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

(11) EP 3 425 310 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
09.01.2019 Bulletin 2019/02

(51) Int Cl.:
F25C 1/08 *(2006.01)*

(21) Application number: **18179451.2**

(22) Date of filing: **25.06.2018**

(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
Designated Validation States:
KH MA MD TN

(30) Priority: **07.07.2017 TR 201710070**

(71) Applicant: **Vestel Beyaz Esya Sanayi ve Ticaret A.S.**
45030 Manisa (TR)

(72) Inventors:
- **EBEPERI, Ismail Caglar**
  45030 Manisa (TR)
- **ASIK, Rustem**
  45030 Manisa (TR)

(74) Representative: **Cayli, Hülya**
Paragon Consultancy Incorporated
Koza Sokak No: 63/2
GOP 06540 Ankara (TR)

(54) OPERATION METHOD FOR COOLING DEVICES

(57) The operation method developed according to the present invention suitable for use in a cooling apparatus, the cooling apparatus comprising the cooling compartment; the evaporator (1), at the condenser and the compressor to enable cooling of this cooling compartment; the control unit which is able to receive user command via a user interface; and the ice making apparatus (A) which comprises the storage (4) in which the water is stored; the first chamber (2) to where a part of the evaporator (1) extends, which is rotatable around an axis, and which is able to stop in the first position, and the second position along with the third position; the second chamber (3) which has the first compartment (3a) to where water contained in the first chamber (2) is transferred in the second position, and the second compartment (3b) to where ice contained in the first chamber (2) is transferred in the third position, and the sensor for measuring the temperature of the water contained in said storage (4), the method comprising the steps of: measuring the temperature of the water contained in the storage (4) upon receiving a command from the user via said user interface; determining the time information during which the evaporator (1) is required to operate to produce ice according to the measured temperature; after the evaporator (1) operates, moving the first chamber (2) to the second position and keeping it for the first time; following the first time, moving the first chamber (2) to the third position and in this third position, for a predetermined second time, transferring the ice that leaves the evaporator (1) by conducting defrosting process, to the second compartment (3b); ending the ice making process at the end of the second time.

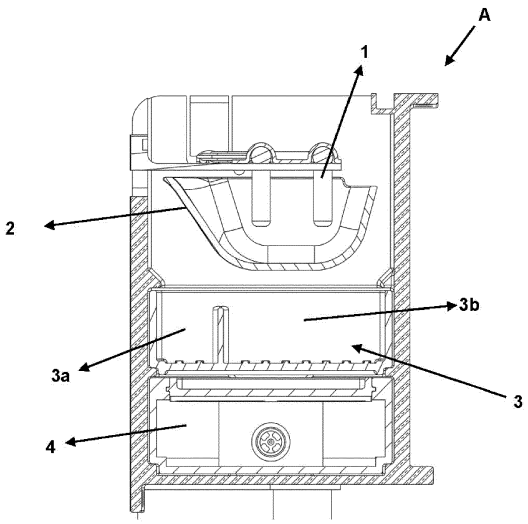

Figure 1

EP 3 425 310 A1

Description

Technical Field

[0001] Present invention relates to operation methods for cooling devices which have the ability to make ice in a fast manner.

Prior Art

[0002] Cooling devices used to cool a product comprise at least a cooling compartment which works at a temperature within the range of 0°C to 5°C, and at least a freezer compartment which works at a temperature below 0°C. Depending on the coldness level required by the product to be cooled, the product is located at the related compartment and, by this way, cooled to be at the proper temperature.

[0003] As well as cooling a product, the cooling devices also have various apparatus which are used to make ice. In its simplest way, this apparatus may be in the form of a tray comprising plurality of chambers in which water is filled. To meet the need of ice, a user fills these chambers with water and places the apparatus to the freezer compartment. As water in the chambers freezes after a while, the user can meet his/her need of ice. However, such apparatus requires considerably long ice making time and may not be able to meet the user needs sufficiently. Due to the fact that need of ice increases especially for the summer months; these apparatus remain incapable to meet the need of ice.

[0004] Within this context, while various embodiments for fast ice making process are known in the prior art, the most common one is, as described in the patent document No. US2007163282A1, plunging a part of the evaporator, which performs the ice making process, into the water contained within an ice bucket filled with water, and providing ice formation in said part of the evaporator. However, the embodiment described in said document, in particular, does not contain any operation method for the water temperature control, which affects the ice making time directly. Therefore, the embodiment described in said document may be insufficient for fast ice making process.

Summary of the Invention

[0005] The operation method according to the present invention suitable for use in a cooling apparatus, the cooling apparatus comprising at least a cooling compartment; at least an evaporator, at least a condenser and at least a compressor to enable cooling of this cooling compartment; at least a control unit which is able to receive user command via a user interface; and at least an ice making apparatus which comprises

- at least a storage in which the water to be used for ice making is stored;
- at least a first chamber into which the water is transferred for ice making, to where at least a part of said evaporator extends in order to transform water into ice by cooling, which is rotatable around an axis by means of at least a movement element, which is able to stop in at least a first position, and at least a second position along with at least a third position as a result of this rotation, which has at least an opening to transfer water and to enable said part of the evaporator to extend into;
- at least a second chamber positioned in a lower region of the first chamber, which has at least a first compartment to where water contained in the first chamber is transferred in the second position of the first chamber, and at least a second compartment to where ice contained in the first chamber is transferred in the third position of the first chamber, and
- at least a sensor for measuring the temperature of the water in said storage,

the method comprising the steps of:

- measuring the temperature of the water contained in the storage upon receiving a command for ice making from the user via said user interface;
- determining the time information, during which the evaporator is required to operate to produce a predetermined amount of ice according to the measured temperature, from a table in the control unit which includes the predetermined operating time information of the evaporator for the related temperature value according to the temperature information of the water;
- after the evaporator operates for the predetermined time, moving the first chamber to the second position via said movement element and transferring the water, which is not transformed into ice by keeping the first chamber (2) in this second position for a predetermined first time, to said first compartment;
- following said first time, moving the first chamber to the third position via the movement element and in this third position, for a predetermined second time, conducting defrosting process to make formed ice leave the evaporator

such that the hot coolant from the compressor is transmitted directly into the part of the evaporator that extends into the first chamber at a third time and that the transmission is ceased for a fourth time, and in the meantime, transferring the ice leaving the evaporator to the second compartment of the second chamber due to the third position of the first chamber;

- ending the ice making process at the end of said second time.

[0006] With the operation method developed according to the present invention, it is provided for the cooling devices, which have the function of fast ice making, to carry out the ice making process in a fast, more efficient and more effective manner by the temperature control. Moreover, it is provided to produce fixed amount of ice in each ice making process and a reliable operation method is obtained.

Object of the Invention

[0007] Object of the present invention is to develop an operation method for the cooling devices having the function of fast ice making.

[0008] Another object of the present invention is to develop a temperature controlled operation method for the cooling devices having the function of fast ice making.

[0009] Another object of the present invention is to develop an operation method for the cooling devices having the function of fast ice making that increases the user satisfaction.

[0010] Another object of the present invention is to develop an operation method for the cooling devices having the function of fast ice making that provides to produce fixed amount of ice.

[0011] Another object of the present invention is to develop a practical and reliable operation method for the cooling devices having the function of fast ice making.

Description of the Drawings

[0012] In an ice making apparatus comprised within the cooling device in which the operation method developed by the present invention is implemented, exemplary embodiments of the operation method is illustrated in the annexed figures, in which:

Figure 1, is a side sectional view of a position of the ice making apparatus.
Figure 2, is a side sectional view of another position of the ice making apparatus.
Figure 3, is a side sectional view of another position of the ice making apparatus.

[0013] All the parts illustrated in figures are individually assigned a reference numeral and the corresponding terms of these numbers are listed below:

Apparatus	(A)
Evaporator	(1)
First chamber	(2)
Second chamber	(3)
First compartment	(3a)
Second compartment	(3b)
Storage	(4)

Description of the Invention

[0014] The cooling devices comprise at least a cooling compartment for cooling a product, at least a freezer compartment, and at least an evaporator for cooling process. The cooling devices also comprise at least an apparatus for ice making process, and the user meets his need of ice with this ice making apparatus. However, since especially for the summer months there is much more need of ice, these apparatus cannot sufficiently meet the need of ice, thereby user dissatisfaction problem arises. Within this context, with the present invention, an operation method for the cooling apparatus comprising the ice making apparatus is developed to solve said problems.

[0015] The operation method developed by the present invention is suitable for use in a cooling device which comprises at least a cooling compartment (this cooling compartment may be a cooler compartment operating at and above a temperature of 0°C and/or may be a freezer compartment operating at and below a temperature of 0°C); at least an

evaporator (1), at least a condenser along with at least a compressor to enable cooling of this cooling compartment; at least a control unit which is able to receive user command via a user interface and arranges the operation of the cooling device, and at least an ice making apparatus (A) exemplary views of which are illustrated in Figures 1-3, wherein said apparatus (A) comprises at least a storage (4) in which the water to be used for ice making is stored; at least a first chamber (2) into which the water is transferred for ice making, to where at least a part of the evaporator (1) extends in order to transform water into ice by cooling, which is rotatable around an axis by means of at least a movement element (for example a motor), which is able to stop in at least a first position (Figure 1), and at least a second position (Figure 2) along with at least a third position (Figure 3) as a result of this rotation, which has at least an opening to transfer water and to enable said part of the evaporator (1) to extend into; at least a second chamber (3) positioned in a lower region of the first chamber (2), which has at least a first compartment (3a) to where water contained in the first chamber (2) is transferred in the second position of the first chamber (2), and at least a second compartment (3b) to where ice contained in the first chamber (2) is transferred in the third position of the first chamber (2), wherein the first compartment (3a) and the storage (4) are preferably connected for water transfer; and at least a sensor (preferably a NTC sensor) for measuring the temperature of the water contained in said storage (4). The developed operation method comprises the steps of measuring the temperature of the water contained in the storage (4) upon receiving a command for ice making from the user via said user interface; determining the time information, during which the evaporator (1) is required to operate to produce a predetermined amount of ice (while this predetermined amount may be an amount information stored in the control unit, it may also be an amount set by the user via the user interface) according to the measured temperature, from a table in the control unit which includes the predetermined operating time information of the evaporator (1) for the related temperature value according to the temperature information of the water; after the evaporator (1) operates for the predetermined time, moving the first chamber (2) to the second position via said movement element, and transferring the water, which is not transformed into ice by keeping the first chamber (2) in this second position for a predetermined first time (for example, 2 to 10 seconds), to said first compartment; following said first time, moving the first chamber (2) to the third position via the movement element, and in this third position, for a predetermined second time (preferably 55 seconds), conducting defrosting process to make formed ice leave the evaporator (1) such that the hot coolant from the compressor is transmitted directly into the part of the evaporator (2) that extends into the first chamber (2) for a third time (preferably between 7 - 15 seconds, in particular 15 seconds) and that the transmission is interrupted for a fourth time (preferably between 3 - 10 seconds, in particular 5 seconds), and in the meantime, transferring the ice leaving the evaporator (1) to the second compartment (3b) of the second chamber (3) due to the third position of the first chamber (2); ending the ice making process at the end of said second time, preferably by moving the first chamber (2) to the first position.

[0016] In an exemplary embodiment of the invention, when the user activates the ice making process via the user interface, initially the temperature of the water contained within the storage (4) is measured via said sensor, and the measured value is transmitted to the control unit. According to this transmitted value, the control unit determines, in response to the measured value, the time during which the evaporator (1) is required to operate for ice making, from the predetermined table (an exemplary table is given at table - 1) comprised therein, and it is provided that the evaporator (1) operates for this determined time so as to perform ice making process.

Table - 1 Operating time of the evaporator corresponding to water temperature in the storage

Water temperature in the storage (°C)	Time (minutes)
5	8
7	10
9	11
11	13
13	16
15	18
17	20
19	22
21	25
23	27
25	29
27	32

(continued)

Water temperature in the storage (°C)	Time (minutes)
29	34
31	37

[0017] At the end of this operating time, operation of the evaporator (1) is ceased, and the first chamber (2) is moved by being rotated by said movement element to the second position which allows to transfer the water, which is not transformed into ice, to the first part (3a) of the second chamber (3). At this second position, it is held for a predetermined first time; thus all the water in the first chamber (2) is enabled to flow to the first compartment (3a). Considering the parameters such as the angle of the first chamber (2) at the first position, volume of the first chamber (2) and amount of water remained without transforming into ice, roughness of the inner surfaces of the first chamber (2), and ice size demanded by the user; and when all of the possibilities are considered in case one and/or more of said parameters are changed; this first time is determined as a time interval when all of the water in the first chamber (2) is poured and where the process time is not unnecessarily extended. In order to determine minimum and maximum time limits of the first time, the best and the worst conditions of the aforementioned parameters with regards to pouring time are considered. For example, when the first chamber (2) is in the maximum angle within the mechanical limits for the second position (in this way, as the influence of gravity increases, the water speed increases as well), when inner surface of the first chamber (2) is smooth as far as possible, when the ice size is set to the biggest size, and thereby when the excess water amount remained without transforming into ice in the first chamber (2) is decreased; the excess water in the first chamber is poured into the first compartment (3a) for example within 2 seconds. When the first chamber (2) is in the minimum angle within the mechanical limits for the second position (considering the conditions in which the first chamber (2) cannot rotate fully), when ice residue etc. is formed at the inner surface of the first chamber (2) due to the previous processes, when the ice size is set to the smallest size, and thereby when the excess water amount remained without transforming into ice is increased; excess water in the first chamber (2) is poured into the first compartment (3a) within 10 seconds. Within this context, said first time is in the range of 2 seconds to 10 seconds. At the end of the first time, the first chamber (2) is continued to be rotated in the same direction and is moved to the third position. This third position is a position that enables the ice formed around the evaporator (1) to be transferred into the second compartment (3b) of the second chamber (3) by the defrosting process. Thus, before the defrosting process, water and ice in the first chamber (2) is separated from each other and the ice broken during the defrosting process is prevented to be melted quickly due to the water that is not transformed into ice. After being moved to the third position, the first chamber (2) is kept in this third position for a predetermined second time and in the meantime, defrosting process is performed in the evaporator (1). This defrosting process is performed by transmitting the coolant, which is transmitted to the condenser for the cooling process and leaves compressor, preferably via a vane, directly to the evaporator (1) that enables ice making, instead of condenser. Ice making machines present in the prior art which operates with similar evaporator dipping method use r134 gas as the coolant. It is forbidden to use this gas in the cooling devices (for example, refrigerators) due to regulations and coolant's hazardous effects to environment. Therefore, in the cooling device in which the operation method developed by the present invention is used, preferably r600a gas is used as the coolant. In this case, during the defrosting process, after a certain time, temperature of the hot fluid that reaches the evaporator (1) from the compressor is not sufficient to defrost the ice formed around the evaporator (1). Therefore, operating times for the defrosting process are required to be determined; and in the studies for this determination process it was determined that when the coolant leaving the compressor is transmitted to the evaporator (1) for the defrosting process (for example when said vane is opened), the fluid gets cold by losing the required temperature for the defrosting process after a third time that is preferably 15 seconds, and therefore there is no defrosting, and that after the third time the transmission is required to be interrupted for a fourth time which is preferably 5 seconds (for example by closing the vane) to defrost in this manner and that the fluid is required to be transmitted to the evaporator (1) again by providing the pressure and temperature at the first transmission. Within this context, the hot fluid leaving the compressor during the defrosting process is transmitted to the evaporator (1) for a third time, this transmission is ceased for a fourth time and this fluid transmitting-ceasing process is continued as a cycle (preferably 3 cycles) for said second time during which the defrosting process is occurred. At the end of said second time the defrosting process is ended. By this way, an effective defrosting process can be conducted. Following the defrosting process, the first chamber (2), again, is returned to the first position where the ice making process is occurred, and the next ice making process command is waited.

[0018] In a preferred embodiment of the invention, said table also comprises the temperature information of an external environment in which the cooling device is present, as well as the water temperature in the storage (4), and the developed method also comprises the steps of measuring the temperature of the external environment as well in which the cooling device is present, before or after measuring the temperature of the water in the storage (4), and determining the operating

time of the evaporator (1) from the predetermined table, together with the measured water temperature in the storage (4) and the temperature of the external environment. Exemplary tables relating to this embodiment are shown in the table - 2a and table 2 - b. Considering also the temperature of the external environment, effectiveness and efficiency of the operation method is increased and a reliable cooling device is obtained.

Temperature of the External Environment (°C)	Water temperature in the Storage (°C)	Time (minutes)
$5 < T_{ext} < 10$	5	7
	7	9
	9	10
	11	12
	13	15
	15	17
	17	19
	19	21
	21	24
	23	26
	25	28
	27	31
	29	33
	31	36

Table 2 – a; an exemplary table for the operating time of the evaporator associated with the water temperature in the storage, for the case that the temperature of the external environment is between 5°C to 10°C.

Temperature of the External Environment (°C)	Water temperature in the Storage (°C)	Time (minutes)
38 < Text < 43	5	10
	7	12
	9	13
	11	16
	13	20
	15	21
	17	24
	19	26
	21	30
	23	33
	25	36
	27	38
	29	40
	31	43

Table 2 – b; an exemplary table for the operating time of the evaporator associated with the water temperature in the storage, for the case that the temperature of the external environment is between 5°C to 10°C.

[0019] As known, temperature of the coolant entering to the evaporator (1) is lower since the heat amount removed from the condenser is increased in the cold external environment, while temperature of the coolant entering to the evaporator (1) is higher since the heat transfer occurred over the condenser is decreased in the hotter external environment conditions. Accordingly, ice amount obtained at the ice making apparatus (A) varies depending on the temperature of the external environment in which the cooling apparatus is present. However, for each activation of the ice making process, it is expected to make ice in a predetermined fixed amount. As an example, when temperature of the water in the storage (4) is 5°C and ice making time for 150g of ice is 10 minutes at the external temperature between 38-43°C, while ice making time is 7 minutes at the external temperature between 5-10°C. In this embodiment, temperature of the external environment is also measured together with the water temperature in the storage (4), and said times are calculated after assessing both temperatures. By this way, ice amount to be obtained can be set in a precise manner depending on the temperature of the external environment.

[0020] In a preferred embodiment of the invention, developed operation method comprises the steps of: after receiving the ice making command from the user, preferably before measuring the temperature of the water in the storage, determining, by at least another sensor, whether the first chamber (2) is in the first position in which the ice making will occur; if it is in the first position, continuing the ice making processes; if it is not in the first position, at first moving the first chamber (2) to the first position by means of the movement element, and after that continuing the ice making processes. In this way, possible failure arising from the overflowing is eliminated by preventing the first chamber (2) from starting at a faulty position and a reliable operation method is obtained.

[0021] In an another alternative embodiment of the present invention, preferably, the water in the storage (4) is transmitted to the first chamber (2) via at least one pump, and in this case the operation method preferably comprises the step of operating said pump for a predetermined fifth time before measuring the temperature of the water in the storage (4).

[0022] In another exemplary embodiment of the invention, predetermined amount of ice is preferably an available, registered amount in the control unit. In another preferred embodiment, this amount may be plurality of values (for example 80 grams, 120 grams, 150 grams, 180 grams etc.) which can be selected by the user via said user interface. In this case, within the developed operation method, preferably, ice making command received from the user also comprises the amount of ice selected by the user, and the table in which the operating time of the evaporator (1) is determined comprises the operating times corresponding to data regarding amount of ice and temperature values, and the control unit provides to operate the evaporator (1) according to this table. Yet in another alternative embodiment, developed operation method preferably comprises the step of: upon the command for ice making from the user, determining the predetermined amount of ice by the user via said user interface and, transferring it to the control unit. In this

case, again, the table in which the operating time of the evaporator (1) is determined comprises the operating times corresponding to data regarding ice amount and temperature values, and the control unit provides to operate the evaporator (1) according to this table. Thereby, the user is able to determine the ice amount by himself/herself, and an operation method enabling ease of use is obtained. An exemplary table is provided at table - 3, in which the changing ice amounts and operating time of the evaporator (1) according to an exemplary water temperature (5°C) in the storage (4) is included.

Table - 3; exemplary operating times of the evaporator associated with the ice amount, for the case that the water temperature in the storage is 5°C.

Water temperature in the Storage (°C)	Operating time of the Evaporator (minutes)	Ice Amount (g)
5°C	4,5	80
	5	90
	5,5	100
	6	110
	6,5	120
	7	130
	7,5	140
	8	150
	8,5	160
	9	170
	9,5	180 10

[0023] In this embodiment, the operation method also preferably comprises the steps of: together with measuring the water temperature in the storage (4), measuring the temperature of the external environment in which the cooling device is present, and determining the operating time of the evaporator (1) according to both water temperature in the storage (4) and temperature of the external environment. Within this context, said table comprises the operating times corresponding to data regarding the ice amount and both temperature value of the water in the storage (4) and temperature value of the external environment; and the control unit provides to operate the evaporator (1) according to this table. An exemplary table is provided at table - 4, in which the operating time of the evaporator (1) is included according to changing ice amounts, an exemplary water temperature (5°C) in the storage (4) and an exemplary temperature of the external environment (between 5°C to 10°C).

Table - 4; exemplary operating times of the evaporator associated with ice amount, for+ the case that the water temperature in the storage is 5°C and the temperature of the external environment is between 5°C to 10°C.

Temperature (°C)	operating time of the Evaporator (minute)	Amount of ice (g)
5°C < Text< 10°C, Water temperature in the Storage = 5°C	3,5	80
	4	90
	4,5	100
	5	110
	5,5	120
	6	130
	6,5	140
	7	150
	7,5	160
	8	170
	8,5	180

[0024] In another preferred embodiment of the invention, developed operation method comprises the steps of: after receiving the ice making command from the user, preferably before measuring the temperature, controlling by preferably another sensor (for example level sensor or weight sensor) whether the water level in the storage (4) is between a first level (minimum level) and a second level (maximum level); if the water level is below the first level, before starting the ice making process or after completing the ice making process, adding water to the storage (4) from a source preferably until the water level in the storage (4) reaches the second level. Thereby, an efficient and reliable operation method is obtained by determining whether there is sufficient water in the storage (4) for ice making.

[0025] In another preferred embodiment of the invention, developed operation method comprises the steps of: after receiving the ice making command from the user, preferably before measuring the temperature, controlling by preferably another sensor (for example level sensor or weight sensor) whether the water level in the storage (4) is between a first level (minimum level) and a second level (maximum level); if the water level is below the second level, before starting the ice making process or after completing the ice making process, adding water to the storage (4) from a source preferably until the water level in the storage (4) reaches the second level. Thereby, an efficient and reliable operation method is obtained by determining whether there is sufficient water in the storage (4) for ice making.

[0026] Yet in another alternative embodiment, developed operation method preferably comprises the steps of: after receiving the ice making command from the user, measuring the ice amount in the second chamber (3) by means of at least one weight sensor comprised within the apparatus (A), and if the ice amount is above a predetermined amount, not starting the ice making process. When the ice making command is received from the user, the ice amount is measured by the weight sensor and it is compared with a predetermined ice amount value provided within the control unit. If the ice amount is above said value, the ice making process is not started. The method developed in this embodiment also preferably comprises the step of: giving a visual and/or audio warning to the user preferably via the user interface if the measured weight value is above said value. Thanks to this embodiment, a blockage may be prevented which could be formed as a result of successive ice making processes, in case the user forgets to take the ice accumulated in the second chamber (3) after an ice making process; and an efficient and reliable operation method can be obtained.

[0027] In another exemplary embodiment of the invention, developed operation method preferably comprises the steps of: before starting the ice making process (for example before transmitting the coolant to the evaporator (1)), controlling whether the water amount in the storage (4) is between a first amount (minimum amount) and a second amount (maximum amount); determining the ice amount in the second chamber (3); if the water amount in the storage (4) is below the first amount or the second amount, determining that there is a need for adding water to the storage (4) before ice making process or after the ice making process is completed; determining the water amount which will be added to the storage (4) by subtracting the detected ice amount from the required water amount by which the water amount in the storage (4) reaches the second amount. With this embodiment, it is provided to detect remainder or forgotten ice in the second chamber (3) after the ice making apparatus (A) is operated by the user for a few times, and to receive required amount of water to the storage (4). In case the ice making apparatus (A) is operated by a user for one or more times, and formed ice is forgotten in the second chamber (3), if the ice melts over time and the formed water is transferred again to the storage (4), correct amount of water should be taken to the storage (4) for the next ice making process. For example,

in case the maximum amount required in the storage (4) is 3000 g and the apparatus (A) produces 150g of ice during the ice making process, if the apparatus (A) is operated by the user for 5 times in a successive manner while the storage (4) is full; 750g of ice will be accumulated in the second chamber (3) and 2250g of water will remain in the storage (4). However, in case the user does not take the ice, for example 250g of ice will melt and be added to the storage (4), and in this case water amount in the storage (4) will be 2500g and the ice amount in the second chamber (3) will be 500g. When ice making command is transmitted to the ice making apparatus (A), in case the lacking 500g of water is taken to the storage (4), the storage will be full. However, in case the ice is forgotten again in the second chamber (3) in the next step, since remained 500g of ice will melt and this melted ice will cause overflow of the storage (4); overflow problem of the storage (4) may be prevented with said embodiment when the user forgets to take the ice accumulated in the second chamber (3).

[0028] With the operation method developed according to the present invention, it is provided for the cooling devices, which have the function of fast ice making, to carry out the ice making process in a fast, more efficient and more effective manner by the temperature control. Moreover, it is provided to produce fixed amount of ice in each ice making process and a reliable operation method is obtained.

Claims

1. An operation method suitable for use in a cooling apparatus, the cooling apparatus comprising at least a cooling compartment; at least an evaporator (1), at least a condenser and at least a compressor to enable cooling of this cooling compartment; at least a control unit which is able to receive user command via a user interface; and at least an ice making apparatus (A) which comprises:

    - at least a storage (4) in which the water to be used for ice making is stored;
    - at least a first chamber (2) into which the water is transferred for ice making, to where at least a part of said evaporator (1) extends in order to transform water into ice by cooling, which is rotatable around an axis by means of at least a movement element, which is able to stop in at least a first position, and at least a second position along with at least a third position as a result of this rotation, which has at least an opening to transfer water and to enable said part of the evaporator (1) to extend into;
    - at least a second chamber (3) positioned in a lower region of the first chamber (2), which has at least a first compartment (3a) to where water contained in the first chamber (2) is transferred in the second position of the first chamber (2), and at least a second compartment (3b) to where ice contained in the first chamber (2) is transferred in the third position of the first chamber (2), and
    - at least a sensor for measuring the temperature of the water contained in said storage (4),

    characterized by comprising the steps of:

    • measuring the temperature of the water contained in the storage (4) upon receiving a command for ice making from the user via said user interface;
    • determining the time information, during which the evaporator (1) is required to operate to produce a predetermined amount of ice according to the measured temperature, from a table in the control unit which includes the predetermined operating time information of the evaporator (1) for the related temperature value according to the temperature information of the water;
    • after the evaporator (1) operates for the predetermined time, moving the first chamber (2) to the second position via said movement element and transferring the water, which is not transformed into ice to said first compartment (3a) by keeping the first chamber (2) in this second position for a predetermined first time;
    • following said first time, moving the first chamber (2) to the third position via the movement element and in this third position, for a predetermined second time, conducting defrosting process to make formed ice leave the evaporator such that the hot coolant from the compressor is transmitted directly into the part of the evaporator (1) that extends into the first chamber (2) at a third time and that the transmission is ceased for a fourth time, and in the meantime, transferring the ice leaving the evaporator (1) to the second compartment (3b) of the second chamber (3) due to the third position of the first chamber (2);
    • ending the ice making process at the end of said second time.

2. An operation method according to Claim 1, **characterized in that** the first time is in the range of 2 to 10 seconds and/or the second time is 55 seconds.

3. An operation method according to Claim 1, **characterized in that** the third time is between 7 - 15 seconds and/or

the fourth time is between the 3 - 10 seconds.

4. An operation method according to Claim 1, **characterized in that** as well as the water temperature information of the storage (4), said table also comprises the operating time information of the evaporator (1) associated with the temperature information of an external environment in which the cooling device is present.

5. An operation method according to Claim 4, **characterized by** also comprising the step of measuring the temperature of the external environment as well in which the cooling device is present, before or after measuring the temperature of the water in the storage (4), and determining the operating time of the evaporator (1) from the predetermined table, together with the measured water temperature in the storage (4) and the temperature of the external environment.

6. An operation method according to Claim 1, **characterized by** comprising the steps of: after receiving the ice making command from the user, determining, by at least another sensor, whether the first chamber (2) is in the first position in which the ice making occurs; if it is in the first position, continuing the ice making processes; if it is not in the first position, at first moving the first chamber (2) to the first position by means of the movement element and after that continuing the ice making processes.

7. An operation method according to Claim 6, **characterized in that** the step of determining whether the first chamber (2) is in the first position in which the ice making occurs is performed before measuring the water temperature in the storage (4).

8. An operation method according to Claim 1, **characterized by** comprising the step of operating at least one pump, which provides to transmit the water in the storage (4) to the first chamber (2), for a predetermined fifth time before measuring the water temperature in the storage (4).

9. An operation method according to Claim 1, **characterized in that** predetermined amount of ice is selected by the user via said user interface from a plurality of values registered in the control unit; ice making command received from the user also comprises the amount of ice selected by the user; the table in which the operating time of the evaporator (1) is determined comprises the operating times corresponding to data regarding amount of ice and temperature values; and the control unit provides operation of the evaporator (1) according to this table.

10. An operation method according to Claim 1, **characterized in that** the method comprises the step of: upon the command for ice making from the user, determining the predetermined amount of ice by the user via said user interface and, transferring it to the control unit; that the table in which the operating time of the evaporator (1) is determined comprises the operating times corresponding to data regarding amount of ice and temperature values, and the control unit provides to operate the evaporator (1) according to this table

11. An operation method according to any of Claim 9 or claim 10, **characterized by** comprising the steps of: together with measuring the water temperature in the storage (4), measuring the temperature of the external environment in which the cooling device is present, and determining the operating time of the evaporator (1) according to both water temperature in the storage (4) and temperature of the external environment.

12. An operation method according to Claim 1, **characterized by** comprising the steps of: after receiving the ice making command from the user, controlling whether the water level in the storage tank (4) is between a first level and a second level that is higher than the first level; if the water level is below the first level, before starting the ice making process or after completing the ice making process, adding water to the storage (4) from a source.

13. An operation method according to Claim 1, **characterized by** comprising the steps of: after receiving the ice making command from the user, controlling whether the water level in the storage tank (4) is between a first level and a second level that is higher than the first level; if the water level is below the second level, before starting the ice making process or after completing the ice making process, adding water to the storage (4) from a source.

14. An operation method according to Claim 1, **characterized by** comprising the steps of: after receiving the ice making command from the user, measuring the amount of ice in the second chamber (3) by means of at least one weight sensor comprised within the apparatus (A), and if the amount of ice is above a predetermined amount, not starting the ice making process.

15. An operation method according to Claim 1, **characterized by** comprising the steps of: before starting the ice making process, controlling whether the water amount in the storage (4) is between a first amount and a second amount that is higher than the first amount; determining the ice amount in the second chamber (3); if the water amount in the storage (4) is below the first amount or the second amount, determining that there is a need for adding water before the ice making process or after the ice making process is completed; determining the amount of water to be added to the storage (4) by subtracting the detected ice amount from the required amount of water by which the water amount in the storage (4) reaches the second amount.

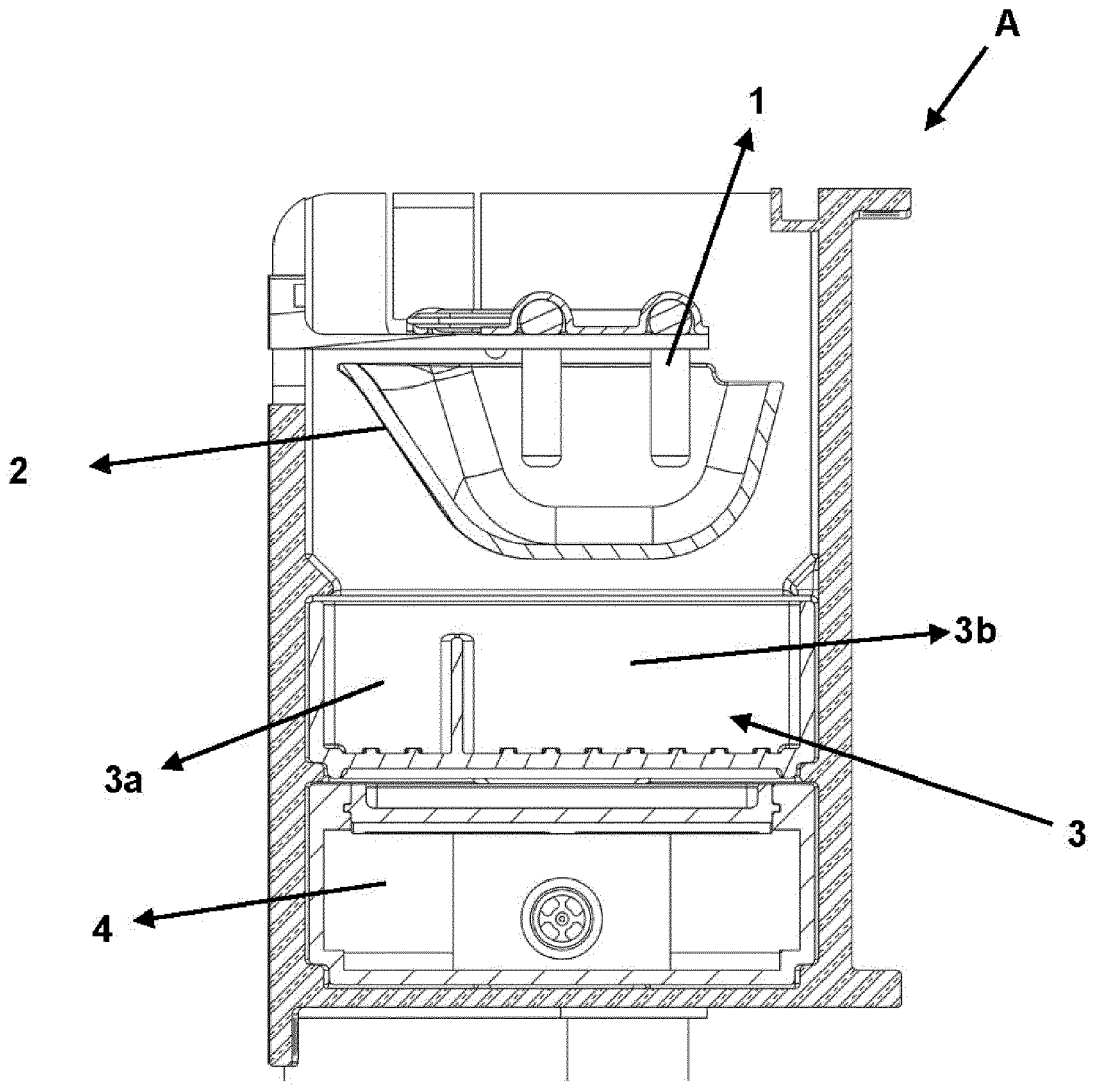

Figure 1

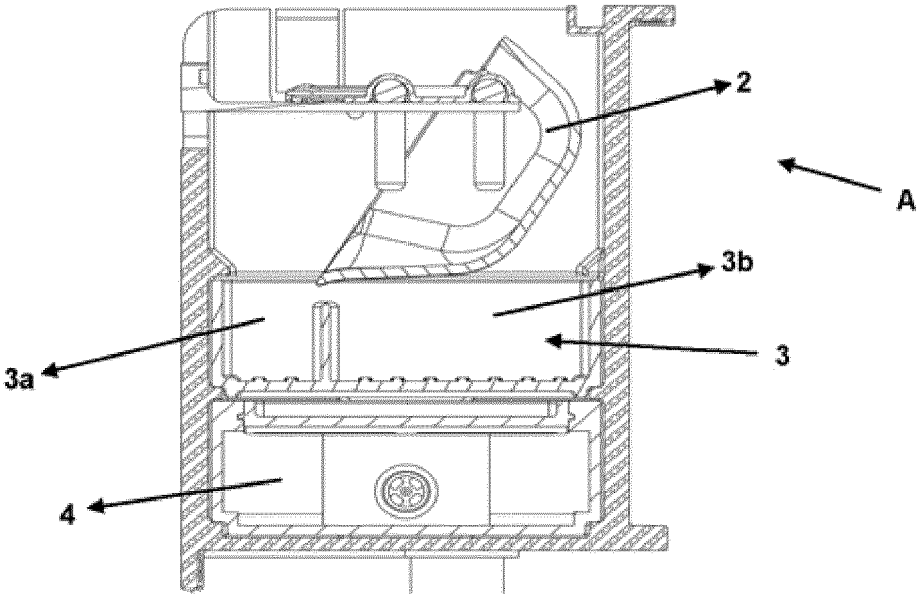

Figure 2

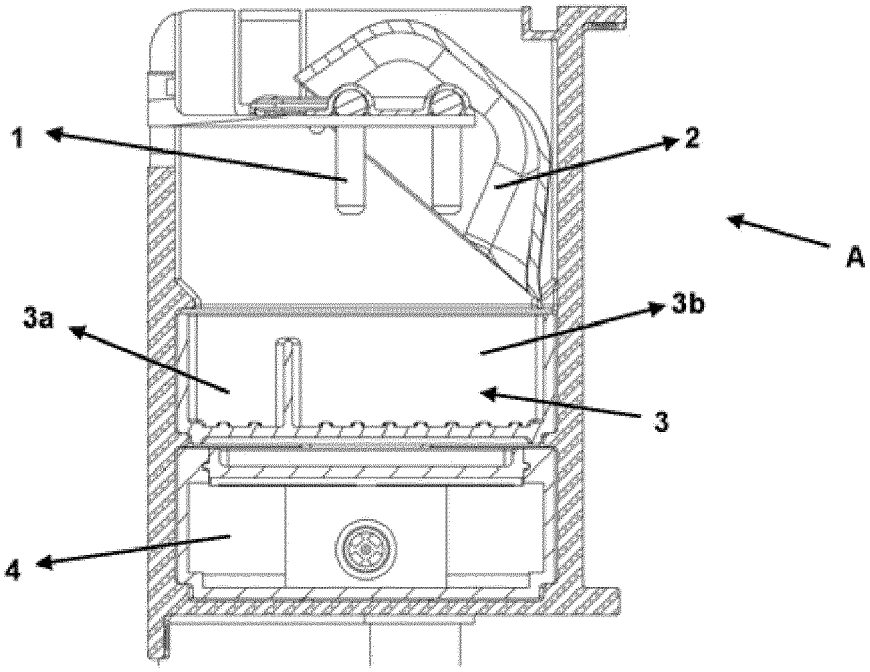

Figure 3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 17 9451

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 2007/089451 A1 (LEE SOON-SE [KR]) 26 April 2007 (2007-04-26) * figures 1-3, 4a, 4b, 4c, 4d *	1-15	INV. F25C1/08
Y	EP 2 778 570 A2 (MANITOWOC FOODSERVICE CO INC [US]) 17 September 2014 (2014-09-17) * paragraph [0008]; figure 2 *	1-15	
A	JP 2013 072591 A (HOSHIZAKI ELECTRIC CO LTD) 22 April 2013 (2013-04-22) * paragraph [0024]; table 1 *	1-15	
A	EP 1 734 319 A2 (MANITOWOC FOODSERVICE CO INC [US]) 20 December 2006 (2006-12-20) * paragraph [0064]; table 3 *	1-15	
A	WO 2012/091484 A2 (WOONGJIN COWAY CO LTD [KR]; LEE JUNG-HUN [KR]; JUNG HEE-DO [KR]) 5 July 2012 (2012-07-05) * figures 6-8 *	1-15	
A	JP 2003 269828 A (SANYO ELECTRIC CO) 25 September 2003 (2003-09-25) * figures 3-5 *	1-15	TECHNICAL FIELDS SEARCHED (IPC) F25C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 November 2018	Kuljis, Bruno

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 17 9451

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-11-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007089451 A1	26-04-2007	CN 1952538 A	25-04-2007
		JP 4567590 B2	20-10-2010
		JP 2007113902 A	10-05-2007
		US 2007089451 A1	26-04-2007
EP 2778570 A2	17-09-2014	AU 2014201376 A1	02-10-2014
		CN 104048459 A	17-09-2014
		EP 2778570 A2	17-09-2014
		KR 20140113885 A	25-09-2014
		TW 201447203 A	16-12-2014
		US 2014260349 A1	18-09-2014
JP 2013072591 A	22-04-2013	JP 5848081 B2	27-01-2016
		JP 2013072591 A	22-04-2013
EP 1734319 A2	20-12-2006	CN 1880890 A	20-12-2006
		EP 1734319 A2	20-12-2006
		US 2006277928 A1	14-12-2006
WO 2012091484 A2	05-07-2012	NONE	
JP 2003269828 A	25-09-2003	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 2007163282 A1 **[0004]**