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(54) **A COOLING DEVICE**

KÜHLVORRICHTUNG

DISPOSITIF DE REFROIDISSEMENT

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(73) Proprietor: **Arçelik Anonim Sirketi
34950 Istanbul (TR)**

(72) Inventors:
• **KOCATURK, Serdar
34950 Istanbul (TR)**
• **ULGUR, Ibrahim Niyazi
34950 Istanbul (TR)**
• **HOCAOGLU, Sabahattin
34950 Istanbul (TR)**

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Description

[0001] The present invention relates to a cooling device comprising one or more compartments wherein the temperature fluctuations are decreased.

[0002] In cooling devices with two compartments and having two evaporators connected in series, preferably in no-frost refrigerators, generally the compressor operates or stops depending on the thermostat value of the freezer compartment. The evaporator fan of the freezer compartment is generally activated together with the compressor and is deactivated when the compressor stops. The evaporator fan of the fresh food compartment operates or stops depending on the thermostat value of the freezer compartment. While an effective cooling is maintained in the freezer compartment, high temperature fluctuations occur in the fresh food compartment wherein the fan operates at long intervals. The temperature fluctuations being high in the fresh food compartment causes the temperature of the foods stored in the said compartment to also change and the quality of the food to be adversely affected.

[0003] In the state of the art European Patent Application No EP1596143, a refrigerator according to the preamble of claim 1 is disclosed.

[0004] The aim of the present invention is the realization of a cooling device wherein the temperature variability is reduced in the fresh food compartment.

[0005] The cooling device and the control method thereof realized in order to attain the aim of the present invention is explicated in the attached claims.

[0006] The cooling device of the present invention comprises a fresh food compartment, a freezer compartment, a compressor, a fresh food compartment evaporator and a freezer compartment evaporator connected in series to each other, a fresh food compartment fan and a freezer compartment fan that blows air separately to each compartment and a control unit that regulates the operation of the compressor and the fans such that both of the compartments are kept within a certain temperature range.

[0007] The control unit, by controlling the temperature value detected by the fresh food compartment sensor when the compressor is activated by the freezer compartment sensor as being actuated, provides the fresh food compartment fan to operate together with the freezer compartment fan if the temperature detected by the fresh food compartment sensor is equal to or greater than a first threshold temperature which is smaller than the activation temperature of the fresh food compartment and greater than the deactivation temperature of the fresh food compartment. In the initial phases of the compressor operation period, the system is provided to operate more efficiently in terms of thermodynamics by means of the fresh food compartment fan operating together with the freezer compartment fan.

[0008] The control unit, furthermore, stops the fresh food compartment fan when the temperature detected

by the fresh food compartment sensor reaches the second threshold temperature value that is greater than the fresh food compartment deactivation temperature. Thus, the the fresh food compartment fan is not expected to operate until the upper cut-in temperature and hence, the increase of temperature fluctuations in the fresh food compartment are prevented.

[0009] In an embodiment of the present invention, the first threshold temperature that determines the criteria for the fresh food compartment fan to operate together with the freezer compartment fan is approximately 1 °C lower than the lower cut-off temperature of the fresh food compartment.

[0010] In another embodiment of the present invention, the first threshold temperature that determines the criteria for the fresh food compartment fan to operate together with the freezer compartment fan is equal to half the sum of the maximum temperature value and the minimum temperature value detected by the fresh food compartment sensor in the previous refrigeration cycle.

[0011] In another embodiment of the present invention, the second threshold temperature that determines the criteria for the fresh food compartment fan to be stopped is lower than the last return temperature, which is the temperature value whereat the temperature changes from the upward trend to the downward trend, detected by the fresh food compartment sensor in the previous refrigeration cycle, by as much as temperature value determined by the producer,.

[0012] By means of the present invention, with the adaptive algorithm carried out by the cooling device control unit, the deactivation temperature of the fresh food compartment fan is determined in accordance with the conditions specified at previous cycles. Thus, as the temperature fluctuations in the fresh food compartment are decreased, energy consumption is provided not to increase.

[0013] The cooling device realized in order to attain the aim of the present invention is illustrated in the attached figures, where:

[0014] Figure 1 - is the schematic view of the cooling device.

[0015] Figure 2 - is the graphic showing the operation of the compressor with respect to time.

[0016] Figure 3 - is the graphic showing the operation of the freezer compartment fan with respect to time.

[0017] Figure 4 - is the graphic showing the change in the temperature detected by the fresh food compartment sensor with respect to time.

[0018] Figure 5 - is the graphic showing the operation cycle of the fresh food compartment fan with respect to time.

[0019] Figure 6 - is the flow chart of an embodiment of the control method.

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

1. Cooling device

2. Fresh food compartment
3. Freezer compartment
4. Compressor
5. Fresh food compartment evaporator
6. Freezer compartment evaporator
7. Fresh food compartment fan
8. Freezer compartment fan
9. Fresh food compartment sensor
10. Freezer compartment sensor
11. Control unit

[0021] The cooling device (1) comprises:

- a fresh food compartment (2) wherein the foods are stored therein for cooling,
- a freezer compartment (3) wherein the foods are stored therein for freezing, kept at lower temperatures than the fresh food compartment (2),
- a compressor (4),
- a fresh food compartment evaporator (5) for cooling the fresh food compartment (2) by providing heat transfer between the refrigerant fluid and the environment,
- a freezer compartment evaporator (6) connected in series to the fresh food compartment evaporator (5), for cooling the freezer compartment (3),
- a fresh food compartment fan (7) which provides to activate the cold air in the vicinity of the fresh food compartment evaporator (5) and blow into the fresh food compartment (2),
- a freezer compartment fan (8) which provides to activate the cold air in the vicinity of the freezer compartment evaporator (6) and blow into the freezer compartment (3),
- a fresh food compartment sensor (9) that measures the temperature inside the fresh food compartment (2),
- a freezer compartment sensor (10) that measures the temperature inside the freezer compartment (3),
- a control unit (11) that provides to keep the temperatures of the fresh food compartment (2) and the freezer compartment (3) within certain temperature ranges by controlling the activation and/or deactivation of the compressor (4), the fresh food compartment fan (7) and/or the freezer compartment fan (8) depending on the temperature values detected by the fresh food compartment sensor (9) and/or the freezer compartment sensor (10) (Figure 1).

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

[0023] TFF: The temperature detected by the fresh food compartment sensor (9)

[0024] TFRZ: The temperature detected by the freezer compartment sensor (10)

[0025] TFFcut-in: the activation temperature of the fresh food compartment (2) predetermined by the producer wherein the compressor (4) is operated for cooling

the fresh food compartment (2).

[0026] TFFcut-out: the deactivation temperature of the fresh food compartment (2) predetermined by the producer wherein the compressor (4), operated depending on the activation temperature (TFFcut-in) of the fresh food compartment (2), is stopped.

[0027] TFRZcut-in: the activation temperature of the freezer compartment (3) predetermined by the producer wherein the compressor (4) is operated for cooling the freezer compartment (3).

[0028] TFRZcut-out: the deactivation temperature of the freezer compartment (3) predetermined by the producer wherein the compressor (4), operated depending on the activation temperature (TFRZ) of the freezer compartment (3), is stopped.

[0029] LRT: the maximum temperature value detected by the fresh food compartment sensor (9), saved in the cycle wherein the compressor (4) is activated by the freezer compartment sensor (10) after the last cycle wherein the compressor (4) is actuated by the fresh food compartment sensor (9).

[0030] T1: The first threshold temperature that is lower than the activation temperature (TFFcut-in) of the fresh food compartment (2) and greater than the deactivation temperature (TFFcut-out) of the fresh food compartment (2).

[0031] T2: The second threshold temperature that is greater than the deactivation temperature (TFFcut-out) of the fresh food compartment (2).

[0032] The temperature of the fresh food compartment (2) is measured by the fresh food compartment sensor (9) and the temperature of the freezer compartment (3) is measured by the freezer compartment sensor (10). The control unit (11) activates the compressor (4) by evaluating whether any one of the compartments (2, 3) require cooling according to the temperature values (TFF or TFRZ) detected by the fresh food compartment sensor (9) or the freezer compartment sensor (10). The compressor (4) is operated and stopped periodically when a cooling requirement occurs in the fresh food compartment (2) or the freezer compartment (3) (Figure 2). In the graphics, time is shown with T(min), and with 0-1, activation and deactivation of the compressor (4), fresh food compartment fan (7) and the freezer compartment fan (8) are shown.

[0033] The compressor (4) is operated by the control unit (11) when the temperature (TFF) detected by the fresh food compartment sensor (9) is equal to or greater than the activation temperature (TFFcut-in) of the fresh food compartment (2). The compressor (4) is stopped by the control unit (11) when the temperature (TFF) detected by the fresh food compartment sensor (9) is equal to or lower than the deactivation temperature (TFFcut-out) of the fresh food compartment (2). Similarly, the compressor (4) is operated by the control unit (11) when the temperature (TFRZ) detected by the freezer compartment sensor (10) is equal to or greater than the activation temperature (TFRZcut-in) of the freezer compartment (3).

The compressor (4) is stopped by the control unit (11) when the temperature (TFRZ) detected by the freezer compartment sensor (10) is equal to or lower than the deactivation temperature (TFRZcut-out) of the freezer compartment (3).

[0034] The control unit (11) compares the temperature (TFF) detected by the fresh food compartment sensor (9) with the first threshold temperature (T1) when the compressor (4) is actuated to operate by the freezer compartment sensor (10). The control unit (11) enables the fresh food compartment fan (7) to operate together with the freezer compartment fan (8) when the temperature (TFF) detected by the fresh food compartment sensor (9) is greater than the first threshold temperature (T1) (Figure 2, Figure 3, Figure 4 and Figure 5).

[0035] When a thermal load increase occurs in the fresh food compartment (2), in other words when the temperature (TFF) detected by the fresh food compartment sensor (9) reaches the activation temperature (TFFcut-in) of the fresh food compartment (2), the compressor (4) is actuated by the fresh food compartment sensor (9) and the fresh food compartment fan (7) is activated together with the compressor (4) (Figure 5). The fresh food compartment fan (7) operates until the temperature (TFF) detected by the fresh food compartment sensor (9) is equal to the deactivation temperature (TFFcut-out) of the fresh food compartment (2). Thus, the increase in temperature inside the fresh food compartment (2) caused by the increase of thermal load is compensated.

[0036] As the compressor (4) is actuated by the fresh food compartment sensor (9) and the fresh food compartment fan (7) is activated, the freezer compartment fan (8) is also activated a short while after the start of the compressor (4) operation period regardless of the temperature (TFRZ) detected by the freezer compartment sensor (10) and operates until the deactivation temperature (TFRZcut-out) of the freezer compartment (3) is detected in the freezer compartment sensor (10).

[0037] As the compressor (4) is activated by being actuated with the freezer compartment sensor (10), the control unit (11) compares the temperature (TFF) detected by the fresh food compartment sensor (9) with the first threshold temperature (T1). The fresh food compartment fan (7) is also operated when the temperature (TFF) detected by the fresh food compartment sensor (9) is greater than the first threshold temperature (T1) (Figure 2, Figure 3, Figure 4 and Figure 5). Thus, in the initial phases of the compressor (4) operation period, operation of the fresh food compartment fan (7) together with the freezer compartment fan (8) provides the cooling device (1) to operate more efficiently in terms of thermodynamics.

[0038] In case the compressor (4) is actuated by the freezer compartment sensor (10) and the fresh food compartment fan (7) is activated together with the compressor (4), the control unit (11) furthermore stops the fresh food compartment fan (7), when the temperature (TFF) detected by the fresh food compartment sensor (9) reaches the second threshold temperature (T2) value. In

this case, it will be unnecessary to operate the fresh food compartment fan (7) until the fresh food compartment (2) upper cut-out temperature (TFFcut-out) is detected by the fresh food compartment sensor (9) and will cause the thermal fluctuation of the fresh food compartment (2) to increase. For, due to the thermal inertia of the fresh food compartment sensor (9), the response of the fresh food compartment sensor (9) to the temperature change in the fresh food compartment (2) comes with a certain lag and the downward trend of the temperature (TFF) detected by the fresh food compartment sensor (9) continues even after the fresh food compartment fan (7) stops. Therefore, when the compressor (4) is actuated by the freezer compartment sensor (10), the deactivation temperature of the fresh food compartment fan (7) is made equal to a second threshold temperature (T2) that is greater than the upper cut-out temperature (TFFcut-out) of the fresh food compartment (2). By means of the downward trend in the temperature detected by the freezer compartment sensor (10) continuing for a while after the fresh food compartment fan (7) stops, the fresh food compartment (2) is cooled some more without operating the fresh food compartment fan (7).

[0039] In an embodiment of the present invention, the first threshold temperature (T1) is approximately 1 °C lower than the activation temperature (TFFcut-in) of the fresh food compartment (2). The difference between the first threshold temperature (T1) and the activation temperature (TFFcut-in) of the fresh food compartment (2) is determined depending on the targeted temperature fluctuation in the fresh food compartment (2) and the operation frequency of the fresh food compartment fan (7).

[0040] In another embodiment of the present invention, the first threshold temperature (T1) is equal to half the sum of the maximum temperature (TFFmax) value and the minimum temperature (TFFmin) value detected by the fresh food compartment sensor (9) in the previous refrigeration cycle. Thus, apart from the activation of the compressor (4) by the freezer compartment sensor (10) in the steady state, in the case the compressor (4) is activated due to the increase of the thermal load in the freezer compartment (3), the unnecessary operation of the fresh food compartment fan (7), which is still at a lower temperature, is avoided. Thus, besides the advantages of varying the control algorithm carried out by the control unit (11) depending on the change in the thermal load in the fresh food compartment (2) and of providing low temperature fluctuations in the fresh food compartment (2), also the advantage of varying the control algorithm depending on the change in the thermal load in the freezer compartment (3) is provided.

[0041] In another embodiment of the present invention, when the compressor (4) is activated depending on the activation temperature (TFRZcut-in) of the freezer compartment (3) detected in the freezer compartment sensor (10), after the last cycle wherein the compressor (4) is actuated by the fresh food compartment sensor (9), the second threshold temperature (T2) is correlated with

the last return temperature (LRT) which is the value whereat the temperature (TFF) detected in the fresh food compartment sensor (9) changes from the upward trend to the downward trend. The fresh food compartment fan (7) is stopped when the temperature (TFF) detected by the fresh food compartment sensor (9) is equal to a temperature that is lower than the saved last return temperature (LRT) by as much as temperature difference (ΔT) determined by the producer. In a version of this embodiment, ΔT is approximately 0.1 °C.

[0042] In the case there isn't any thermal load increase in the fresh food compartment (2), the compressor (4) is generally activated according to the activation temperature (TFRZcut-in) of the fresh food compartment (2) detected in the freezer compartment sensor (10). Thus, in consecutive refrigeration cycles wherein the compressor (4) is actuated by the freezer compartment sensor (10), after a few cycles, the interior temperatures of the fresh food compartment (2) are settled within a certain range and show a stable behavior with low temperature fluctuations. This stable course of the interior temperatures in the fresh food compartment (2) continues until a cycle wherein the compressor (4) is actuated by the fresh food compartment sensor (9) after a thermal load increase in the fresh food compartment (2). After the next refrigeration cycle wherein the compressor (4) is actuated by the fresh food compartment sensor (9), the last return temperature (LRT) is updated and saved depending on the amount of increase in the thermal load received into the fresh food compartment (2). In the subsequent cycles wherein the compressor (4) is actuated by the freezer compartment sensor (10), the deactivation temperature of the fresh food compartment fan (7) is determined according to the updated last return temperature (LRT). Since the deactivation temperature of the fresh food compartment fan (7) determined according to the updated last return temperature (LRT) and the activation temperature at the start of the compressor (4) operation period is limited by the activation temperature (TFFcut-in) of the fresh food compartment (2), the value of the average temperature with low fluctuation inside the fresh food compartment (2) does not change too much.

[0043] The control unit (11) of the cooling device (1) of the present invention operates according to the following method (Figure 6):

- The temperatures (TFF and TFRZ) detected by the fresh food compartment sensor (9) and the freezer compartment sensor (10) are measured (101),
- Whether any one of the compartments (2, 3) require cooling is determined depending on the temperatures (TFF, TFRZ) detected by the fresh food compartment sensor (9) and the freezer compartment sensor (10) (102),
- The compressor (4) is operated if any one of the compartments (2, 3) require cooling (103),
- The compressor (4) is controlled whether it is actuated by the fresh food compartment sensor (9) or

the freezer compartment sensor (10) (104),

- If the compressor (4) is not actuated by the freezer compartment sensor (10), then the fresh food compartment fan (7) and the freezer compartment fan (8) are operated (106),
- The fresh food compartment (2) is controlled whether or not it is cooled (107),
- If the fresh food compartment (2) is cooled, then freezer compartment (3) is controlled whether or not it is cooled (108),
- If the freezer compartment (3) is cooled then the process is terminated (109),
- If the compressor (4) is actuated by the freezer compartment sensor (10) then the temperature (TFF) detected by the fresh food compartment sensor (9) is controlled (105),
- When the temperature (TFF) detected by the fresh food compartment sensor (9) is greater than the first threshold temperature (T1) then the fresh food compartment fan (7) is operated together with the freezer compartment fan (8) (110),
- Whether or not the fresh food compartment sensor (9) has reached the second threshold temperature (T2) value is controlled (112),
- If the temperature detected by the fresh food compartment sensor (9) has reached the second threshold temperature value (T2), then the fresh food compartment fan (7) is stopped (113),
- If the temperature (TFF) detected by the fresh food compartment sensor (9) is smaller than the first threshold temperature (T1) then the freezer compartment fan (8) is operated (111),
- The freezer compartment (3) is controlled whether or not it is cooled (108),
- If the freezer compartment (3) is cooled, then the process is terminated (109).

[0044] By means of the present invention, the temperature fluctuations inside the fresh food compartment (2) are decreased by enabling the control unit (11) to carry out a control algorithm that varies depending on the thermal load in the fresh food compartment (2). Thus, the storage conditions of the foods stored in the fresh food compartment (2) are improved and hence, they are provided to last for a longer period of time.

[0045] It is to be understood that the present invention is not limited by 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) that comprises:

- a fresh food compartment (2) wherein the foods are stored therein for cooling,
 - a freezer compartment (3) wherein the foods are stored therein for freezing, kept at lower temperatures than the fresh food compartment (2),
 - a compressor (4),
 - a fresh food compartment evaporator (5) for cooling the fresh food compartment (2) by providing heat transfer between the refrigerant fluid and the environment,
 - a freezer compartment evaporator (6) connected in series to the fresh food compartment evaporator (5), for cooling the freezer compartment (3),
 - a fresh food compartment fan (7) which provides to activate the cold air in the vicinity of the fresh food compartment evaporator (5) and blow into the fresh food compartment (2),
 - a freezer compartment fan (8) which provides to activate the cold air in the vicinity of the freezer compartment evaporator (6) and blow into the freezer compartment (3),
 - a fresh food compartment sensor (9) that measures the temperature inside the fresh food compartment (2),
 - a freezer compartment sensor (10) that measures the temperature inside the freezer compartment (3),
 - a control unit (11) that provides to keep the temperatures of the fresh food compartment (2) and the freezer compartment (3) within certain temperature ranges by controlling the activation and/or deactivation of the compressor (4), the fresh food compartment fan (7) and/or the freezer compartment fan (8) depending on the temperature values detected by the fresh food compartment sensor (9) and/or the freezer compartment sensor (10),
and **characterized in that** the control unit (11) controls the temperature (TFF) detected by the fresh food compartment sensor (9) when the compressor (4) is operated by the actuation of the freezer compartment sensor (10) and if the temperature (TFF) detected by the fresh food compartment sensor (9) is greater than a first threshold temperature (T1) which is lower than the fresh food compartment (2) activation temperature (TFFcut-in) and greater than the fresh food compartment (2) deactivation temperature (TFFcut-out), then operates the fresh food compartment fan (7) together with the freezer compartment fan (8).
2. A cooling device (1) as in Claim 1, **characterized by** the control unit (11) that stops the fresh food compartment fan (7) when the temperature (TFF) detected by the fresh food compartment sensor (9) is equal to or smaller than a second threshold temperature value (T2) that is greater than the fresh food compartment (2) deactivation temperature (TFFcut-out).
3. A cooling device (1) as in Claim 1 or 2, **characterized by** the control unit (11) that operates the fresh food compartment fan (7) together with the freezer compartment fan (8) at the first threshold temperature (T1) that is approximately 1 °C lower than the fresh food compartment (2) activation temperature (TFFcut-in).
4. A cooling device (1) as in Claim 1 or 2, **characterized by** the control unit (11) that operates the fresh food compartment fan (7) together with the freezer compartment fan (8) at the first threshold temperature (T1) that is equal to half the sum of the maximum temperature value (TFFmax) and the minimum temperature value (TFFmin) detected by the fresh food compartment sensor (9) in the previous refrigeration cycle.
5. A cooling device (1) as in any one of the Claims 2 to 4, **characterized by** the control unit (11) that stops the fresh food compartment fan (7) when the temperature (TFF) detected by the fresh food compartment sensor (9) reaches to the second threshold temperature (T2), which is lower than the last return temperature (LRT), which is saved in the cycle wherein the compressor (4) is activated by the freezer compartment sensor (10) after the last cycle wherein the compressor (4) is actuated by the fresh food compartment sensor (9) and and which is the maximum temperature value detected by the fresh food compartment sensor (9), by as much as temperature difference (ΔT) determined by the producer.
6. For a cooling device (1) as in any one of the above claims, a control method comprising the following steps:
- Measuring the temperatures (TFF and TFRZ) detected by the fresh food compartment sensor (9) and the freezer compartment sensor (10) (101),
 - Determining whether any one of the compartments (2, 3) require cooling depending on the temperatures (TFF and TFRZ) detected by the fresh food compartment sensor (9) and the freezer compartment sensor (10) (102),
 - Operating the compressor (4) if any one of the compartments (2, 3) require cooling (103),
 - Controlling whether the compressor (4) is actuated by the fresh food compartment sensor (9) or the freezer compartment sensor (10) (104),
 - If the compressor (4) is not actuated by the freezer compartment sensor (10), then operating the fresh food compartment fan (7) and the freezer compartment fan (8) (106),

- Controlling whether or not the fresh food compartment (2) is cooled (107),
 - If the fresh food compartment (2) is cooled, then controlling whether or not the freezer compartment (3) is cooled (108),
 - If the freezer compartment (3) is cooled then terminating the process (109),
 - If the compressor (4) is actuated by the freezer compartment sensor (10) then controlling the temperature (TFF) detected by the fresh food compartment sensor (9) (105),
 - When the temperature (TFF) detected by the fresh food compartment sensor (9) is greater than the first threshold temperature (T1) then operating the fresh food compartment fan (7) together with the freezer compartment fan (8) (110),
 - Controlling whether or not the fresh food compartment sensor (9) has reached the second threshold temperature value (T2) (112),
 - If the temperature detected by the fresh food compartment sensor (9) has reached the second threshold temperature value (T2), then stopping the fresh food compartment fan (7) (113),
 - If the temperature (TFF) detected by the fresh food compartment sensor (9) is smaller than the first threshold temperature (T1) then operating the freezer compartment fan (8) (111),
 - Controlling whether or not the freezer compartment (3) is cooled (108),
 - If the freezer compartment (3) is cooled, then terminating the process (109).

• ein Tiefkühlfachgebläse (8), das dafür sorgt, dass kalte Luft in der Nähe des Tiefkühlfachverdampfers (6) aktiviert wird und in das Tiefkühlfach (3) geblasen wird,
 • einen Frischkostfachsensor (9), der die Temperatur im Inneren des Frischkostfachs (2) misst,
 • einen Tiefkühlfachsensor (10), der die Temperatur im Tiefkühlfach (3) misst,
 • eine Steuereinheit (11), die dafür sorgt, dass die Temperatur des Frischkostfachs (2) und des Tiefkühlfachs (3) innerhalb bestimmter Temperaturbereiche bleibt, indem sie abhängig von den Temperaturwerten, die vom Frischkostfachsensor (9) und/oder vom Tiefkühlfachsensor (10) erfasst werden, die Aktivierung und/oder Deaktivierung des Kompressors (4), des Frischkostfachgebläses (7) und/oder des Tiefkühlfachgebläses (8) steuert, und **dadurch gekennzeichnet, dass** die Steuereinheit (11) die Temperatur (TFF) steuert, die vom Frischkostfachsensor (9) erfasst wird, wenn der Kompressor (4) durch Betätigen des Tiefkühlfachsensors (10) betätigt wird, und wenn die Temperatur (TFF), die vom Frischkostfachsensor (9) erfasst wird, größer als eine erste Schwellentemperatur (T1) ist, die niedriger als die Aktivierungstemperatur (TFFcut-in) des Frischkostfachs (2) und größer als die Deaktivierungstemperatur (TFFcut-out) des Frischkostfachs (2) ist, das Frischkostfachgebläse (7) zusammen mit dem Tiefkühlfachgebläse (8) betätigt.

Patentansprüche

1. Kühlvorrichtung (1), umfassend:

• ein Frischkostfach (2), in dem Lebensmittel zum Kühlen aufbewahrt werden,
 • ein Tiefkühlfach (3), in dem Lebensmittel zum Tiefkühlen aufbewahrt werden und das auf einer niedrigeren Temperatur gehalten wird als das Frischkostfach (2),
 • einen Kompressor (4),
 • einen Frischkostfachverdampfer (5) zum Kühlen des Frischkostfachs (2), indem er für eine Wärmeübertragung zwischen dem Kühlfluid und der Umgebung sorgt,
 • einen Tiefkühlfachverdampfer (6), der in Serie mit dem Verdampfer (5) des Fachs für frische Lebensmittel verbunden ist, um das Tiefkühlfach (3) zu kühlen,
 • ein Frischkostfachgebläse (7), das dafür sorgt, dass kalte Luft in der Nähe des Frischkostfachverdampfers (5) aktiviert wird und in das Frischkostfach (2) geblasen wird,

2. Kühlvorrichtung (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Steuereinheit (11) das Frischkostfachgebläse (7) anhält, wenn die Temperatur (TFF), die vom Frischkostfachsensor (9) erfasst wird, gleich oder kleiner als ein zweiter Schwellentemperaturwert (T2) ist, der größer als die Deaktivierungstemperatur (TFFcut-out) des Frischkostfachs (2) ist.

3. Kühlvorrichtung (1) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Steuereinheit (11) das Frischkostfachgebläse (7) zusammen mit dem Tiefkühlfachgebläse (8) bei der ersten Schwellentemperatur (T1) betätigt, die etwa 1 °C niedriger als die Aktivierungstemperatur (TFFcut-in) des Frischkostfachs (2) ist.

4. Kühlvorrichtung (1) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Steuereinheit (11) das Frischkostfachgebläse (7) zusammen mit dem Tiefkühlfachgebläse (8) bei der ersten Schwellentemperatur (T1) betätigt, die gleich der Hälfte der Summe des maximalen Temperaturwerts (TFFmax) und des minimalen Temperaturwerts (TFFmin) ist,

die im vorhergehenden Kühlzyklus vom Frischkostfachsensor (9) erfasst wurden.

5. Kühlvorrichtung (1) nach einem der Ansprüche 2 bis 4, **dadurch gekennzeichnet, dass** die Steuereinheit (11) das Frischkostfachgebläse (7) anhält, wenn die Temperatur (TFF), die vom Frischkostfachsensor (9) gemessen wird, die zweite Schwellentemperatur (T2) erreicht, die niedriger als die letzte Rückgabetemperatur (LRT) ist, die im Zyklus gespeichert wurde, in dem der Kompressor (4) nach dem letzten Zyklus, in dem der Kompressor (4) durch den Frischkostfachsensor (9) betätigt wurde, durch den Tiefkühlfachsensor (10) aktiviert wurde, und die mit einer Temperaturdifferenz von (ΔT), die vom Hersteller festgelegt wird, der maximale Temperaturwert ist, der vom Frischkostfachsensor (9) erfasst wird.
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6. Steuerverfahren für eine Kühlvorrichtung (1) nach einem der vorangehenden Ansprüche, folgende Schritte umfassend:
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 - Messen der Temperaturen (TFF und TFRZ), die vom Frischkostfachsensor (9) und vom Tiefkühlfachsensor (10) erfasst werden (101),
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 - Bestimmen, ob eines der Fächer (2, 3) der Kühlung bedarf, abhängig von den Temperaturen (TFF und TFRZ), die vom Frischkostfachsensor (9) und vom Tiefkühlfachsensor (10) erfasst werden (102),
 - 30
 - Betätigen des Kompressors (4), wenn eines der Fächer (2, 3) der Kühlung bedarf (103),
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 - Prüfen, ob der Kompressor (4) vom Frischkostfachsensor (9) oder vom Tiefkühlfachsensor (10) betätigt wird (104),
 - 40
 - wenn der Kompressor (4) nicht vom Tiefkühlfachsensor (10) betätigt wird, Betätigen des Frischkostfachgebläses (7) und des Tiefkühlfachgebläses (8) (106),
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 - Prüfen, ob das Frischkostfach (2) gekühlt wird (107),
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 - wenn das Frischkostfach (2) gekühlt wird, Prüfen, ob das Tiefkühlfach (3) gekühlt wird (108),
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 - wenn das Tiefkühlfach (3) gekühlt wird, Beenden des Prozesses (109),
 -
 - wenn der Kompressor (4) durch den Tiefkühlfachsensor (10) betätigt wird, Prüfen der Temperatur (TFF), die vom Frischkostfachsensor (9) erfasst wird (105),
 -
 - Wenn die vom Frischkostfachsensor (9) erfasste Temperatur (TFF) größer als die erste Schwellentemperatur (T1) ist, betätigen des Frischkostfachgebläses (7) zusammen mit dem Tiefkühlfachgebläse (8) (110),
 -
 - Prüfen, ob der Frischkostfachsensor (9) den zweiten Schwellentemperaturwert (T2) erreicht hat (112),
 -
 - Wenn die vom Frischkostfachsensor (9) erfas-

ste Temperatur den zweiten Schwellentemperaturwert (T2) erreicht hat, anhalten des Frischkostfachgebläses (7) (113),

- Wenn die vom Frischkostfachsensor (9) erfasste Temperatur (TFF) kleiner als die erste Schwellentemperatur (T1) ist, betätigen des Tiefkühlfachgebläse (8) (111),
- Prüfen, ob das Tiefkühlfach (3) gekühlt wird (108),
- Wenn das Tiefkühlfach (3) gekühlt wird, beenden des Prozesses (109).

Revendications

1. Un dispositif de refroidissement (1) comprenant

- un compartiment d'aliments frais (2) dans lequel les aliments sont stockés pour le refroidissement
- un compartiment de congélation (3) dans lequel les aliments sont stockés pour la congélation, qui est gardé à des températures plus basses que celles du compartiment d'aliments frais (2)
- un compresseur (4),
- un évaporateur de compartiment d'aliments frais (5) qui refroidit le compartiment d'aliments frais (2) en permettant le transfert de la chaleur entre le milieu et le fluide réfrigérant.
- un évaporateur de compartiment de congélation (6) relié en série à l'évaporateur de compartiment d'aliments frais (5), pour le refroidissement du compartiment de congélation (3),
- un ventilateur de compartiment d'aliments frais (7) qui déplace l'air froid environ l'évaporateur de compartiment d'aliments frais (5) et le pousse dans le compartiment d'aliments frais (2),
- un ventilateur de compartiment de congélation (8) qui déplace l'air froid environ l'évaporateur de compartiment de congélation (6) et le pousse dans le compartiment de congélation (3),
- un capteur de compartiment d'aliments frais (9) qui mesure la température dans le compartiment d'aliments frais (2),
- un capteur de compartiment de congélation (10) qui mesure la température dans le compartiment de congélation (3),
- une unité de commande (11) qui garde les températures du compartiment d'aliments frais (2) et du compartiment de congélation (3) dans des gammes de températures en contrôlant l'activation et/ou désactivation du compresseur (4), du ventilateur de compartiment d'aliments frais (7) et/ou du ventilateur de compartiment de congélation (8) en fonction des valeurs de température détectées par le capteur de compartiment d'aliments frais (9) et/ou par le

- capteur de compartiment de congélation (10), et **caractérisé en ce que** l'unité de commande (11) contrôle la température (TFF) détectée par le capteur de compartiment d'aliments frais (9) lorsque le compresseur (4) est mis en marche par l'activation du capteur de compartiment de congélation (10) et met en marche le ventilateur de compartiment d'aliments frais (7) aussi bien que le ventilateur de compartiment de congélation (8) si la température (TFF) détectée par le capteur de compartiment d'aliments frais (9) est supérieure à une première température de seuil (T1) qui est inférieure à la température d'activation (TFFcut-in) du compartiment d'aliments frais (2) et supérieure à la température de désactivation (TFFcut-out) du compartiment d'aliments frais (2).
2. Un dispositif de refroidissement (1) selon la Revendication 1, **caractérisé par** l'unité de commande (11) qui arrête le ventilateur de compartiment d'aliments frais (7) lorsque la température (TFF) détectée par le capteur de compartiment d'aliments frais (9) est égale à ou inférieure à la seconde température de seuil (T2) qui est supérieure à la température de désactivation (TFFcut-out) du compartiment d'aliments frais (2).
3. Un dispositif de refroidissement (1) selon la Revendication 1 ou 2, **caractérisé par** l'unité de commande (11) qui met en marche le ventilateur de compartiment d'aliments frais (7) aussi bien que le ventilateur de compartiment de congélation (8) à la première température de seuil (T1) qui est environnément 1°C inférieure à la température d'activation (TFFcut-in) du compartiment d'aliments frais (2).
4. Un dispositif de refroidissement (1) selon la Revendication 1 ou 2, **caractérisé par** l'unité de commande (11) qui met en marche le ventilateur de compartiment d'aliments frais (7) aussi bien que le ventilateur de compartiment de congélation (8) à la première température de seuil (T1) qui est égale à la moitié de la somme de la valeur de température maximale (TFFmax) et la valeur de température minimale (TFFmin) détectées par le capteur de compartiment d'aliments frais (9) dans le précédent cycle de réfrigération.
5. Un dispositif de refroidissement (1) selon l'une quelconque des revendications de 2 à 4, **caractérisé par** l'unité de commande (11) qui arrête le ventilateur de compartiment d'aliments frais (7) lorsque la température (TFF) détectée par le capteur de compartiment d'aliments frais (9) atteint à la seconde température de seuil (T2), qui est inférieure à la température de retour dernière (LRT) autant que la différence de température (ΔT) déterminée par le producteur, qui est enregistrée dans le cycle où le compresseur (4) est activé par le capteur de compartiment de congélation (10) après le cycle dernier où le compresseur (4) est actionné par le capteur de compartiment d'aliments frais (9), et qui est la valeur de température maximale détectée par le capteur de compartiment d'aliments frais (9).
6. Une méthode de commande pour un dispositif de refroidissement (1) selon l'une quelconque des revendications précédentes, comprenant les étapes suivantes:
- De mesurer les températures (TFF et TFRZ) détectées par le capteur de compartiment d'aliments frais (9) et le capteur de compartiment de congélation (10) (101),
 - De déterminer si ou non l'un des compartiments (2, 3) nécessite un refroidissement en fonction des températures (TFF et TFRZ) détectées par le capteur de compartiment d'aliments frais (9) et le capteur de compartiment de congélation (10) (102),
 - De mettre en marche le compresseur (4) si l'un des compartiments (2, 3) nécessite le refroidissement (103),
 - De contrôler si ou non le compresseur (4) est actionné par le capteur de compartiment d'aliments frais (9) ou le capteur de compartiment de congélation (10) (104),
 - De mettre en marche le ventilateur de compartiment d'aliments frais (7) et le ventilateur de compartiment de congélation (8) si le compresseur (4) n'est pas activé par le capteur de compartiment de congélation (10) (106),
 - De contrôler si ou non le compartiment d'aliments frais (2) est refroidit (107),
 - De contrôler si ou non le compartiment de congélation (3) est refroidit si le compartiment d'aliments frais (2) est refroidit (108),
 - D'arrêter le processus si le compartiment de congélation (3) est refroidit (109),
 - De contrôler la température (TFF) détectée par le capteur de compartiment d'aliments frais (9) si le compresseur (4) est actionné par le capteur de compartiment de congélation (10) (105),
 - De mettre en marche le ventilateur de compartiment d'aliments frais (7) et le ventilateur de compartiment de congélation (8) lorsque la température (TFF) détectée par le capteur de compartiment d'aliments frais (9) est supérieure à la première température de seuil (T1) (110),
 - De contrôler si ou non le capteur de compartiment d'aliments frais (9) a atteint à la seconde température de seuil (T2) (112),
 - D'arrêter le ventilateur de compartiment d'aliments frais (7) si la température détectée par le capteur de compartiment d'aliments frais (9) a

atteint à la seconde température de seuil (T2) (113),

- De mettre en marche le ventilateur de compartiment de congélation (8) si la température (TFF) détectée par le capteur de compartiment d'aliments frais (9) est inférieure à la première température de seuil (T1) (111), 5
- De contrôler si ou non le compartiment de congélation (3) est refroidit (108),
- D'arrêter le processus si le compartiment de congélation (3) est refroidit (109). 10

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Figure 1

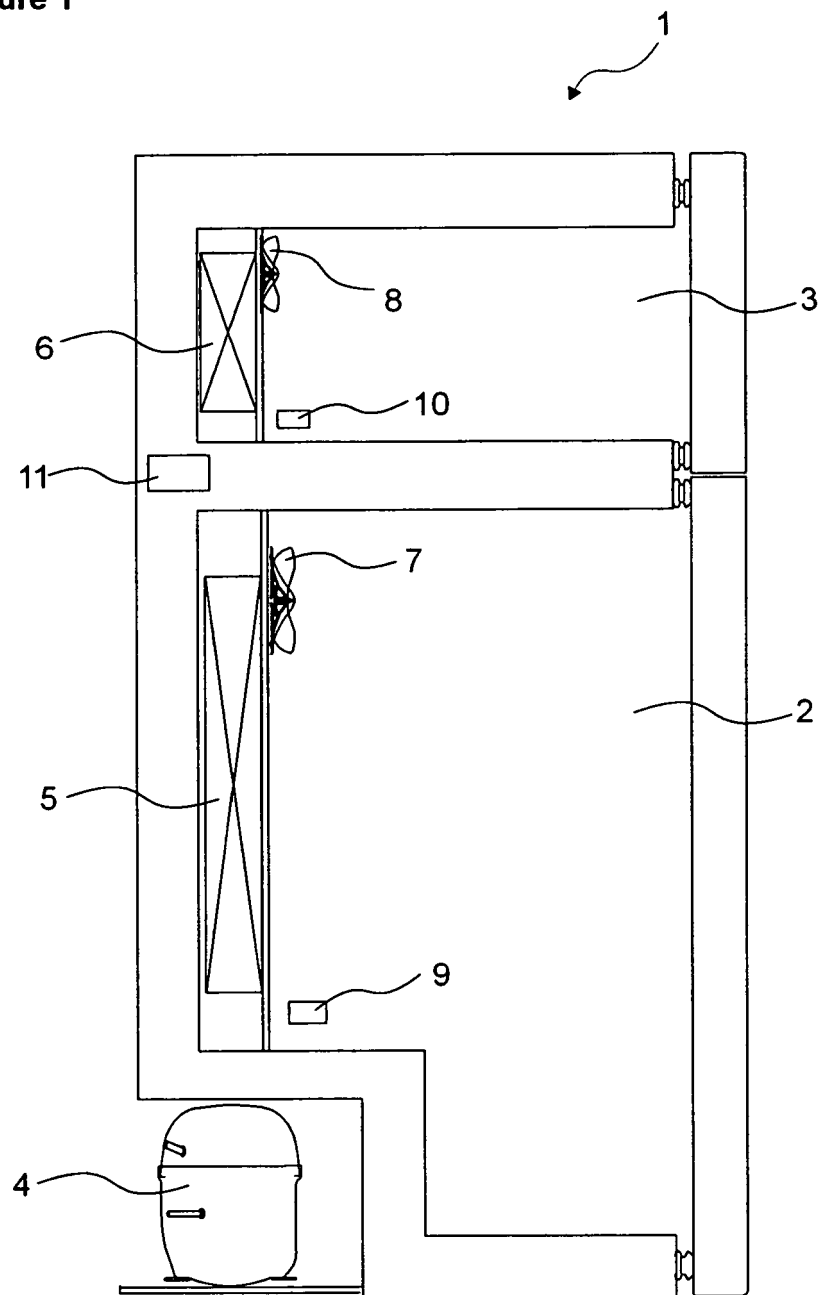


Figure 2

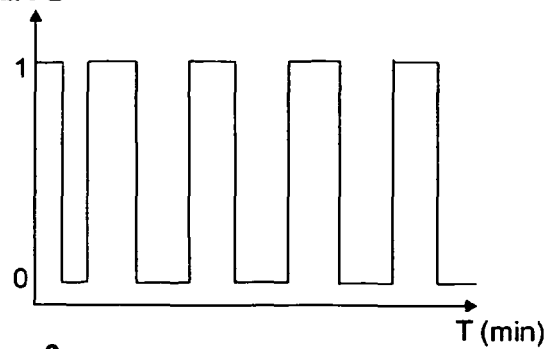


Figure 3

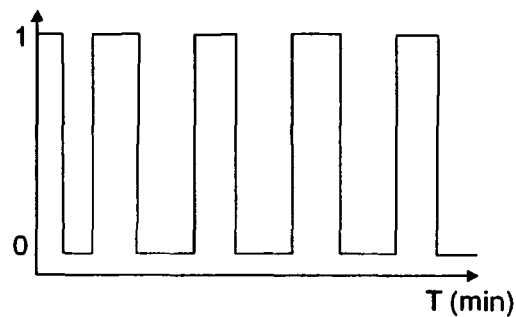


Figure 4

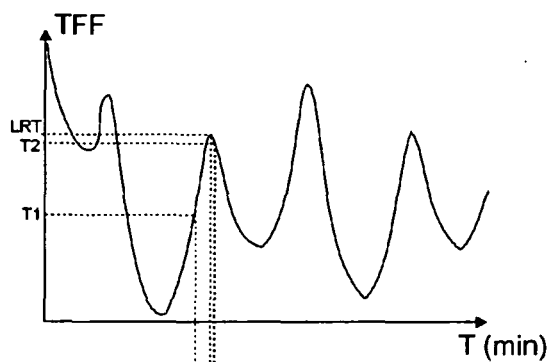


Figure 5

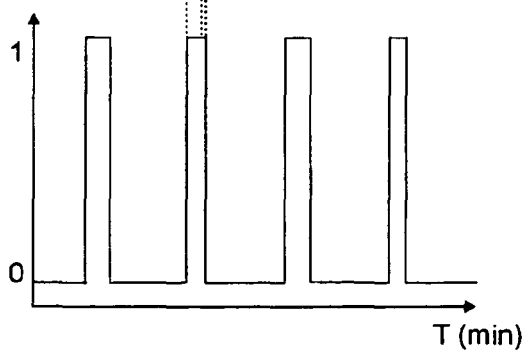
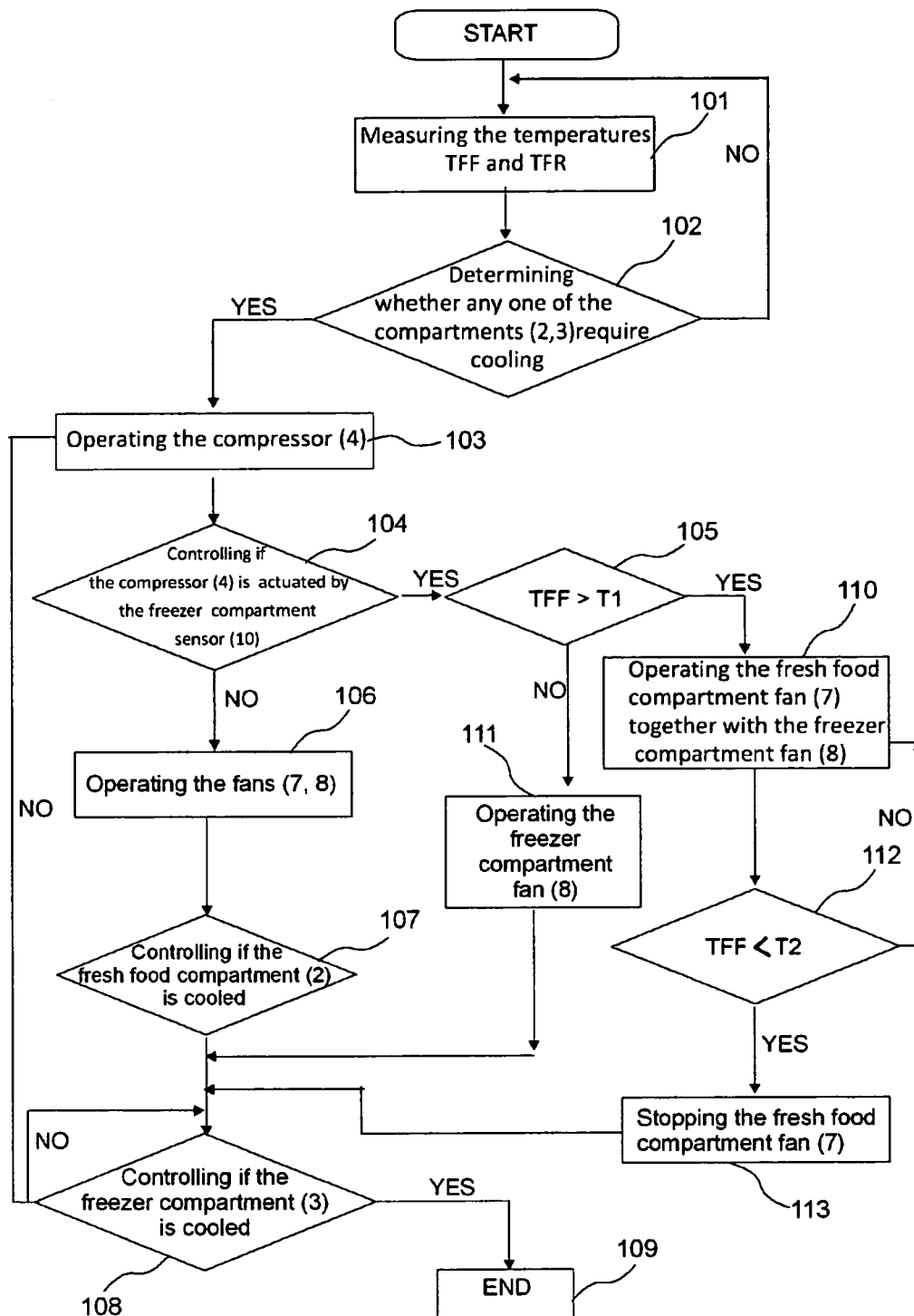


Figure 6



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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