid storage region by the liquid supply pump flows downward within the liquid supply conduit under the action of gravity, thereby supplying liquid to the ice mold.

7. The refrigerator according to claim 6, **characterized in that** the secondary liquid storage region has an inclined bottom surface, a supply opening for supplying liquid from the liquid storage region is provided on the upper inclined side of the bottom surface, and the inlet opening of the liquid supply conduit is provided on the lower inclined side of the bottom surface.

8. The refrigerator according to claim 7, **characterized in that**:
the liquid supply conduit is formed by:

a first pipe having the inlet opening and extending outward from the liquid storage container; and
a second pipe having the outlet opening and provided inside a piping housing;
a pump body of the liquid supply pump provided inside the liquid storage container is driven in a non-contact manner via magnetic coupling by a drive part of the liquid supply pump provided inside the piping housing,
in a state where the piping housing, which is detachable relative to the liquid storage container, is installed on the liquid storage container, a first connection part on the side opposite to the inlet opening of the first pipe and a second connection part on the side opposite to the outlet opening of the second pipe are engaged with each other,
and the magnetic coupling is in a drive transmission state.

9. The refrigerator according to claim 8, **characterized in that**:

the first pipe extends diagonally downward from the liquid storage container,
the second connection part of the second pipe has elasticity,
when the detached piping housing is moved approximately horizontally to approach the liquid storage container for installation on the liquid storage container,
the elastically deformed second connection part advances along the extension direction of the first pipe in a manner to cover the outer surface of the first connection part, to become an engaged state,
and the drive part side portion of the magnetic coupling advances in a manner to approach the pump body side portion, to become a drive transmission state.

10. The refrigerator according to claim 9, **characterized in that** the refrigerator comprises a freezing compartment and a refrigerating compartment, the liquid supply apparatus is provided in the refrigerating compartment, and the ice mold is provided in the freezing compartment.

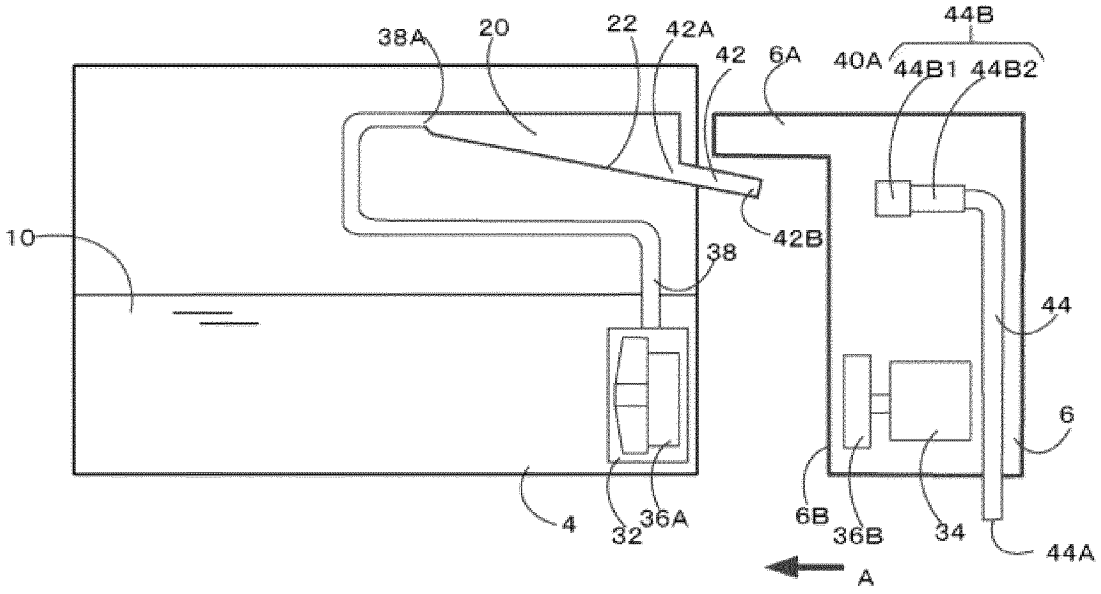
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Fig.1A

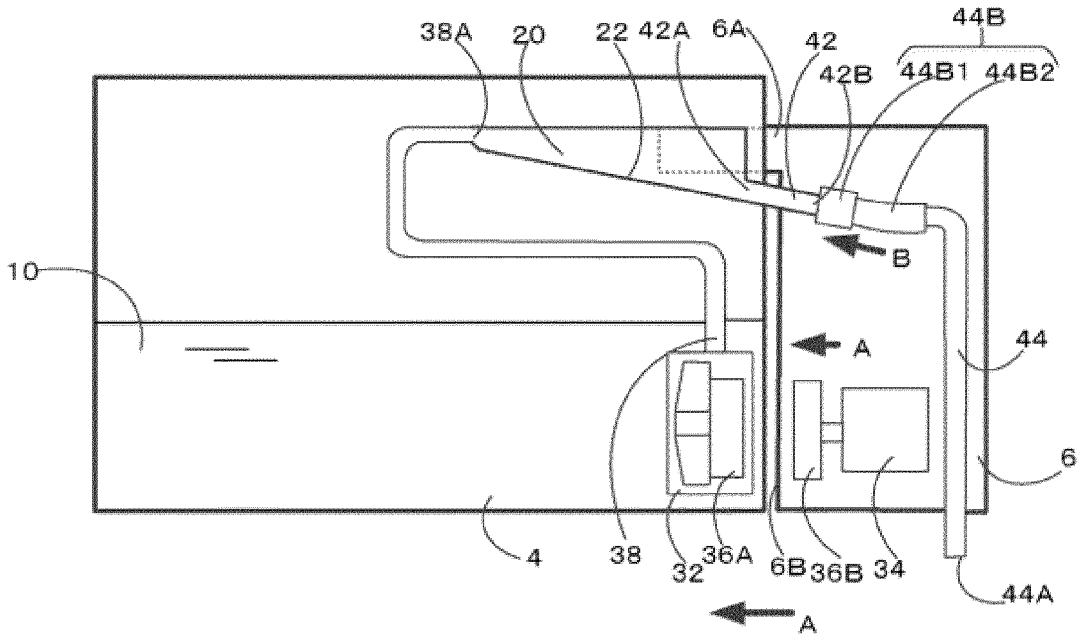
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Fig.1B

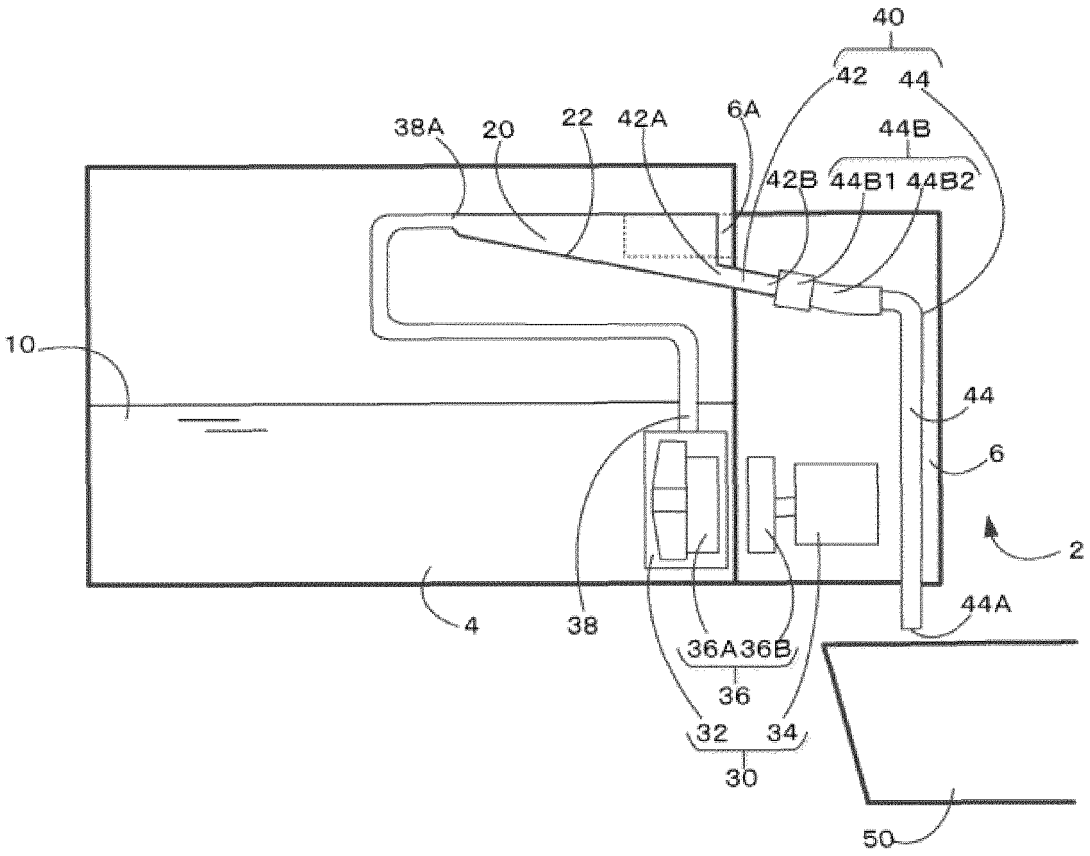
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Fig.1C

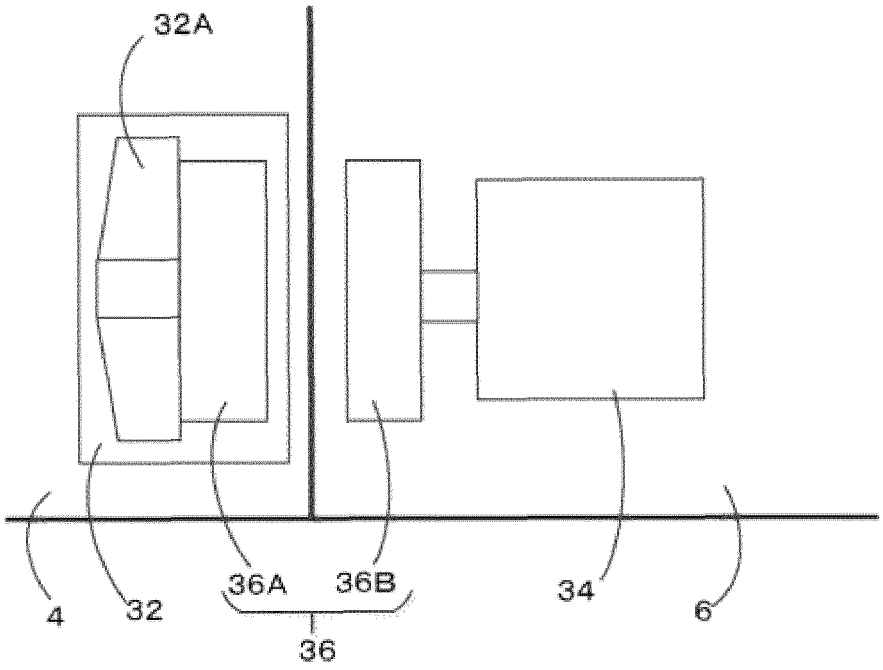
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Fig.2

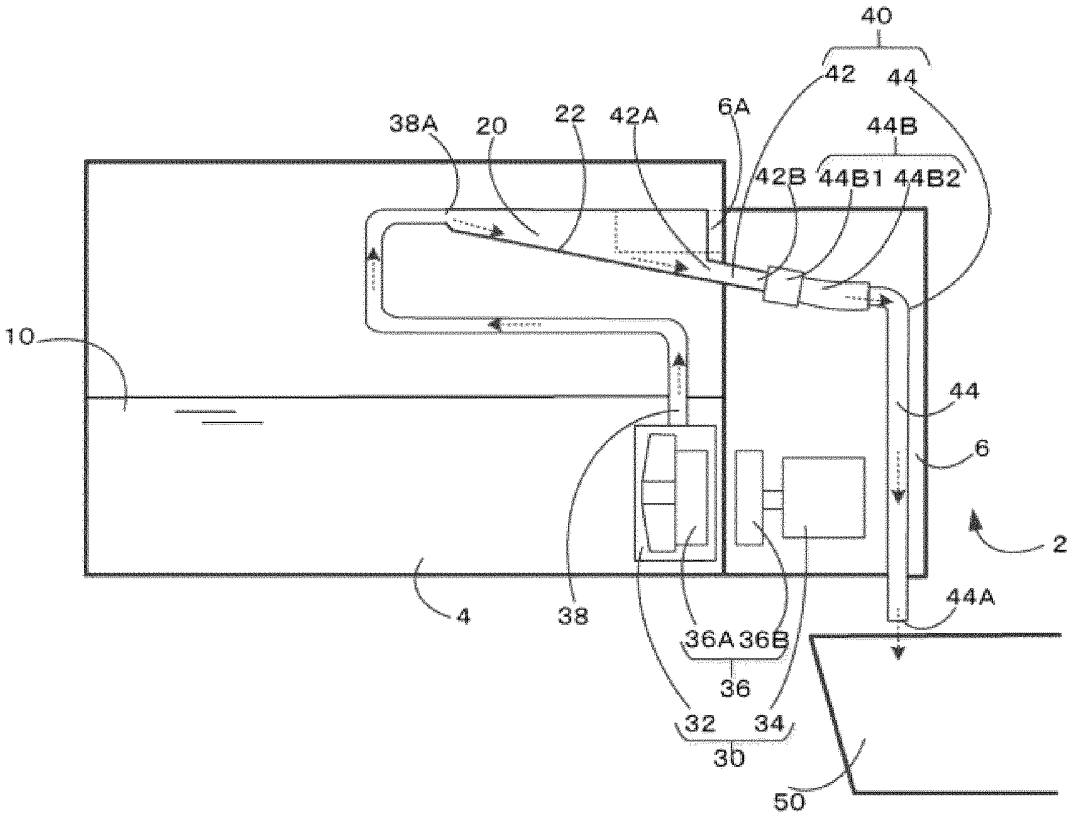
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Fig.3

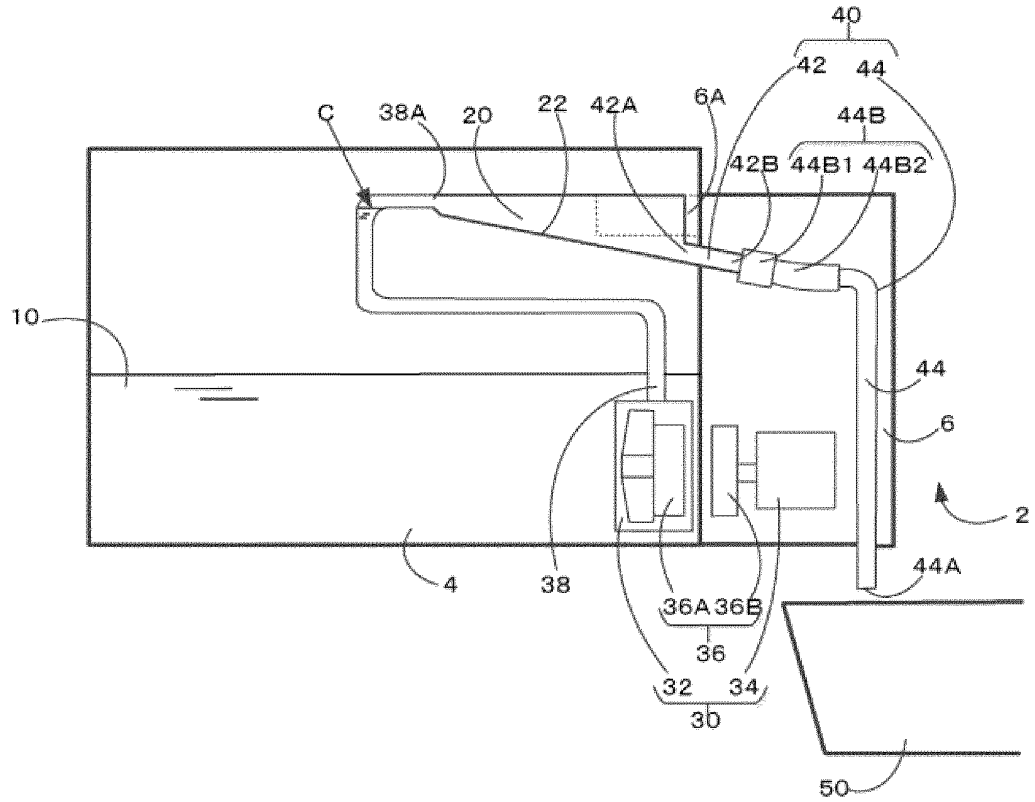
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Fig.4

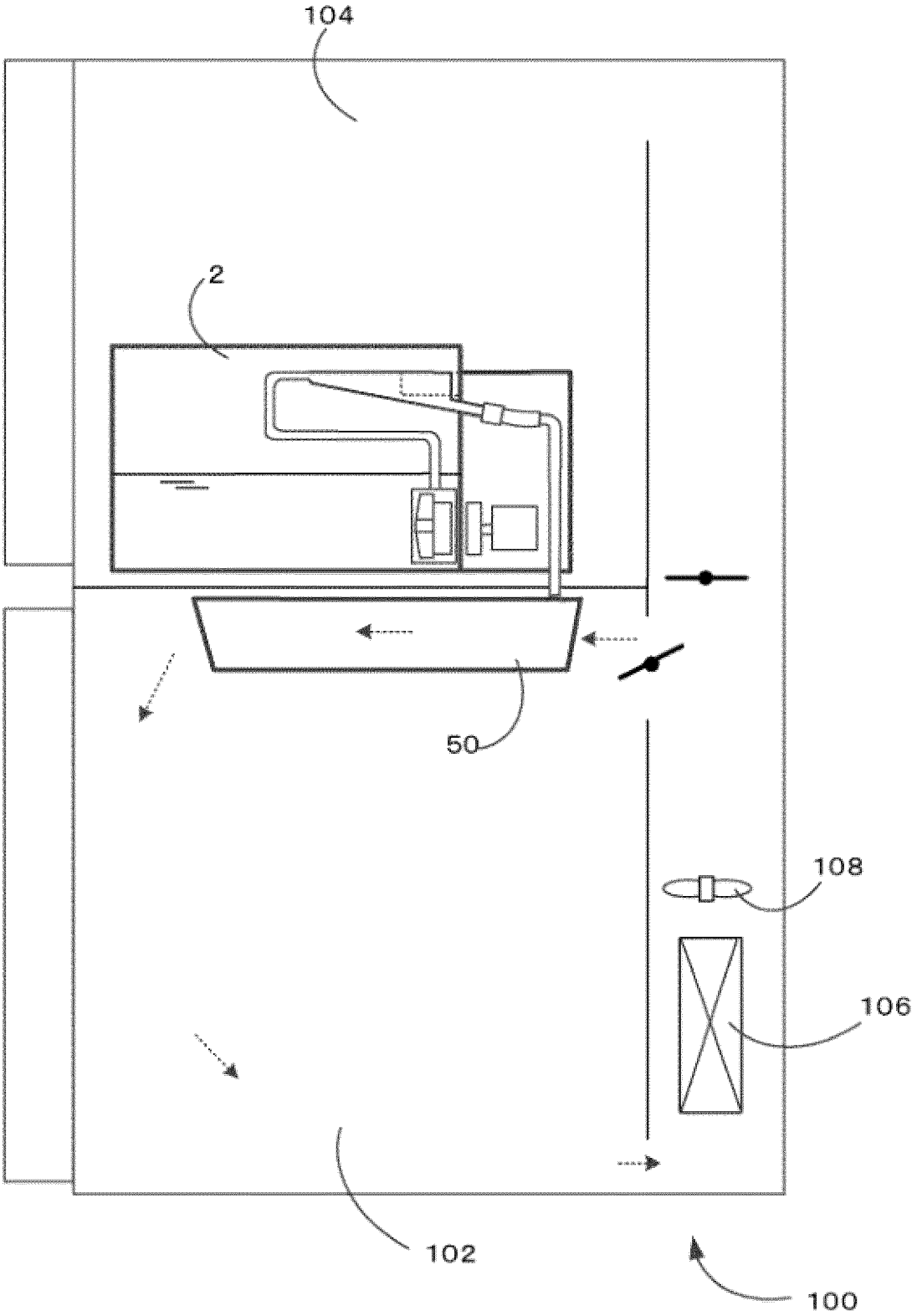

Fig.5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/086137

A. CLASSIFICATION OF SUBJECT MATTER

F25C1/00(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:F25C,F24D,F25D,G05D

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)

CNTXT, ENTXT, WPABS, DWPI, CJFD, WFNPL, 中国期刊全文数据库, CJFD: 海尔, AQUA株式会社, 储液, 贮液, 集液, 集水, 存液, 储水, 储存, 供液, 箱体, 冰, 泵, 重力, 流, 制冰, 泵, 自动, 流动, 冰箱, 储液, 辅助, 配管, 供给, 倾斜, 下, 上, 逆向, 转动, 清洁, Liquid, storage tank, stor+, liquid, container, ice, auxiliary, box, lower, flow, path, open+, valve, gravit+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2021092337 A (AQUA K.K.) 17 June 2021 (2021-06-17) claim 1, and figure 2	1-10
A	CN 102322717 A (HEFEI MIDEA RONGSHIDA REFRIGERATOR CO., LTD. et al.) 18 January 2012 (2012-01-18) entire document	1-10
A	CN 106196846 A (QINGDAO HAIER INTELLIGENT TECHNOLOGY RESEARCH AND DEVELOPMENT CO., LTD.) 07 December 2016 (2016-12-07) entire document	1-10
A	CN 112923622 A (QINGDAO HAIER REFRIGERATOR CO., LTD. et al.) 08 June 2021 (2021-06-08) entire document	1-10
A	CN 111829220 A (QINGDAO HAIER REFRIGERATOR CO., LTD. et al.) 27 October 2020 (2020-10-27) entire document	1-10

☑ 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
11 July 2023	**20 July 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.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/086137

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2021089109 A (AQUA K. K.) 10 June 2021 (2021-06-10) entire document	1-10
A	JP 2021103033 A (AQUA K. K.) 15 July 2021 (2021-07-15) entire document	1-10
A	JP H0229571 A (MITSUBISHI ELECTRIC CORP.) 31 January 1990 (1990-01-31) entire document	1-10
A	JP H06273019 A (TOSHIBA CORP.) 30 September 1994 (1994-09-30) entire document	1-10
A	JP H0763450 A (TOSHIBA CORP.) 10 March 1995 (1995-03-10) entire document	1-10
A	US 2011214447 A1 (WHIRLPOOL S.A.) 08 September 2011 (2011-09-08) entire document	1-10
A	US 9273894 B1 (WHITTY, K. F. et al.) 01 March 2016 (2016-03-01) entire document	1-10
A	WO 2021052389 A1 (QINGDAO HAIER REFRIGERATOR CO., LTD. et al.) 25 March 2021 (2021-03-25) entire document	1-10

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2023/086137

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
JP	2021092337	A	17 June 2021	None			
CN	102322717	A	18 January 2012	None			
CN	106196846	A	07 December 2016	None			
CN	112923622	A	08 June 2021	None			
CN	111829220	A	27 October 2020	None			
JP	2021089109	A	10 June 2021	None			
JP	2021103033	A	15 July 2021	None			
JP	H0229571	A	31 January 1990	None			
JP	H06273019	A	30 September 1994	KR	940022036	A	19 October 1994
				TW	273006	B	21 March 1996
JP	H0763450	A	10 March 1995	None			
US	2011214447	A1	08 September 2011	BRPI	0700975	A	23 September 2008
				EP	2118592	A1	18 November 2009
				WO	2008095268	A1	14 August 2008
US	9273894	B1	01 March 2016	None			
WO	2021052389	A1	25 March 2021	JP	2021046966	A	25 March 2021
				EP	4033182	A1	27 July 2022

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H07260306 B **[0003]**