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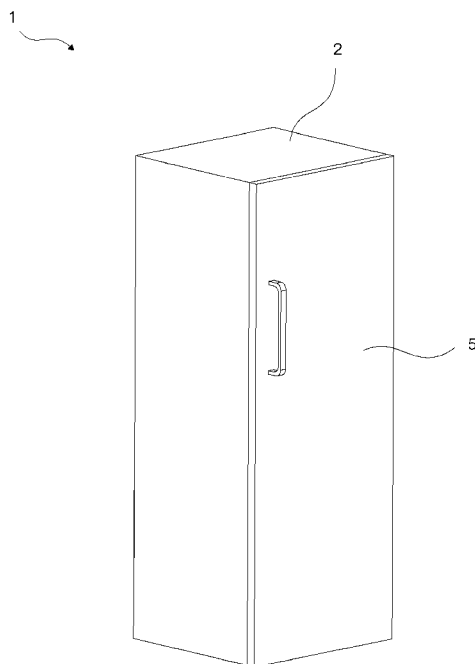
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(54) Title: A COOLING DEVICE WITH IMPROVED REFRIGERATION PERFORMANCE

Figure 1



(57) Abstract: The present invention relates to a cooling device (1) compris-
ing a body (2); a fresh food compartment (3) that is disposed in the body (2)
and wherein the foodstuffs are placed to be cooled; a freezing compartment
(4) kept at lower temperatures than the fresh food compartment (3), wherein
foodstuffs are placed to be frozen; a door (5) providing access to the fresh
food compartment (3) and the freezing compartment (4), and a lid (6) that en-
ables the freezing compartment (4) to be closed so as to prevent the heat
transfer between the fresh food compartment (3) and the freezing compart-
ment (4).

Description**A COOLING DEVICE WITH IMPROVED REFRIGERATION PERFORMANCE**

- [0001] The present invention relates to a cooling device the refrigeration performance of which is improved.
- [0002] Cooling devices comprise a fresh food compartment wherein foods and beverages are stored and a freezing compartment that enables foods to be stored by being frozen. In some of the single door cooling devices, the freezing compartment and the fresh food compartment are separated by means of a lid closing the freezing compartment. The compartments are refrigerated by means of the refrigeration cycle composed of the circulation of the refrigerant fluid through the units composed of the compressor, the condenser, the capillary tube and the evaporator. Since the refrigeration cycle stops during a power failure, the temperatures of the compartments increase and this increase in temperature causes the foods to spoil by adversely affecting the storage lives thereof.
- [0003] In the state of the art European Patent Application No. EP2549210, a cooling device is disclosed, comprising a thermosyphon that enables the temperature of the refrigeration compartment to be decreased by carrying the refrigerant fluid in the freezing compartment to the refrigeration compartment during a power failure.
- [0004] The aim of the present invention is the realization of a cooling device wherein the storage lives of the foods are prolonged by controlling the heat transfer realized between the two compartment at different temperatures during a power failure.
- [0005] The cooling device realized in order to attain the aim of the present invention, explicated in the first claim and the respective claims thereof, comprises a body; a fresh food compartment that is disposed in the body and wherein the foodstuffs are placed to be cooled; a freezing compartment kept at lower temperatures than the fresh food compartment, wherein foodstuffs are placed to be frozen, and a lid that enables the freezing compartment to be closed so as to prevent the air flow between the fresh food compartment and the freezing compartment. The lid prevents the hot air from entering the freezing compartment by covering

the open front surface of the freezing compartment.

[0006] The cooling device of the present invention comprises an electromagnet that is placed onto the body so as to be located at the freezing compartment side of the body and that is energized by the electric current taken from the mains and a metal plate that is disposed on the lid so as to be opposite to the electromagnet when the lid is closed. The electromagnet shows magnetic properties when an electric current flows therethrough. The metal plate is positioned on the lid so as to be in the electromagnetic field of the electromagnet. By means of the attraction force exerted by the electromagnet to the metal plate, as long as an electric current is delivered to the electromagnet, the lid is prevented from opening besides the user intervention. The air flow between the fresh food compartment and the freezing compartment is prevented. In case of a power failure, the electric current delivered from the mains to the electromagnet is interrupted, thus the electromagnet loses its magnetic properties. When the pressure exerted by the electromagnet so as to force the lid to remain closed is removed, the lid opens a little. Air passes through this opening from the fresh food compartment to the freezing compartment. The air flow to the fresh food compartment from the freezing compartment, which has a lower temperature than the fresh food compartment, slows down the increase of the fresh food compartment temperature during the power failure. The heat transfer between the fresh food compartment and the freezing compartment is realized by natural convection until the temperature balance between the compartments is established.

[0007] In an embodiment of the present invention, the cooling device comprises a PCM container that is disposed in the freezing compartment and that comprises phase change material. The phase changing material is obtained by combining one or more than one eutectic material and freezes at a certain temperature depending on its chemical characteristic during the operation of the cooling device. The freezing compartment wherein the foodstuffs to be frozen are placed is kept at about -18°C. Therefore, a phase change material that is solid at -15°C or at temperatures below

-15°C is placed into the PCM container. The phase change material draws heat from the environment in case of a power failure and enables the temperature increase in both the freezing compartment and the fresh food compartment to be slowed down. Thus, foodstuffs in the freezing compartment and the fresh food compartment can be stored for a longer period of time without getting spoiled. The PCM container is placed into the freezing compartment so as to contact with the evaporator.

[0008] In another embodiment of the present invention, the cooling device comprises a biasing means with one end connected to the body and the other end extending towards the lid. The free end of the biasing means bears against the lid during the closing of the lid and is squeezed between the body and the lid when the lid is completely closed. The pressure the biasing means exerts on the lid is in the opposite direction of the pressure the electromagnet exerts on the lid. The pressure exerted by the electromagnet overcomes the pressure exerted by the biasing means and keeps the lid closed. When the electromagnet loses its electromagnetic properties due to a power failure and the pressure exerted by the electromagnet onto the lid is interrupted, the biasing means, preferably a spring, pushes the lid and opens the same.

[0009] In another embodiment of the present invention, the cooling device comprises a battery that is disposed on the body and a control unit that enables the electromagnet to be energized with the electric current received from the battery. By means of the battery, during the power failure the lid is enabled to be kept closed and the freezing compartment is enabled to keep its coldness. In this embodiment, the electromagnet comprises electrical connections connected to both the mains and the battery. When the electric current from the mains is interrupted, the control unit activates the battery and enables the battery to deliver the energy taken from the mains and stored by the same to the electromagnet. Thus, the electromagnet does not lose its electromagnetic properties and the lid can be kept closed. Consequently, the cold air leakage from the freezing compartment to the outer environment is prevented. When the power failure ends, the control unit deactivates the battery and enables the

electromagnet to be energized with the electric current received from the mains.

[0010] In another embodiment of the present invention, the cooling device comprises a temperature sensor that is disposed in the freezing compartment and the control unit that provides the controlling of the battery according to the data received from the temperature sensor. In case of a power failure, the lid is kept open and the air is delivered from the freezing compartment to the fresh food compartment until the freezing compartment temperature value detected by the temperature sensor reaches the freezing compartment limit value predetermined by the producer and whereat the foodstuffs in the freezing compartment starts to thaw. When the limit temperature value is reached, the control unit activates the battery and enables the electromagnet to close the lid and the foodstuffs in the freezing compartment are prevented from thawing.

[0011] In another embodiment of the present invention, the cooling device comprises a button that is disposed on the body and the control unit that activates/deactivates the battery according to the data received from the button. In case of a power failure, the foodstuffs, which are required to be stored for a longer time without getting spoiled, vary according to the user needs. By means of the button, in case of a power failure the user can select the compartment the foodstuffs in which he/she desires to be preserved for a longer time. When the user triggers the button, the control unit prevents the delivery of electric current from the battery to the electromagnet and enables the lid to be kept open during the power failure and thus, enables the foodstuffs in the fresh food compartment to be stored for a longer time without getting spoiled. In case the button is not triggered, the control unit provides the delivery of electric current from the battery to the electromagnet and enables the lid to be kept closed during the power failure and thus, enables the foodstuffs in the freezing compartment to be stored without thawing for a longer time.

[0012] In another embodiment, the cooling device comprises a fan that is disposed in the freezing compartment and that is energized by the energy received from the battery. The fan energized by the battery enables the air

from the freezing compartment to reach all the regions of the fresh food compartment. Thus, the fresh food compartment is enabled to be effectively cooled.

[0013] In another embodiment of the present invention, the cooling device comprises a frame that surrounds the freezing compartment and that is disposed on the body so as to contact with the lid when the lid is closed. By providing a leak-proof connection between the frame and the lid, the freezing compartment is enabled to be effectively cooled.

[0014] In another embodiment of the present invention, the cooling device comprises a handle that is disposed on the lid and an arm that is disposed on the handle and that enables the electric current delivered to the electromagnet to be interrupted when triggered. When the user pulls the handle and triggers the arm on the handle, the electric current being delivered to the electromagnet is interrupted and the pressure exerted by the electromagnet so as to keep the lid closed is terminated and the user is enabled to easily open the lid.

[0015] In another embodiment of the present invention, the control unit enables the user to be informed by visual and/or audio warnings according to the data received from the temperature sensor. When the freezing compartment temperature value detected by the temperature sensor reaches the freezing compartment limit temperature value, the control unit enables the user to be warned by visual and/or audio warnings. Thus, the user can understand that the foodstuffs stored in the cooling device will spoil in a short time if the electric current continues.

[0016] By means of the present invention, a cooling device is realized wherein the foodstuffs stored in the compartment are enabled to be stored for a longer time without getting spoiled by means of the air flow controllably realized between the freezing compartment and the fresh food compartment in case of a power failure.

[0017] The cooling device realized in order to attain the aim of the present invention is illustrated in the attached figures, where:

[0018] Figure 1 – is the perspective view of a cooling device.

[0019] Figure 2 – is the sideways cross-sectional view of the cooling device in an

embodiment of the present invention.

[0020] Figure 3 – is the partial perspective view of the freezing compartment in an embodiment of the present invention.

[0021] Figure 4 – is the partial perspective view of the freezing compartment in an embodiment of the present invention.

[0022] Figure 5 – is the partial perspective view of the lid in an embodiment of the present invention.

[0023] The elements illustrated in the figures are numbered as follows:

1. Cooling device
2. Body
3. Fresh food compartment
4. Freezing compartment
5. Door
6. Lid
7. PCM container
8. Electromagnet
9. Metal plate
10. Biasing means
11. Battery
12. Control unit
13. Temperature sensor
14. Button
15. Frame
16. Handle
17. Arm
18. Fan

[0024] The cooling device (1) comprises a body (2); a fresh food compartment (3) that is disposed in the body (2) and wherein the foodstuffs are placed to be cooled; a freezing compartment (4) kept at lower temperatures than the fresh food compartment (3), wherein foodstuffs are placed to be frozen; a door (5) providing access to the fresh food compartment (3) and the freezing compartment (4), and a lid (6) that enables the freezing compartment (4) to be closed so as to prevent the air flow between the

fresh food compartment (3) and the freezing compartment (4) (Figure 1 and Figure 2).

[0025] The cooling device (1) of the present invention comprises an electromagnet (8) that is placed onto the body (2) so as to be located at the freezing compartment (4) side of the body (2) and that is energized by the electric current taken from the mains and a metal plate (9) that is disposed on the lid (6) so as to be opposite to the electromagnet (8) when the lid (6) is closed. When the cooling device (1) is operated, the electromagnet (8) is energized with the electric current received from the mains and shows electromagnetic properties, thus enabling the lid (6) to be kept closed with the attraction force the electromagnet (8) exerts on the metal plate (9) on the lid (6). Thus, during the operation of the cooling device (1), the air flow between the fresh food compartment (3) and the freezing compartment (4) is prevented and the freezing compartment (4) is enabled to be kept at a lower temperature than the fresh food compartment (3). In case of a power failure, the electric current delivered from the mains to the electromagnet (8) is interrupted, thus the electromagnet (8) loses its magnetic properties. Since the attraction force exerted by the electromagnet (8) onto the metal plate (9) is terminated, the lid (6) opens and enables the air to flow between the fresh food compartment (3) and the freezing compartment (4). By means of the heat transfer between the fresh food compartment (3) and the freezing compartment (4), the increase in the temperature of the fresh food compartment (3) is slowed down while the cooling device (1) is not operated due to a power failure. Thus, the foodstuffs in the fresh food compartment (3) are stored for a longer time without getting spoiled (Figure 4 and Figure 5).

[0026] In an embodiment of the present invention, the cooling device (1) comprises a PCM container (7) that is disposed in the freezing compartment (4) and that comprises phase change material. The phase change material freezes at a certain temperature according to its chemical characteristics during the operation of the cooling device (1) and draws heat from the freezing compartment (4) while the cooling device (1) is not

operated due to a power failure and enables the environment to be kept at a lower temperature than the case no phase change material is used.

Thus, while the cooling device (1) is not operated due to a power failure, increase in the temperatures of both the freezing compartment (4) and the fresh food compartment (3) is slowed down (Figure 2).

[0027] In another embodiment of the present invention, the cooling device (1) comprises a biasing means (10) with one end connected to the body (2) and the other end extending towards the lid (6). While the lid (6) is closed, the biasing means (10) is squeezed between the body (2) and the lid (6). When the electromagnet (8) loses its electromagnetic properties due to a power failure, the compressed biasing means (10) transfers the stored energy to the lid (6) and enables the lid (6) to be opened so as to allow a sufficient air flow between the fresh food compartment (3) and the freezing compartment (4) (Figure 3).

[0028] In another embodiment of the present invention, the cooling device (1) comprises a battery (11) that is disposed on the body (2) and a control unit (12) that enables the electromagnet (8) to be energized with the electric current received from the battery (11). In case of a power failure, the electric current delivered from the mains to the electromagnet (8) is interrupted and the control unit (12) activates the battery (11) and enables the electric current to be delivered from the battery (11) to the electromagnet (8). The electromagnet (8) again shows magnetic properties by being energized with the electric current received from the battery (11). Thus, with the attraction force exerted by the electromagnet (8) to the metal plate (9), the lid (6) is closed again. Thus, while the cooling device (1) is not operated due to a power failure, increase in the temperature of the freezing compartment (4) is slowed down by preventing air leak from the freezing compartment (4) to the outer environment (Figure 2).

[0029] In another embodiment of the present invention, the cooling device (1) comprises a temperature sensor (13) that is disposed in the freezing compartment (4) and the control unit (12) that provides the controlling of the battery (11) according to the data received from the temperature

sensor (13). After the lid (6) opens in case of a power failure, the control unit (12) monitors the freezing compartment (4) temperature (T_{FRZ}) detected by the temperature sensor (13). The control unit (12) activates the battery (11) and enables the electric current to be delivered from the battery (11) to the electromagnet (8) if the freezing compartment (4) temperature value (T_{FRZ}) detected by the temperature sensor (13) reaches the freezing compartment (4) limit value (T_{FRZlim}) predetermined by the producer and whereat the foodstuffs in the freezing compartment (4) starts to thaw. With the attraction force exerted by the electromagnet (8) to the metal plate (9), the lid (6) is closed again and the air flow from the freezing compartment (4) is terminated. Thus, while the cooling device (1) is not operated due to a power failure, the foodstuffs in the freezing compartment (4) are enabled to be stored for a longer time without getting spoiled (Figure 2).

[0030] In another embodiment of the present invention, the cooling device (1) comprises a button (14) that is disposed on the body (2) and the control unit (12) that activates/deactivates the battery (11) according to the data received from the button (14). In case of a power failure, the lid (6) is opened and thus the foodstuffs in the fresh food compartment (3) are enabled to be stored for a longer time without getting spoiled. In case the lid (6) is kept closed, the foodstuffs in the freezing compartment (4) can be stored for a longer period of time without thawing. When the button (14) is triggered, the control unit (12) prevents the delivery of electric current from the battery (11) to the electromagnet (8) and enables the lid (6) to be kept open during the power failure and thus, enables the foodstuffs in the fresh food compartment (3) to be stored for a longer time without getting spoiled. When the button (14) is not triggered, the control unit (12) provides the delivery of electric current from the battery (11) to the electromagnet (8) and enables the lid (6) to be kept closed during the power failure and thus, enables the foodstuffs in the freezing compartment (4) to be stored for a longer time without getting spoiled (Figure 3 and Figure 4).

[0031] In another embodiment, the cooling device (1) comprises a fan (18) that is disposed in the freezing compartment (4) and that is energized by the

energy received from the battery (11). After the lid (6) opens in case of a power failure, the air flow between the fresh food compartment (3) and the freezing compartment (4) occurs with natural convection. In this case, the temperature distribution in the fresh food compartment (3) is not homogeneous and the regions close to the freezing compartment (4) are at a lower temperature than the regions away from the freezing compartment (4). By means of the fan (18) energized by the battery (11), the cold air blown from the freezing compartment (4) to the fresh food compartment (3) is distributed homogeneously in the fresh food compartment (3) and the formation of regions with different temperatures is prevented. Thus, the foodstuffs stored in the fresh food compartment (3) can be stored for a longer time without getting spoiled (Figure 2).

[0032] In another embodiment of the present invention, the cooling device (1) comprises a frame (15) that surrounds the freezing compartment (4) and that is disposed on the body (2) so as to contact with the lid (6) when the lid (6) is closed. In this embodiment, the electromagnet (8) is disposed on the frame (15) and the cable connections between the electromagnet (8) and the mains and between the electromagnet (8) and the battery (11) are made through the cable channels arranged in the frame (15). Thus, the installation of the electromagnet (8) to the cooling device (1) is facilitated (Figure 3 and Figure 4).

[0033] In another embodiment of the present invention, the cooling device (1) comprises a handle (16) that is disposed on the lid (6) and an arm (17) that is disposed on the handle (16) and that enables the electric current delivered to the electromagnet (8) to be interrupted when triggered. When the user opens the lid (6) to place foodstuffs into the freezing compartment (4) or to take foodstuffs from the freezing compartment (4), the electromagnet (8) applies counter force so as to keep the lid (6) closed. When the user triggers the arm (17) disposed on the handle (16), the electric current delivered to the electromagnet (8) is interrupted. Thus, the user is enabled to easily open the lid (6), user satisfaction is improved (Figure 4).

[0034] In another embodiment of the present invention, the control unit (12)

enables the user to be informed by visual and/or audio warnings according to the data received from the temperature sensor (13). When the freezing compartment (4) temperature value (T_{FRZ}) detected by the temperature sensor (13) reaches the freezing compartment (4) limit temperature value (T_{FRZlim}), the control unit (12) enables the user to be warned by visual and/or audio warnings.

[0035] In the cooling device (1) of the present invention, in case of a power failure, the lid (6) that closes the freezing compartment (4) is opened/closed and the heat transfer between the freezing compartment (4) and the fresh food compartment (3) is controlled. The PCM container (7) that is disposed in the freezing compartment (4) and that contains phase change material enables the foodstuffs in the freezing compartment (4) and the fresh food compartment (3) to be stored for a longer time without getting spoiled during a power failure.

Claims

1. A cooling device (1) **comprising** a body (2); a fresh food compartment (3) that is disposed in the body (2) and wherein the foodstuffs are placed to be cooled; a freezing compartment (4) kept at lower temperatures than the fresh food compartment (3), wherein foodstuffs are placed to be frozen; a door (5) providing access to the fresh food compartment (3) and the freezing compartment (4), and a lid (6) that enables the freezing compartment (4) to be closed so as to prevent the air flow between the fresh food compartment (3) and the freezing compartment (4), **characterized by**
 - an electromagnet (8) that is placed onto the body (2) so as to be located at the freezing compartment (4) side of the body (2) and that is energized by the electric current taken from the mains, and
 - a metal plate (9) that is disposed on the lid (6) so as to be opposite to the electromagnet (8) when the lid (6) is closed.
2. A cooling device (1) as in Claim 1, **characterized by** a PCM container (7) that is disposed in the freezing compartment (4) and that comprises phase change material.
3. A cooling device (1) as in Claim 1, **characterized by** a biasing means (10) with one end connected to the body (2) and the other end extending towards the lid (6).
4. A cooling device (1) as in any one of the above claims, **characterized by** a battery (11) that is disposed on the body (2) and a control unit (12) that enables the electromagnet (8) to be energized with the electric current received from the battery (11).
5. A cooling device (1) as in Claim 4, **characterized by** a temperature sensor (13) that is disposed in the freezing compartment (4) and the control unit (12) that provides the controlling of the battery (11) according to the data received from the temperature sensor (13).
6. A cooling device (1) as in Claim 4, **characterized by** a button (14) that is disposed on the body (2) and the control unit (12) that activates/deactivates the battery (11) according to the data received from the button (14).
7. A cooling device (1) as in any one of the Claims 4 to 6, **characterized by** a fan (18) that is disposed in the freezing compartment (4) and that is energized with

the energy received from the battery (11).

8. A cooling device (1) as in Claim 1, **characterized by** a frame (15) that surrounds the freezing compartment (4) and that is disposed on the body (2) so as to contact with the lid (6) when the lid (6) is closed.
9. A cooling device (1) as in Claim 1, **characterized by** a handle (16) that is disposed on the lid (6) and an arm (17) that is disposed on the handle (16) and that enables the electric current delivered to the electromagnet (8) to be interrupted when triggered.
10. A cooling device (1) as in Claim 5, **characterized by** the control unit (12) that enables the user to be informed by visual and/or audio warnings according to the data received from the temperature sensor (13).

Figure 1

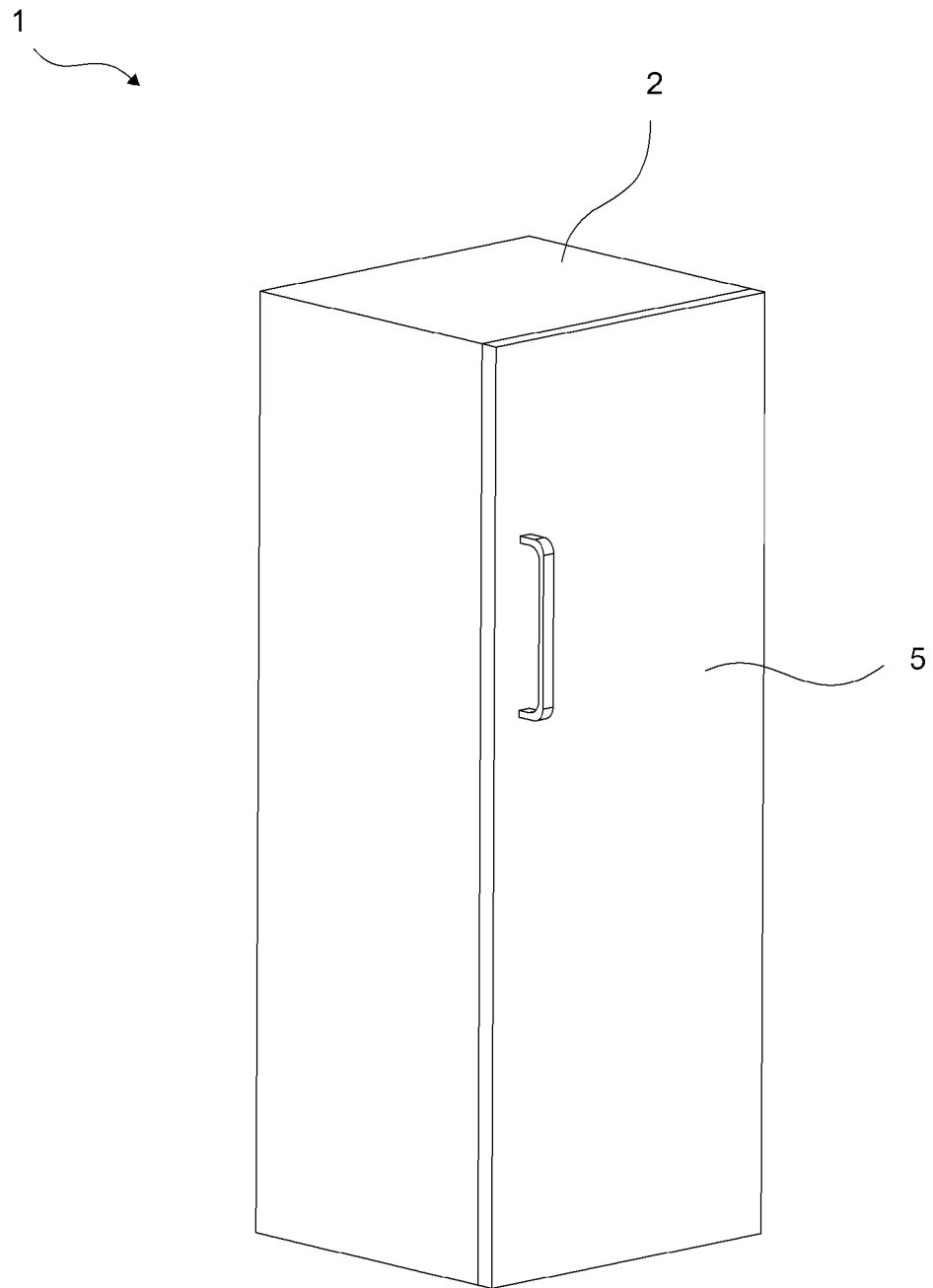


Figure 2

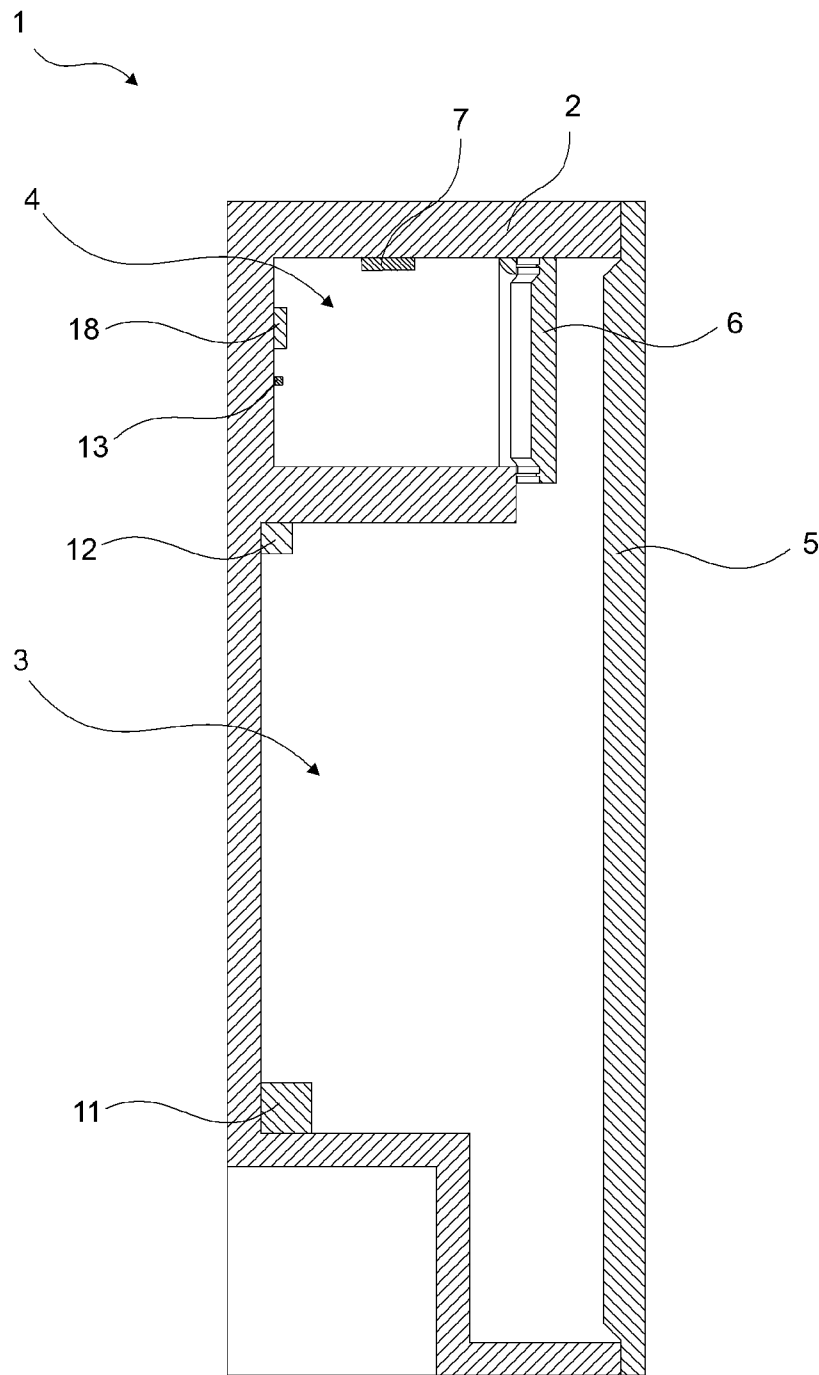


Figure 3

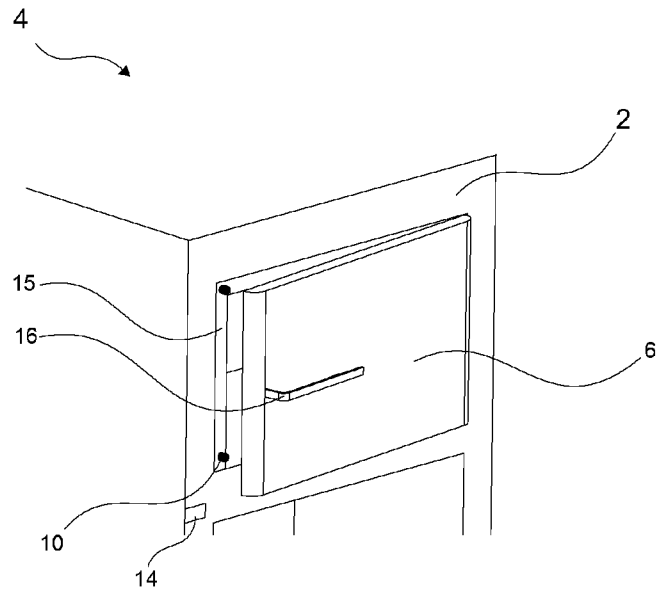


Figure 4

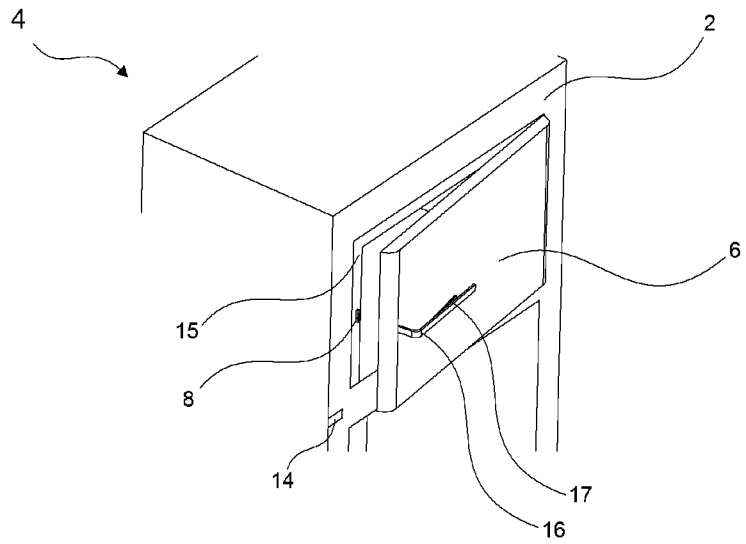
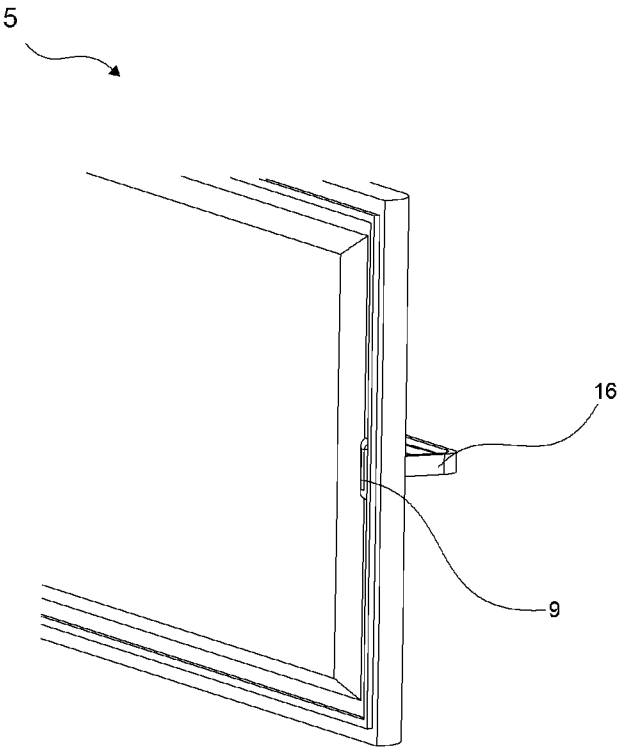


Figure 5



INTERNATIONAL SEARCH REPORT

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PCT/EP2016/059915

A. CLASSIFICATION OF SUBJECT MATTER
INV. F25D23/02 F25D23/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F25D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/209763 A1 (ZABBATINO JOSEPH [US]) 16 August 2012 (2012-08-16) paragraphs [0023] - [0045]; figures 1-8 -----	1-10
X	WO 2010/133502 A2 (ARCELIK AS [TR]; ERTIS VASI KADIR [TR]; KERPICCI HUSNU [TR]; AKBAS MUS) 25 November 2010 (2010-11-25) paragraphs [0001] - [0036]; figures 1-5 -----	1,8
A	JP 2004 211977 A (SANYO ELECTRIC CO) 29 July 2004 (2004-07-29) the whole document -----	1
A	US 2006/260348 A1 (MARTIN DEAN A [US] ET AL) 23 November 2006 (2006-11-23) the whole document -----	1



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See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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