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(54) **Title**: A REFRIGERATOR THE AIR CIRCULATION OF WHICH IS CONTROLLED

(57) **Abstract**: The present invention relates to a refrigerator (1) comprising a freezing chamber (2), a refrigerating chamber (3), a chamber wall (4) separating the freezing chamber (2) from the refrigerating chamber (3), an evaporator (5) disposed behind the freezing chamber (2), providing the freezing chamber (2) to be cooled, a shroud (6) disposed at the front of the evaporator (5), an evaporator channel (7) disposed between the rear wall of the freezing chamber (2) and the shroud (6), through which air flow over the evaporator (5) is provided, a fan (8) that provides air in the freezing chamber (2) to be circulated by passing it over the evaporator (5), an air distribution channel (9) disposed at the side of the shroud (6) facing the freezing chamber (2), a front plate (10) that separates the air distribution channel (9) from the freezing chamber (2), at least one air supply port (11) disposed on the front plate (10), providing the air passed over the evaporator (5) by the fan (8) and sent to the air distribution channel (9) to be directed into the freezing chamber (2) and a returning path (12) disposed in the chamber wall (4), that delivers the air sucked from the freezing chamber (2) by the fan (8) into the evaporator channel (7).

Description

A REFRIGERATOR THE AIR CIRCULATION OF WHICH IS CONTROLLED

[0001] The present invention relates to a refrigerator wherein the air circulation in the freezing chamber is controlled.

[0002] In the freezing chambers of double-door no-frost refrigerators, the air blown into the chamber by the fan providing air circulation, is delivered unto the evaporator by being sucked in from the holes at the lower side of the chamber, near the door, by means of a return channel and the air cooled herein is resent into the chamber, thus the air circulation is performed in the freezing chamber. The fan in the freezing chamber does not operate continuously, it generally operates and stops together with the compressor. At operation and stop times of the fan, air flow at opposite directions to each other is observed. At fan stop times, the cold air sinks to the bottom sections of the freezing chamber due to having higher density. On the other hand, the air heating up due to heat transfer at sections near the side walls and the door moves towards the upper portion of the chamber as a result of density of the air falling. At times when the fan does not operate, since the cold air sinking due to high density is not circulated, the temperature of the freezing chamber rises quickly and the operating periods and hence energy consumption of the compressor increases in order to provide the required refrigeration.

[0003] In the state of the art United States Patents No. US6735975, US6318099, US5802867 and US5678413 and European Patents No. EP1074803, EP0881441, EP0899526 and EP0592004, various control mechanisms are explained that regulate the cool air circulation in the freezing and the refrigerating chambers of refrigerators.

[0004] The aim of the present invention is the realization of a refrigerator wherein the operating periods and hence energy consumption of the compressor is decreased by controlling air circulation in the freezing chamber.

[0005] The refrigerator realized in order to attain the aim of the present invention, explicated in the first claim and the respective claims thereof, comprises an evaporator providing the freezing chamber to be refrigerated, a shroud disposed at the front of the evaporator, an aperture situated at the lower

side of the shroud, that connects the evaporator channel containing the evaporator therein to the air distribution channel at the front and a damper, one end connected to the shroud, allowing passage of air from the aperture by closing the evaporator channel when in the open position and closing the aperture by opening the evaporator channel when in the closed position.

[0006] The damper is actuated by preferably an electromagnetic type movement mechanism that provides the damper to move between the aperture and the evaporator channel, opening the aperture or the evaporator channel and closing the other one, depending on whether or not the fan operates.

[0007] In the refrigerator, a chamber wall is disposed between the freezing chamber and the refrigerating chamber and in the operating period of the fan, the air in the freezing chamber is sucked into the evaporator channel from the returning path in the chamber wall extending from the front backwards. The temperature of the returning path is higher than the freezing chamber since it is near the refrigerating chamber and increases the temperature of the air passing therethrough.

[0008] The embodiment of the present invention is activated at times when the fan does not operate, the damper closes in between the evaporator channel and the returning path in the stop period of the fan and prevents the cold air sinking downwards from over the evaporator from “escaping” into the returning path since the density inside the freezing chamber is high. Consequently, the air sinking in the freezing chamber is prevented from heating up and the freezing chamber is provided to be kept cold at the stop times of the fan.

[0009] At times when the fan operates, the damper allows air to be sucked from the returning path into the evaporator channel by opening the evaporator channel, in other words, reactivates the returning path that is deactivated at times when the fan does not operate.

[0010] In the refrigerator of the present invention, air circulations in the freezing chamber and the refrigerating chamber are controlled independently, there is no air circulation between the freezing chamber and the refrigerating chamber. The cold air directed by the damper of the present invention

circulates only in the freezing chamber.

[0011] In the refrigerator of the present invention, at times when the fan (8) and the compressor do not operate, the cold air is prevented from entering into the returning path, disposed in the chamber wall between the freezing chamber and the refrigerating chamber by sinking due to density difference, the air in the freezing chamber is preserved for a long time without heating up and energy saving is provided.

[0012] The refrigerator realized in order to attain the aim of the present invention is illustrated in the attached figures, where:

[0013] Figure 1 – is the schematic view of the air circulation in the refrigerator freezing chamber of the present invention at times when the fan does not operate.

[0014] Figure 2 – is the schematic view of the air circulation in the refrigerator freezing chamber of the present invention at times when the fan operates.

[0015] The elements illustrated in the figures are numbered as follows:

1. Refrigerator
2. Freezing chamber
3. Refrigerating chamber
4. Chamber wall
5. Evaporator
6. Shroud
7. Evaporator channel
8. Fan
9. Air distribution channel
10. Front plate
11. Air supply port
12. Returning path
13. Aperture
14. Damper
15. Movement mechanism

[0016] The refrigerator (1) comprises a body, one or more than one door disposed on the front side of the body, a compressor providing the refrigeration cycle to be performed, a freezing chamber (2), a refrigerating

chamber (3) disposed inside the body, a chamber wall (4) separating the freezing chamber (2) from the refrigerating chamber (3), an evaporator (5) disposed behind the freezing chamber (2), providing the freezing chamber (2) to be cooled, a shroud (6) disposed at the front of the evaporator (5), an evaporator channel (7) disposed between the rear wall of the freezing chamber (2) and the shroud (6), through which air flow is provided over the evaporator (5), a fan (8) that provides air in the freezing chamber (2) to be circulated by passing over the evaporator (5), that generally operates simultaneously with the compressor at the operation period and stops simultaneously with the compressor at the stop period, an air distribution channel (9) disposed on the side of the shroud (6) facing the freezing chamber (2), a front plate (10) that separates the air distribution channel (9) from the freezing chamber (2), at least one air supply port (11) disposed on the front plate (10), providing the air passed through the evaporator (5) by the fan (8) and delivered to the air distribution channel (9) to be directed into the freezing chamber (2) and a returning path (12) disposed in the chamber wall (4), that delivers the air sucked from the freezing chamber (2) by the fan (8) into the evaporator channel (7) from under the freezing chamber (2).

[0017] The refrigerator (1) of the present invention comprises,

[0018] -an aperture (13) disposed at the lower side of the shroud (6), connecting the evaporator channel (7) behind the shroud (6) to the air distribution channel (9) at the front side and

[0019] - a damper (14) pivotally mounted on the shroud (6), at the edge of the aperture (13) so as to rotate around an axis, moving inside the evaporator channel (7) between the body rear wall (D) and the shroud (6) depending on whether or not the fan (8) operates, closing the aperture (13) and opening the evaporator channel (7) in the closed position, extending transversely into the evaporator channel (7) by opening the aperture (13) in the open position and thus preventing air passage from the evaporator channel (7) into the returning path (12) by closing the evaporator channel (7).

[0020] In the freezing chamber (2), the damper (14) connected to the shroud (6)

at the front of the evaporator (5) operates as bi-positional, allows air flow from the aperture (13) by moving away from the aperture (13) when the evaporator channel (7) is closed and prevents air flow in the evaporator channel (7). When the damper (14) opens the evaporator channel (7), it closes over the aperture (13), allowing air flow through the evaporator channel (7) and prevents air flow from the aperture (13).

[0021] The refrigerator (1) furthermore comprises a preferably electromagnetic type movement mechanism (15), that provides the damper (14) to open the aperture (13) and close the evaporator channel (7) by extending thereinto by actuating the damper (14) or that provide the damper (14) to open the evaporator channel (7) by closing the aperture (13) depending on whether or not the fan (8) operates.

[0022] In the freezing chamber (2), during the stop periods of the fan (8) and the compressor, there is neither refrigerant flow nor forced air flow in the refrigerating system, an air circulation is observed that is in the opposite direction to the air circulation during the fan (8) operation, formed due to temperature differences and the density of air changing at different temperatures. At stop periods of the fan (8), the air heating up in the freezing chamber (2) at sections near the door rises towards the ceiling of the freezing chamber (2) and from here passes into the evaporator channel (7) and is cooled by the evaporator (5). At the compressor stop period, even though there is no refrigerant flow in the refrigeration system, the cooling effect of the evaporator (5) continues due to thermal inertia. The air cooled by the evaporator (5) sinks in the evaporator channel (7) by getting heavier, in other words moves in the downward direction.

[0023] The damper (14) is changed to the open position by the movement mechanism (15) at times when the fan (8) does not operate, moves away from the aperture (13) by opening from the shroud (6) towards inside the evaporator channel (7) and bears against the body rear wall (D), thus closes the evaporator channel (7) and cuts off the connection between the evaporator channel (7) and the returning path (12), providing the air sinking in the evaporator channel (7) to be sent into the air distribution channel (9) through the released aperture (13) and from here to the

freezing chamber (2) by means of the air supply ports (11) (Figure 1).

[0024] The damper (14) cuts off the air flow from the evaporator channel (7) to the returning path (12) at times when the fan (8) does not operate, preventing the sinking cold air from evaporator entering and heating up in the returning path (12), which is at a position near the refrigerating chamber (3) at approximately + 5 degree temperature, and therefore having the potential to heat the air. At times when the fan (8) does not operate, the cold air passing from the evaporator channel (7) into the air distribution channel (9) by means of the damper (14) changing to the open position, disperses into the freezing chamber (2) by passing through the air supply ports (11), thus the quick temperature rise in the freezing chamber (2) at times when the fan (8) does not operate is prevented.

[0025] The damper (14) is changed to the closed position by the movement mechanism (15) at times when the fan (8) operates, the evaporator channel (7) is opened by closing the aperture (13) and thus air passage between the evaporator channel (7) and the returning path (12) is provided, the air activated by the fan (8) and cooled by being passed over the evaporator (5), enters into the air distribution channel (9) from the upper side of the evaporator channel (7), and sent from here to the freezing chamber (2) by means of the air supply ports (11) at the front plate (10). The air in the freezing chamber (2) enters into the returning path (12) by the sucking effect of the fan (8) and continues circulation inside the freezing chamber (2) by passing from the returning path (12) into the evaporator channel (7) since it is not obstructed by the damper (14) (Figure 2).

[0026] In the refrigerator (1) of the present invention, in the freezing chamber (2) the cold air is prevented from entering into the returning path (12), disposed in the chamber wall (4) between the freezing chamber (2) and the refrigerating chamber (3), by sinking in the freezing chamber (2) due to difference in density, and the temperature of the cold air is prevented from rising at times when the fan (8) and the compressor do not operate, the cold air in the freezing chamber (2) is utilized for a long period of time. Energy consumption is decreased by prolonging the stop periods of the

fan (8) and the compressor.

[0027] 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 refrigerator (1) **comprising** a freezing chamber (2), a refrigerating chamber (3), a chamber wall (4) separating the freezing chamber (2) from the refrigerating chamber (3), an evaporator (5) disposed behind the freezing chamber (2), providing the freezing chamber (2) to be cooled, a shroud (6) disposed at the front of the evaporator (5), an evaporator channel (7) disposed between the rear wall of the freezing chamber (2) and the shroud (6), through which air flow over the evaporator (5) is provided, a fan (8) that provides air in the freezing chamber (2) to be circulated by passing it over the evaporator (5), an air distribution channel (9) disposed at the side of the shroud (6) facing the freezing chamber (2), a front plate (10) that separates the air distribution channel (9) from the freezing chamber (2), at least one air supply port (11) disposed on the front plate (10), providing the air passed over the evaporator (5) by the fan (8) and sent to the air distribution channel (9) to be directed into the freezing chamber (2) and a returning path (12) disposed in the chamber wall (4), that delivers the air sucked from the freezing chamber (2) by the fan (8) into the evaporator channel (7),

   characterized by

   - an aperture (13) disposed on the lower side of the shroud (6), connecting the evaporator channel (7) behind the shroud (6) with the air distribution channel (9) at the front side and

   - a damper (14) pivotally mounted on the shroud (6), at the edge of the aperture (13), moving inside the evaporator channel (7) between the body rear wall (D) and the shroud (6) closing the aperture (13) and opening the evaporator channel (7) in the closed position, opening the aperture (13) and preventing air passage from the evaporator channel (7) into the returning path (12) by closing the evaporator channel (7) in the open position.
2. A refrigerator (1) as in Claim 1, **characterized by** a movement mechanism (15), that provides the damper (14) to open the aperture (13) and close the evaporator channel (7) by extending thereinto by actuating the damper (14) or provide the damper (14) to open the evaporator channel (7) by closing the aperture (13) depending on whether or not the fan (8) operates.
3. A refrigerator (1) as in Claim 1 or 2, **characterized by** the damper (14) that is

changed to the open position by the movement mechanism (15) at times when the fan (8) does not operate, opening the aperture (13) by opening from the shroud (6) towards inside the evaporator channel (7) and bearing against the body rear wall (D), thus cutting off the connection between the evaporator channel (7) and the returning path (12) by closing the evaporator channel (7).

4. A refrigerator (1) as in any one of the above Claims, **characterized by** the damper (14) that is changed to the closed position by the movement mechanism (15) at times when the fan (8) operates, opening the evaporator channel (7) by closing the aperture (13) and thus providing air passage between the evaporator channel (7) and the returning path (12).

Figure 1

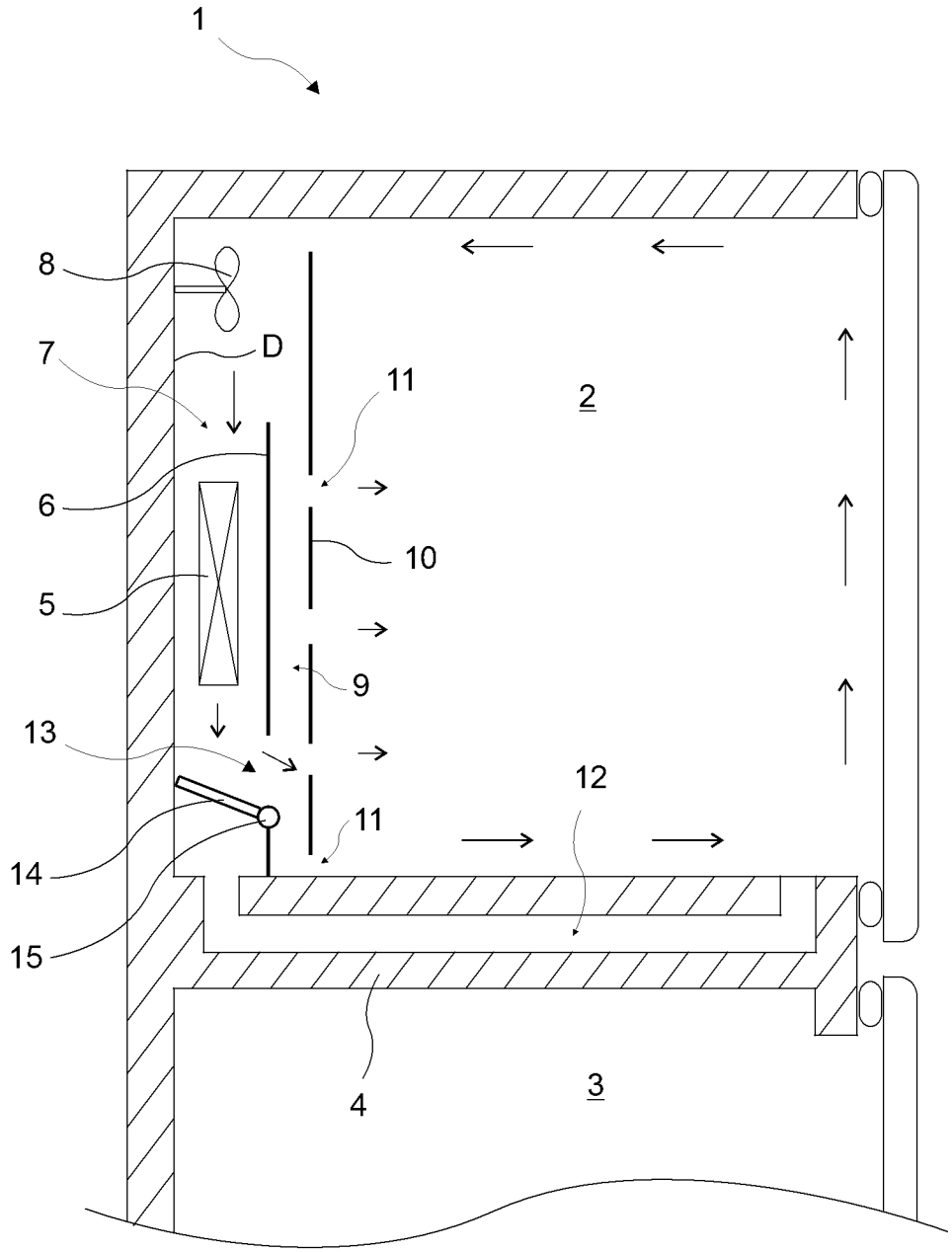

Figure 2