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(54) **A COOLING DEVICE WITH TWO COMPARTMENTS**

KÜHLVORRICHTUNG MIT ZWEI FÄCHERN

DISPOSITIF DE REFROIDISSEMENT AYANT DEUX COMPARTIMENTS

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Description

[0001] The present invention relates to a cooling device comprising a fresh food compartment and a freezing compartment.

[0002] Domestic type cooling devices generally consist of two separate compartments, a fresh food compartment and a freezing compartment, that are kept at different temperatures. The fresh food compartment is utilized preferably for storing fresh food and the freezing compartment for storing frozen food.

[0003] In the state of the art, in the cooling devices having two compartments at different temperatures from each other, the refrigeration process is performed by means of evaporators disposed in the compartments, connected to each other in series or in parallel instead of forced air circulation. Besides, both refrigeration circuits are connected to a single compressor. For the compressor cut-in condition, the fresh food compartment temperature is taken as reference in some cooling devices and the freezing compartment is taken as reference in others. In such embodiments, while one of the compartments is tried to be kept at a desired temperature interval, excessive heating or excessive cooling problems are observed in the other compartment. In cooling devices wherein both compartment temperatures are taken as reference, the compressor cannot be used efficiently and energy consumption increases.

[0004] Operating conditions of the fan, that is used in the cooling compartment and/or the freezing compartment and that provides the air in the compartment to be dispersed, are generally determined according to the operation of the compressor or the temperature values of the compartment wherein the fan is located. In embodiments wherein the fan is simultaneously operated with the compressor, the compartment temperature cannot be sensitively adjusted and energy is consumed unnecessarily. In situations wherein the operating conditions of the fan are determined according to the temperature values of the compartment in which the fan is located, the temperature of the related compartment may not reach the cut-in temperature of the fan according to the environment conditions and this prevents the homogeneous distribution of the cool air in the compartment.

[0005] In the state of the art Japanese Patent Application No. JP10185395, a cooling device is described, wherein the fan disposed in the fresh food compartment is operated at certain temperature intervals in order to keep the fresh food compartment temperature constant when the freezing compartment temperature is used as the cut-in condition.

[0006] In the state of the art International Patent Application No. WO2005106358, a cooling device is described, that comprises a fresh food compartment fan, the operation of which is regulated according to the freezing compartment conditions.

[0007] WO 2010/076229 A2 discloses a cooling device according to the preamble of claim 1.

[0008] The aim of the present invention is the realization of a cooling device, of which the cooling efficiency is improved.

[0009] A cooling device according to the first claim and the dependent claims thereof is realized in order to attain the aim of the present invention. A control unit that controls the activation and the deactivation of the compressor and the fan is provided.

[0010] In order to activate the compressor, the fresh food compartment temperature and/or the freezing compartment temperature should reach respectively the fresh food compartment temperature predetermined by the producer whereat the compressor is activated and/or the freezing compartment temperature predetermined by the producer whereat the compressor is activated. In order to deactivate the compressor, the fresh food compartment temperature and the freezing compartment temperature should reach respectively the fresh food compartment temperature predetermined by the producer wherein the compressor is deactivated and the freezing compartment temperature predetermined by the producer wherein the compressor is deactivated.

[0011] In the A cooling device of the present invention, the fan located in the fresh food compartment and providing the activation of the air is activated at the fresh food compartment temperature whereat the compressor is deactivated. Thus, even at low-temperature environments wherein the fresh food compartment temperature does not reach the fresh food compartment temperature whereat the compressor is activated, the activation of the fan is provided.

[0012] In an embodiment of the present invention, the fresh food compartment temperature whereat the fan is deactivated is lower than the fresh food compartment temperature whereat the fan is activated. After the fan is activated, the fresh food compartment temperature continues to decrease and after some time the fan is deactivated. When the ambient temperature is low, the freezing compartment realizes the compressor deactivation condition later than the fresh food compartment. By keeping small the temperature range whereat the fan is operated, the excessive cooling of the fresh food compartment is prevented.

[0013] In an embodiment of the present invention, when the fan is not activated during a critical duration predetermined by the producer, at least one heater located in and/or in the vicinity of the fresh food compartment is activated if the fresh food compartment temperature is lower than the fresh food compartment temperature whereat the fan is activated. Thus, the fan is provided to be activated by rapidly bringing the fresh food compartment temperature to the fresh food compartment temperature whereat the compressor is deactivated.

[0014] In a derivative of this embodiment, the heater is deactivated when the fresh food compartment temperature reaches the fresh food compartment temperature whereat the compressor is deactivated.

[0015] In an embodiment of the present invention, the

variable speed fan is utilized in the fresh food compartment. Thus, the fan is provided to rotate at different speeds at different fresh food compartment temperatures. Consequently, energy saving is provided.

[0016] In a derivative of this embodiment, the speed of the fan decreases as the fresh food compartment temperature decreases. Thus, the fresh food compartment temperature is prevented from decreasing suddenly.

[0017] By means of the present invention, the fan is prevented from remaining idle for a long time at low ambient temperatures, thus providing a homogeneous heat distribution in the fresh food compartment.

[0018] The cooling device realized in order to attain the aim of the present invention is illustrated in the attached figure, where:

[0019] Figure 1 - is the schematic view of a cooling device.

[0020] The elements illustrated in the figure are numbered as follows:

1. Cooling device
2. Fresh food compartment
3. Freezing compartment
4. Compressor
5. Fresh food compartment temperature sensor
6. Freezing compartment temperature sensor
7. Fan
8. Control unit
9. Heater

[0021] The cooling device (1) comprises a fresh food compartment (2) wherein the foodstuff is placed to be cooled, a freezing compartment (3) wherein the foodstuff is placed to be frozen, kept at temperatures lower than that of the fresh food compartment (2), a compressor (4) compressing and circulating the refrigerant in the refrigeration cycle, a fresh food compartment temperature sensor (5) measuring the fresh food compartment (2) temperature, a freezing compartment temperature sensor (6) measuring the freezing compartment (3) temperature, a fan (7) providing air circulation in the fresh food compartment (2) and a control unit (8) (Figure 1).

[0022] The following symbols are used for explicating the A cooling device (1) of the present invention:

- TR: the fresh food compartment temperature detected by the fresh food compartment temperature sensor (5)
- $T_{Rcut\text{-}in}$: the fresh food compartment temperature predetermined by the producer, whereat the compressor (4) is activated by the control unit (8).
- $T_{Rcut\text{-}out}$: the fresh food compartment temperature predetermined by the producer, whereat the compressor (4) is deactivated by the control unit (8).
- T_F : the freezing compartment temperature detected by the freezing

[0023] compartment temperature sensor (6)

- $T_{Fcut\text{-}in}$: the freezing compartment temperature predetermined by the producer, whereat the compressor (4) is activated by the control unit (8).
- $T_{Fcut\text{-}out}$: the freezing compartment temperature predetermined by the producer, whereat the compressor (4) is deactivated by the control unit (8).
- $T_{FANcut\text{-}in}$: the fresh food compartment temperature predetermined by the producer, whereat the fan (7) is activated by the control unit (8).
- $T_{FANcut\text{-}out}$: the fresh food compartment temperature predetermined by the producer, whereat the fan (7) is deactivated by the control unit (8).
- t: critical duration predetermined by the producer.

[0024] The cooling device (1) furthermore comprises a control unit (8)

- that, when the compressor (4) is deactivated, compares the fresh food compartment temperature (T_R) and the freezing compartment temperature (T_F) respectively with the fresh food compartment temperature ($T_{Rcut\text{-}in}$) whereat the compressor (4) is activated and with the freezing compartment temperature ($T_{Fcut\text{-}in}$) whereat the compressor (4) is activated and that activates the compressor (4) when at least one of the fresh food compartment temperature (T_R) and the freezing compartment temperature (T_F) reaches respectively the fresh food compartment temperature ($T_{Rcut\text{-}in}$) whereat the compressor (4) is activated and with the freezing compartment temperature ($T_{Fcut\text{-}in}$) whereat the compressor (4) is activated, and
- that, when the compressor (4) is activated, compares the fresh food compartment temperature (T_R) and the freezing compartment temperature (T_F) respectively with the fresh food compartment temperature ($T_{Rcut\text{-}out}$) whereat the compressor (4) is deactivated and with the freezing compartment temperature ($T_{Fcut\text{-}out}$) whereat the compressor (4) is deactivated and that deactivates the compressor (4) when both of the fresh food compartment temperature (T_R) and the freezing compartment temperature (T_F) reach respectively the fresh food compartment temperature ($T_{Rcut\text{-}out}$) whereat the compressor (4) is deactivated and with the freezing compartment temperature ($T_{Fcut\text{-}out}$) whereat the compressor (4) is deactivated.

[0025] In the cooling device (1) of the present invention, the control unit (8) activates the fan (7) at the fresh food compartment temperature ($TF_{ANcut\text{-}in}$) which is equal to the fresh food compartment temperature ($T_{Rcut\text{-}out}$) whereat the compressor (4) is deactivated. Thus, even if the compressor (4) is activated at every cycle when the freezing compartment temperature (T_F) reaches the freezing compartment temperature ($T_{Fcut\text{-}in}$) whereat the compressor (4) is activated, it is guaranteed that the fresh food compartment temperature (T_R) reach-

es the fresh food compartment temperature ($T_{FANcut-in}$) whereat the fan (7) is activated. Consequently, the fan (7) is activated at every cycle and the air in the fresh food compartment (2) is provided to be dispersed in a homogeneous manner.

[0026] In an embodiment of the present invention, the control unit (8) deactivates the fan (7) at the fresh food compartment temperature ($T_{FANcut-out}$) whereat the fan (7) is deactivated that is lower than the fresh food compartment temperature ($T_{FANcut-in}$) whereat the fan (7) is activated. Since the fresh food compartment temperature (T_R) continues to decrease when the freezing compartment temperature (T_F) does not reach the freezing compartment temperature ($T_{Fcut-out}$) whereat the compressor (4) is deactivated during the operation of the compressor (4), the fan (7) is deactivated when the fresh food compartment temperature ($T_{FANcut-out}$) whereat the fan (7) is deactivated, predetermined by the producer is reached and thus the objects in the fresh food compartment (2) are prevented from overheating.

[0027] In this embodiment of the present invention, the cooling device (1) comprises a heater (9) that provides the heating of the fresh food compartment (2) when needed. In this embodiment, the control unit (8) activates the heater (9) if the fresh food compartment temperature (T_R) is lower than the fresh food compartment temperature ($T_{FANcut-in}$) whereat the fan (7) is activated when the fan (7) is not operated for a critical duration (t) predetermined by the producer. Consequently, the fan (7) is prevented from being inactive for a long time and the air distribution in the fresh food compartment (2) is prevented from getting heterogeneous.

[0028] In a derivative of this embodiment, the control unit (8) deactivates the heater (9) when the fresh food compartment temperature (T_R) reaches the fresh food compartment temperature ($T_{FANcut-in}$) whereat the fan (7) is activated. Thus, the fan (7) is activated as the heater (9) is deactivated and the air in the fresh food compartment (2) is propelled.

[0029] In an embodiment of the present invention, the rotational speed of the fan (7) can be changed. Thus, the fan (7) speed can be determined as required and unnecessary energy consumption is prevented.

[0030] In a derivative of this embodiment, the rotational speed of the fan (7) decreases as the fresh food compartment temperature (T_R) approaches the fresh food compartment temperature ($T_{FANcut-out}$) whereat the fan (7) is deactivated getting away from the fresh food compartment temperature ($T_{FANcut-in}$) whereat the fan (7) is activated.

[0031] By means of the present invention, the fan (7) is activated at certain intervals, thus providing a homogeneous distribution of the air in the fresh food compartment (2). Thus, the fresh food compartment (2) is more effectively cooled.

[0032] It is to be understood that the present invention is not limited to the embodiments disclosed above and a person skilled in the art can easily introduce different embodiments. These should be considered within the scope of the protection postulated by the claims of the present invention.

Claims

1. A cooling device (1) comprising a fresh food compartment (2) wherein the foodstuff is placed to be cooled, a freezing compartment (3) wherein the foodstuff is placed to be frozen, kept at temperatures lower than that of the fresh food compartment (2), a compressor (4) compressing and circulating a refrigerant in a refrigeration cycle, a fresh food compartment temperature sensor (5) measuring the fresh food compartment (2) temperature, a freezing compartment temperature sensor (6) measuring the freezing compartment (3) temperature, a fan (7) providing the air circulation in the fresh food compartment (2) and a control unit (8)

- that, when the compressor (4) is deactivated, compares the fresh food compartment temperature (T_R) and the freezing compartment temperature (T_F) respectively with the fresh food compartment temperature ($T_{Rcut-in}$) whereat the compressor (4) is activated and with the freezing compartment temperature ($T_{Fcut-in}$) whereat the compressor (4) is activated and that activates the compressor (4) when at least one of the fresh food compartment temperature (T_R) and the freezing compartment temperature (T_F) reaches respectively the fresh food compartment temperature ($T_{Rcut-in}$) whereat the compressor (4) is activated and with the freezing compartment temperature ($T_{Fcut-in}$) whereat the compressor (4) is activated, and
- that, when the compressor (4) is activated, compares the fresh food compartment temperature (T_R) and the freezing compartment temperature (T_F) respectively with the fresh food compartment temperature ($T_{Rcut-out}$) whereat the compressor (4) is deactivated and with the freezing compartment temperature ($T_{Fcut-out}$) whereat the compressor (4) is deactivated and that deactivates the compressor (4) when both of the fresh food compartment temperature (T_R) and the freezing compartment temperature (T_F) reach respectively the fresh food compartment temperature ($T_{Rcut-out}$) whereat the compressor (4) is deactivated and with the freezing compartment temperature ($T_{Fcut-out}$) whereat the compressor (4) is deactivated.

characterized in that the control unit (8) activates the fan (7) at the fresh food compartment temperature ($T_{FANcut-in}$) which is equal to the fresh food compartment temperature ($T_{Rcut-out}$) whereat the com-

pressor (4) is deactivated.

2. A cooling device (1) as in Claim 1, **characterized in that** the control unit (8) deactivates the fan (7) at a fresh food compartment temperature ($T_{FANcut-out}$) whereat the fan (7) is deactivated that is lower than the fresh food compartment temperature ($T_{FANcut-in}$) whereat the fan (7) is activated.

3. A cooling device (1) as in Claim 1 or 2, **characterized in that** a heater (9) provides the heating of the fresh food compartment (2) when required and the control unit (8) activates the heater (9) if the fresh food compartment temperature (T_R) is lower than the fresh food compartment temperature ($T_{FANcut-in}$) whereat the fan (7) is activated.

4. A cooling device (1) as in Claim 3, **characterized in that** the control unit (8) deactivates the heater (9) when the fresh food compartment temperature (T_R) reaches the fresh food compartment temperature ($T_{FANcut-in}$) whereat the fan (7) is activated.

5. A cooling device (1) as in any one of the above Claims, **characterized in that** the rotational speed of the fan (7) can be changed.

6. A cooling device (1) as in Claim 5, **characterized in that** the rotational speed of the fan (7) decreases as the fresh food compartment temperature (T_R) approaches the fresh food compartment temperature ($T_{FANcut-out}$) whereat the fan (7) is deactivated getting away from the fresh food compartment temperature ($T_{FANcut-in}$) whereat the fan (7) is activated.

Patentansprüche

1. Kühlvorrichtung (1) umfassend ein Frischhaltefach (2), in das Lebensmittel zum Kühlen gelegt werden, ein Gefrierfach (3), in das Lebensmittel zum Einfrieren gelegt werden und das bei Temperaturen unter derjenigen des Frischhaltefachs (2) gehalten wird, einen Kompressor (4), der ein Kühlmittel in einem Kühlzyklus verdichtet und zirkulieren lässt, einen Frischhaltefachtemperatursensor (5), der die Temperatur des Frischhaltefachs (2) misst, einen Gefrierfachtemperatursensor (6), der die Temperatur des Gefrierfachs (3) misst, ein Gebläse (7), das für die Luftzirkulation im Frischhaltefach (2) bereitstellt, und eine Steuereinheit (8),

   - die, wenn der Kompressor (4) deaktiviert wird, die Frischhaltefachtemperatur (T_R) und die Gefrierfachtemperatur (T_F) jeweils mit der Frischhaltefachtemperatur ($T_{Rcut-in}$), bei der der Kompressor (4) aktiviert wird, und mit der Gefrierfachtemperatur (TF_{cut-in}) vergleicht, bei der der Kompressor (4) aktiviert wird, und die den Kompressor (4) aktiviert, wenn wenigstens eine von der Frischhaltefachtemperatur (T_R) und der Gefrierfachtemperatur (T_F) jeweils die Frischhaltefachtemperatur ($T_{Rcut-in}$), bei der der Kompressor (4) aktiviert wird, bzw. die Gefrierfachtemperatur (TF_{cut-in}) erreicht, bei der der Kompressor (4) aktiviert wird, und
   - die, wenn der Kompressor (4) aktiviert wird, die Frischhaltefachtemperatur (T_R) und die Gefrierfachtemperatur (T_F) jeweils mit der Frischhaltefachtemperatur ($T_{Rcut-out}$), bei der der Kompressor (4) deaktiviert wird, und mit der Gefrierfachtemperatur ($T_{Fcut-out}$) vergleicht, bei der der Kompressor (4) deaktiviert wird, und die den Kompressor (4) deaktiviert, wenn wenigstens eine von der Frischhaltefachtemperatur (T_R) und der Gefrierfachtemperatur (T_F) jeweils die Frischhaltefachtemperatur ($T_{Rcut-out}$), bei der der Kompressor (4) deaktiviert wird, bzw. die Gefrierfachtemperatur ($T_{Fcut-out}$) erreicht, bei der der Kompressor (4) deaktiviert wird, und

   dadurch gekennzeichnet, dass die Steuereinheit (8) das Gebläse (7) bei der Frischhaltefachtemperatur ($T_{FANcut-in}$) aktiviert, die gleich der Frischhaltefachtemperatur ($T_{Rcut-out}$) ist, bei der der Kompressor (4) deaktiviert wird.

2. Kühlvorrichtung (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Steuereinheit (8) das Gebläse (7) bei einer Frischhaltefachtemperatur ($T_{FANcut-out}$), bei der das Gebläse (7) deaktiviert wird, deaktiviert, die niedriger als die Frischhaltefachtemperatur ($T_{FANcut-in}$) ist, bei der das Gebläse (7) aktiviert wird.

3. Kühlvorrichtung (1) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** eine Heizeinrichtung (9) bei Bedarf für das Erwärmen des Frischhaltefach (2) sorgt und die Steuereinheit (8) die Heizeinrichtung (9) aktiviert, wenn die Frischhaltefachtemperatur (T_R) niedriger als die Frischhaltefachtemperatur ($T_{FANcut-in}$) ist, bei der das Gebläse (7) aktiviert wird.

4. Kühlvorrichtung (1) nach Anspruch 3, **dadurch gekennzeichnet, dass** die Steuereinheit (8) die Heizeinrichtung (9) deaktiviert, wenn die Frischhaltefachtemperatur (T_R) die Frischhaltefachtemperatur ($T_{FANcut-in}$) erreicht, bei der das Gebläse (7) aktiviert wird.

5. Kühlvorrichtung (1) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** die Drehzahl des Gebläses (7) veränderbar ist.

6. Kühlvorrichtung (1) nach Anspruch 5, **dadurch gekennzeichnet, dass** die Drehzahl des Gebläses (7)

abnimmt, wenn sich die Frischhaltefachtemperatur (T_R) der Frischhaltefachtemperatur ($T_{FANut\text{-}out}$) nähert, bei der das Gebläse (7) deaktiviert ist, und sich von der Frischhaltefachtemperatur ($T_{FANcut\text{-}in}$) entfernt, bei der das Gebläse (7) aktiviert wird.

Revendications

1. Un dispositif de refroidissement (1) comprenant un compartiment d'aliments frais (2) où les aliments à refroidir sont placés, un compartiment de congélation (3) où les aliments à congeler sont placés, maintenu à des températures plus basses que le compartiment d'aliments frais (2), un compresseur (4) qui comprime et circule le fluide frigorigène dans le cycle de refroidissement, un capteur de température du compartiment d'aliments frais (5) qui mesure la température du compartiments d'aliments frais (2), un capteur de température du compartiment de congélation (6) qui mesure la température du compartiment de congélation (3), un ventilateur (7) permettant la circulation de l'air dans le compartiment d'aliments frais (2) et une unité de commande (8),

   - qui, lorsque le compresseur (4) est désactivé, compare la température du compartiment d'aliments frais (T_R) et la température du compartiment de congélation (T_F) respectivement avec la température du compartiment d'aliments frais ($T_{Rcut\text{-}in}$) à laquelle le compresseur (4) est activé et avec la température du compartiment de congélation ($T_{Fcut\text{-}in}$) à laquelle le compresseur (4) est activé et qui active le compresseur (4) lorsqu'au moins une de la température du compartiment d'aliments frais (T_R) et la température du compartiment de congélation (T_F) atteint respectivement la température du compartiment d'aliments frais ($T_{Rcut\text{-}in}$) à laquelle le compresseur (4) est activé et la température du compartiment de congélation ($TF_{cut\text{-}in}$) à laquelle le compresseur (4) est activé, et
   - qui, lorsque le compresseur (4) est activé, compare la température du compartiment d'aliments frais (T_R) et la température du compartiment de congélation (T_F) respectivement avec la température du compartiment d'aliments frais ($T_{Reut\text{-}out}$) à laquelle le compresseur (4) est désactivé et avec la température du compartiment de congélation ($T_{Fcut\text{-}out}$) à laquelle le compresseur (4) est désactivé et qui désactive le compresseur (4) lorsque les deux température du compartiment d'aliments frais (T_R) et la température du compartiment de congélation (T_F) atteint respectivement la température du compartiment d'aliments frais ($T_{Rcut\text{-}out}$) à laquelle le compresseur (4) est désactivé et la température du compartiment de congélation ($T_{Fcut\text{-}out}$) à laquelle le compresseur (4) est désactivé,

   caractérisé en ce que l'unité de commande (8) active le ventilateur (7) à la température du compartiment d'aliments frais ($T_{FANcut\text{-}in}$) qui est égale à la température du compartiment d'aliments frais ($T_{Rcut\text{-}out}$) à laquelle le compresseur (4) est désactivé.

2. Un dispositif de refroidissement (1) selon la Revendication 1, **caractérisé en ce que** l'unité de commande (8) désactive le ventilateur (7) à une température du compartiment d'aliments frais ($T_{FANcut\text{-}out}$) à laquelle le ventilateur (7) est désactivé, qui est inférieure à la température du compartiment d'aliments ($T_{FANcut\text{-}in}$) à laquelle le ventilateur (7) est activé.

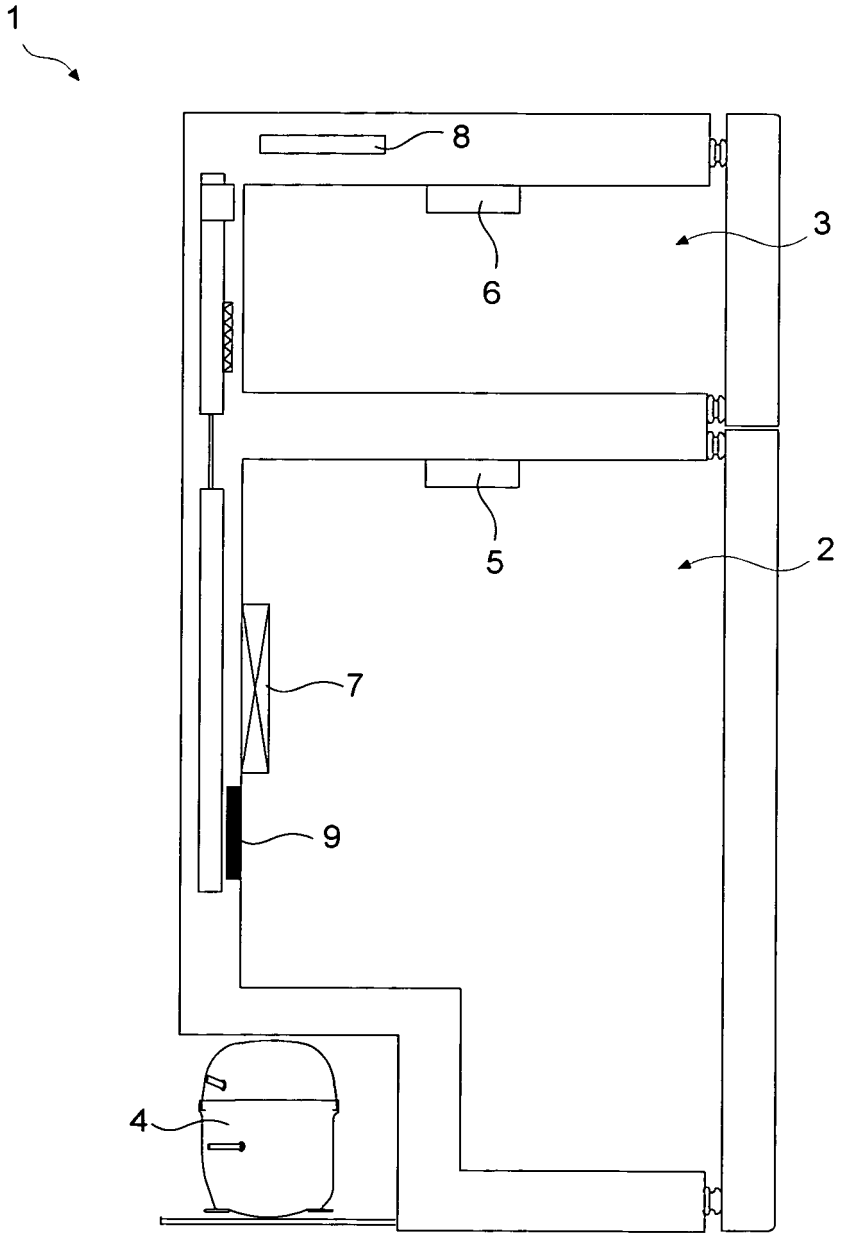
3. Un dispositif de refroidissement (1) selon la Revendication 1 ou 2, **caractérisé en ce qu'**un dispositif de chauffage (9) permet le chauffage du compartiment d'aliments frais (2) lorsque l'on désire et l'unité de commande (8) active le dispositif de chauffage (9) si la température du compartiment d'aliments frais (T_R) est inférieure à la température du compartiment d'aliments ($T_{FANcut\text{-}in}$) à laquelle le ventilateur (7) est activé.

4. Un dispositif de refroidissement (1) selon la Revendication 3, **caractérisé en ce que** l'unité de commande (8) désactive le dispositif de chauffage (9) lorsque la température du compartiment d'aliments frais (T_R) atteint la température du compartiment d'aliments ($T_{FANcut\text{-}in}$) à laquelle le ventilateur (7) est activé.

5. Un dispositif de refroidissement (1) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la vitesse de rotation du ventilateur (7) peut être changée.

6. Un dispositif de refroidissement (1) selon la Revendication 5, **caractérisé en ce que** la vitesse de rotation du ventilateur (7) diminue comme la température du compartiment d'aliments frais (T_R) se rapproche de la température du compartiment d'aliments ($T_{FANcut\text{-}out}$) à laquelle le ventilateur (7) est désactivé et s'éloigne de la température du compartiment d'aliments frais ($T_{FANcut\text{-}in}$) à laquelle le ventilateur (7) est activé.

Figure 1



REFERENCES CITED IN THE DESCRIPTION

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