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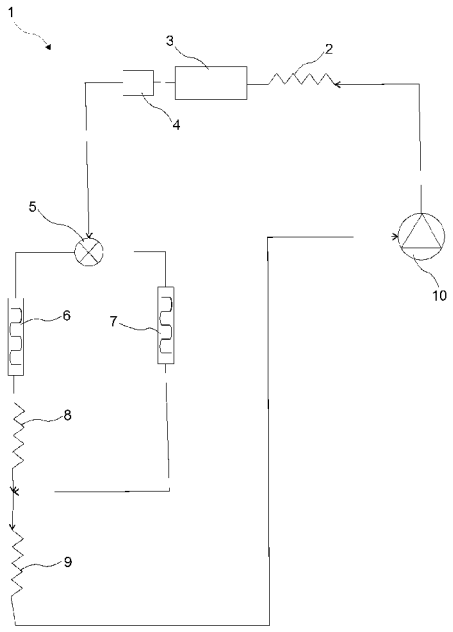
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(54) Title: REFRIGERATION APPLIANCE HAVING A HEAT EXCHANGE CIRCUIT WITH IMPROVED THERMAL PERFORMANCE

Fig. 1



(57) Abstract: The present invention relates to a refrigeration appliance provided with a thermally improved refrigeration circuit. The present invention more particularly relates to a refrigeration appliance having a freezer compartment (11) and a refrigeration compartment preserving food items, said refrigeration appliance having a refrigeration circuit (1) comprising a compressor (10) for compressing a refrigerant to a predetermined temperature and pressure, a condenser coil (2) in connection with said compressor (2) and in which the refrigerant is condensable into liquid, a fresh food evaporator (8) in connection with said condenser coil (2) through a fresh food expansion part (6) and a freezer evaporator (9) in connection with said condenser coil (2) through a freezer expansion part (7).

Description

REFRIGERATION APPLIANCE HAVING A HEAT EXCHANGE CIRCUIT WITH IMPROVED THERMAL PERFORMANCE

[0001] The present invention relates to a refrigeration appliance provided with a thermally improved refrigeration circuit.

[0002] It is known that in a conventional vapor compression system, a closed refrigerant circuit is provided having a compressible refrigerant which flows through a compressor, a condenser, a refrigerant expansion part and an evaporator. A refrigerant compressed in the compressor is typically condensed into a liquid by the condenser, and then evaporated in the evaporator.

[0003] The condenser effects transfer of thermal energy from the compressed refrigerant to the ambient air and the evaporator transfers thermal energy from the ambient air in the refrigeration compartment to the compressed refrigerant. The compressed refrigerant in the refrigerant circuit is in superheated vapor phase while leaving the compressor. It transforms into the liquid-vapor state in the condenser and then into the liquid state enroute to the refrigerant expansion part. The refrigerant changes to liquid-vapor phase in the refrigerant expansion part while the pressure thereof is being reduced.

[0004] It is to be noted that a refrigeration appliance with a fresh food evaporator for cooling the fresh food compartment and a freezer evaporator for cooling the freezer compartment typically includes a refrigeration circuit with a compressor and a condenser in which the freezer evaporator and the fresh food evaporator are serially arranged and fluidly connected to one another by respective lines for circulating the refrigerant.

[0005] Among others, one of the prior art disclosures in the technical field of the present invention may be referred to as WO2010063551, which discloses a refrigeration appliance comprising at least two shelves which are designed for two different storage temperatures. The refrigeration appliance has a branched refrigerating circuit, a first branch of the refrigerating circuit being guided via an evaporator of the warmer shelf and a second branch being guided via an evaporator of the cooler shelf. The

evaporator of the cooler shelf comprises two conduits, a first in the first branch being mounted upstream of the evaporator of the warmer shelf and the second being associated with the second branch.

[0006] The present invention is devised under the recognition that a flange heater as part of the refrigeration circuit is disposable to ensure improved thermal performance. More particularly, the flange heater is only disposed along one of the refrigerant cycles and its heating effect on the freezer compartment while the refrigerant is circulated through the freezer evaporator and not through the fresh food evaporator is advantageously prevented.

[0007] The present invention therefore provides a refrigeration appliance having serially arranged and fluidly connected freezer and fresh food evaporator tubes in the manner that the flange heater is only disposed along the circuit line of the freezer evaporator as provided by the characterizing features defined in Claim 1.

[0008] Primary object of the present invention is to provide a refrigeration appliance having a thermally more efficient serial double-cycle refrigeration circuit with a flange heater.

[0009] The present invention proposes a refrigeration appliance having a refrigeration circuit utilized for cooling food items in refrigeration and freezer compartments by way of circulating a compressed refrigerant.

[0010] To this end, a compressor, a condenser coil in connection with said compressor, a first refrigerant expansion part and a first evaporator as a freezer evaporator are provided as a closed fluid communication circuit. A first cooling line is by-passed when the refrigerant is directly circulated to said first evaporator through a second cooling line and said second cooling line is by-passed when the refrigerant is directed to the fresh food evaporator.

[0011] A switching valve selectively allows refrigerant flow in the first cooling circuit line or the second cooling circuit line. The refrigerant flows through the flange heater only when it is circulated through the freezer evaporator and the additional heating effect by the flange heater on the freezer compartment when it flows to the fresh food evaporator is prevented.

[0012] Accompanying drawings are given solely for the purpose of exemplifying a refrigeration appliance having a refrigeration circuit with a flange heater by-pass line, whose advantages over prior art were outlined above and will be explained in brief hereinafter.

[0013] The drawings are not meant to delimit the scope of protection as identified in the claims nor should they be referred to alone in an effort to interpret the scope identified in said claims without recourse to the technical disclosure in the description of the present invention.

[0014] Fig. 1 demonstrates a general schematic diagram of a refrigeration circuit in a refrigeration appliance.

[0015] Fig. 2 demonstrates a general schematic diagram of a refrigeration circuit with a flange heater by-pass line in a refrigeration appliance according to the present invention.

[0016] Fig. 3 demonstrates a general isometric view of a freezer compartment with a flange heater according to the present invention.

[0017] The following part numbers refer to respective parts in the present detailed description:

1. Refrigeration circuit
2. Condenser coil
3. Flange heater
4. Drier
5. Switching valve
6. Fresh food expansion part
7. Freezer expansion part
8. Fresh food evaporator
9. Freezer evaporator
10. Compressor
11. Freezer compartment
12. First cooling line
13. Second cooling line
14. Rectangular surface portion

[0018] Reference will now be made in detail to the embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[0019] The present invention relates to a refrigeration appliance with two refrigeration compartments preserving food items, said appliance further having a compressor (10) compressing a refrigerant to a high temperature and a high pressure, said compressor (10) typically having a suction inlet and a high pressure outlet. A condenser coil (2) in connection with said high-pressure outlet of said compressor (10) is provided to condensate the refrigerant into a liquid.

[0020] A first evaporator as a freezer evaporator (9) evaporating the refrigerant has an inlet connected to a freezer expansion part (7) in the form of capillary tubes. The freezer evaporator (9) typically has a refrigerant flowing pipe and a multitude of plate-shaped fins extending in parallel in an equidistant manner. A switching valve (5) selectively connects the condenser coil (2) to a fresh food expansion part (6, capillary tubes) in the form of a first cooling line (12) or to said freezer expansion part (7) as a second cooling line (13).

[0021] Said switching valve (5) therefore controls the flowing direction of the refrigerant as will be delineated in the proceeding section. Said second evaporator as a fresh food evaporator (8) is in turn connected to said compressor (10) through the fresh food expansion part (6). The fresh food evaporator (8) may have the same construction as the freezer evaporator (9).

[0022] According to the present invention, the first cooling line (12) comprises the compressor (10) circulating a compressible refrigerant to the condenser coil (2) in which the refrigerant is condensed into liquid due to transfer of thermal energy from the compressed refrigerant to the ambient air. The refrigerant flows through a drier (4), the fresh food expansion part (6), changing to liquid-vapor phase while its pressure is reduced. The refrigerant is then evaporated in the fresh food evaporator (8) and the freezer evaporator (9) due to heat exchange with the air in the compartments and returns to the compressor (10). The fresh food evaporator (8) and the freezer evaporator (9) are connected in series through the first cooling line (12).

[0023] The second cooling line (13) comprises the compressor (10) circulating the

compressible refrigerant to the condenser coil (2) in which the refrigerant is condensed into liquid. The refrigerant flows through a flange heater (3), a second cooling line (13) drier (4) and the freezer expansion part (7) changing to liquid-vapor phase while its pressure is reduced. The refrigerant is then evaporated in the freezer evaporator (9).

[0024] According to the present invention, the flange heater (3) provides that no condensation occurs along the length of a sealing element providing sealed closure of the freezer compartment (11) door in between the same and the outer rectangular surface portion (14) of the compartment body facing the door. The freezer compartment (11) is shown in Fig. 3 with the flange heater (3) pipes extending behind said rectangular surface portion (14) and therealong to prevent condensation.

[0025] Condensation forms due to vapor in the air having a surface temperature below the freezing point of water. To this end, the flange heater (3, Yoder condenser loop) is a rectangular multi-segment pipe running around the perimeter of the door, placeable relative to the freezer compartment (11) door's (11)sealing means (door gasket), the latter effectuating insulation between the door and the freezer compartment. The flange heater (3) is primarily aimed at preventing condensation around the sealing means, ensuring that the condensation evaporates, which otherwise deteriorates the performance of the gasket as it tends to remain stuck to the compartment's outer body portions facing the door.

[0026] According to an aspect of the present invention, the switching valve (5) is an electrically operated valve realized in the form of a solenoid valve. The unit is a three-way solenoid valve having selectively opening outlets to the first and second cooling lines (13, 14) in accordance with the operation mode of the refrigeration circuit (1). More specifically, the switching valve (5) selectively allows refrigerant flow in the first cooling circuit line (12) through the fresh food evaporator (8) or the second cooling line (13) through the freezer evaporator (9).

[0027] In a nutshell, the present invention proposes a refrigeration appliance having a freezer compartment (11) and a refrigeration compartment preserving food items, said refrigeration appliance having a refrigeration

circuit (1) comprising a compressor (10) for compressing a refrigerant to a predetermined temperature and pressure, a condenser coil (2) in connection with said compressor (10) and in which the refrigerant is condensable into liquid, a fresh food evaporator (8) in connection with said condenser coil (2) through a fresh food expansion part (6) and a freezer evaporator (9) in connection with said condenser coil (2) through a freezer expansion part (7).

[0028] In one embodiment of the present invention, a first cooling line (12) is provided in which a refrigerant is circulatable to said fresh food evaporator (8) by said compressor (10) and a second cooling line (13) is provided in which the refrigerant is directable to the freezer evaporator (9) in the manner that a switching valve (5) controls the flowing direction of the refrigerant selectively through said first cooling line (12) or said second cooling line (13).

[0029] In a further embodiment of the present invention, a flange heater (3) is provided in the second cooling line (13) in the manner that said refrigerant flowing through said first cooling line (12) by-passes said flange heater (3).

[0030] In a further embodiment of the present invention, said fresh food evaporator (8) and said freezer evaporator (9) are connected in series through the first cooling line (12). This advantageously provides that the refrigerant fluid leaving the fresh food evaporator (8) can be used to cool the freezer compartment (11). This additional effect is maintained by the invention while the flange heater (3) is prevented from generating heating effect during flow of the refrigerant in the first cooling line (12) as when the refrigerant serially moves through said fresh food evaporator (8) and said freezer evaporator (9), the additional impact of the flange heater (3) is essentially unnecessary.

[0031] In a further embodiment of the present invention, said flange heater (3) is a tubing between said switching valve (5) and said freezer expansion part (7) extending along the length of a sealing element attached to the door of said freezer compartment (11) in between the door and an outer rectangular surface portion (14) of the freezer compartment (11) body facing said door.

[0032] In a further embodiment of the present invention, said flange heater (3) is disposed along said rectangular surface portion (14) in the proximity thereof within a closed volume portion of said freezer compartment (11) body.

[0033] In a further embodiment of the present invention, said flange heater (3) is a rectangular multi-segment pipe running around the perimeter of said rectangular surface portion (14) and said door.

[0034] The present invention therefore affords a refrigeration circuit (1) by which the flange heater (3) is only disposed along the line of the freezer evaporator (9) in the serially arranged freezer and fresh food evaporators (9, 8).

Claims

1. A refrigeration appliance having a freezer compartment (11) and a refrigeration compartment preserving food items, said refrigeration appliance further having a refrigeration circuit (1) comprising a compressor (10) for compressing a refrigerant to a predetermined temperature and pressure, a condenser coil (2) in connection with said compressor (10) and in which the refrigerant is condensable into liquid, a fresh food evaporator (8) in connection with said condenser coil (2) through a fresh food expansion part (6) and a freezer evaporator (9) in connection with said condenser coil (2) through a freezer expansion part (7) **characterized in that**;

   a first cooling line (12) is provided in which a refrigerant is circulatable to said fresh food evaporator (8) by said compressor (10) and a second cooling line (13) is provided in which the refrigerant is directable to the freezer evaporator (9) in the manner that a switching valve (5) controls the flow direction of the refrigerant selectively through said first cooling line (12) or said second cooling line (13) and,

   a flange heater (3) is provided in the second cooling line (13) in the manner that said refrigerant flowing through said first cooling line (12) by-passes said flange heater (3).
2. A refrigeration appliance as in Claim 1, **characterized in that** said fresh food evaporator (8) and said freezer evaporator (9) are connected in series through the first cooling line (12).
3. A refrigeration appliance as in Claim 1 or 2, **characterized in that** said flange heater (3) is a tubing between said switching valve (5) and said freezer expansion part (7) extending along the length of a sealing element attached to the door of said freezer compartment (11)(11) in between the door and an outer rectangular surface portion (14) of the freezer compartment (11) body facing said door.
4. A refrigeration appliance as in Claim 3, **characterized in that** said flange heater (3) is disposed along said rectangular surface portion (14) in the proximity thereof within a closed volume portion of said freezer compartment (11) body.
5. A refrigeration appliance as in Claim 3 or 4, **characterized in that** said flange heater (3) is a rectangular multi-segment pipe running around the perimeter of

said rectangular surface portion (14) and said door.

Fig. 1

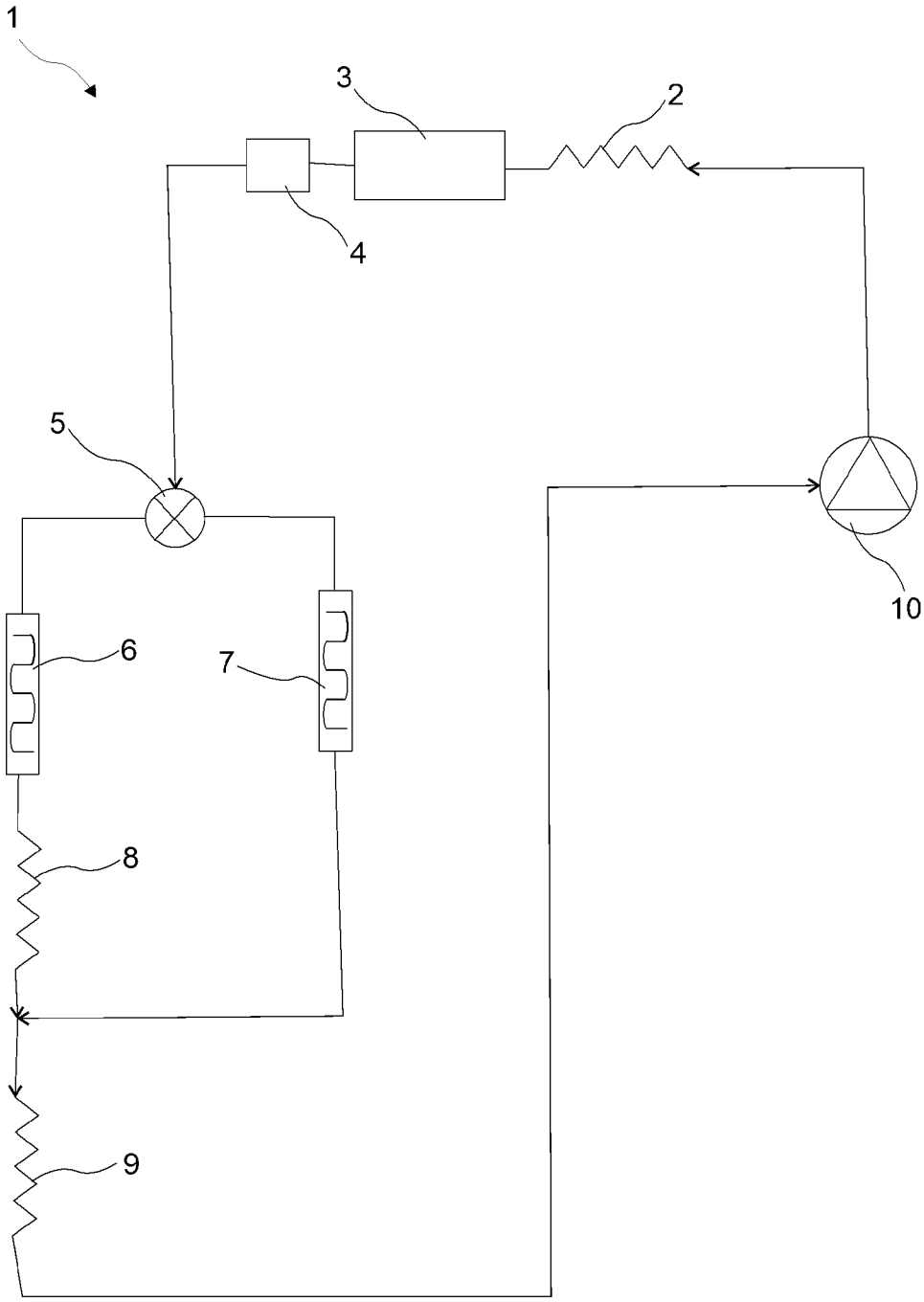


Fig. 2

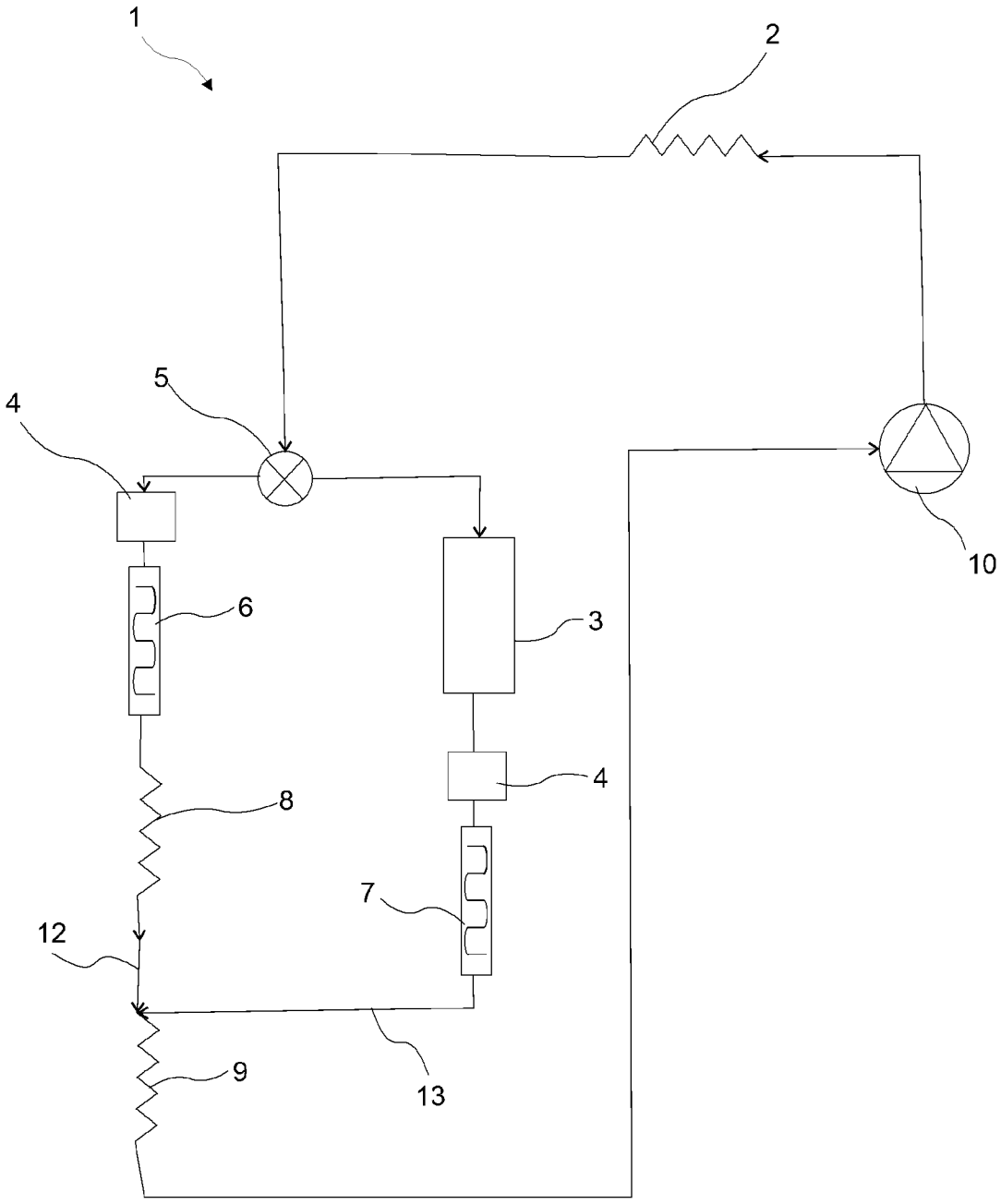
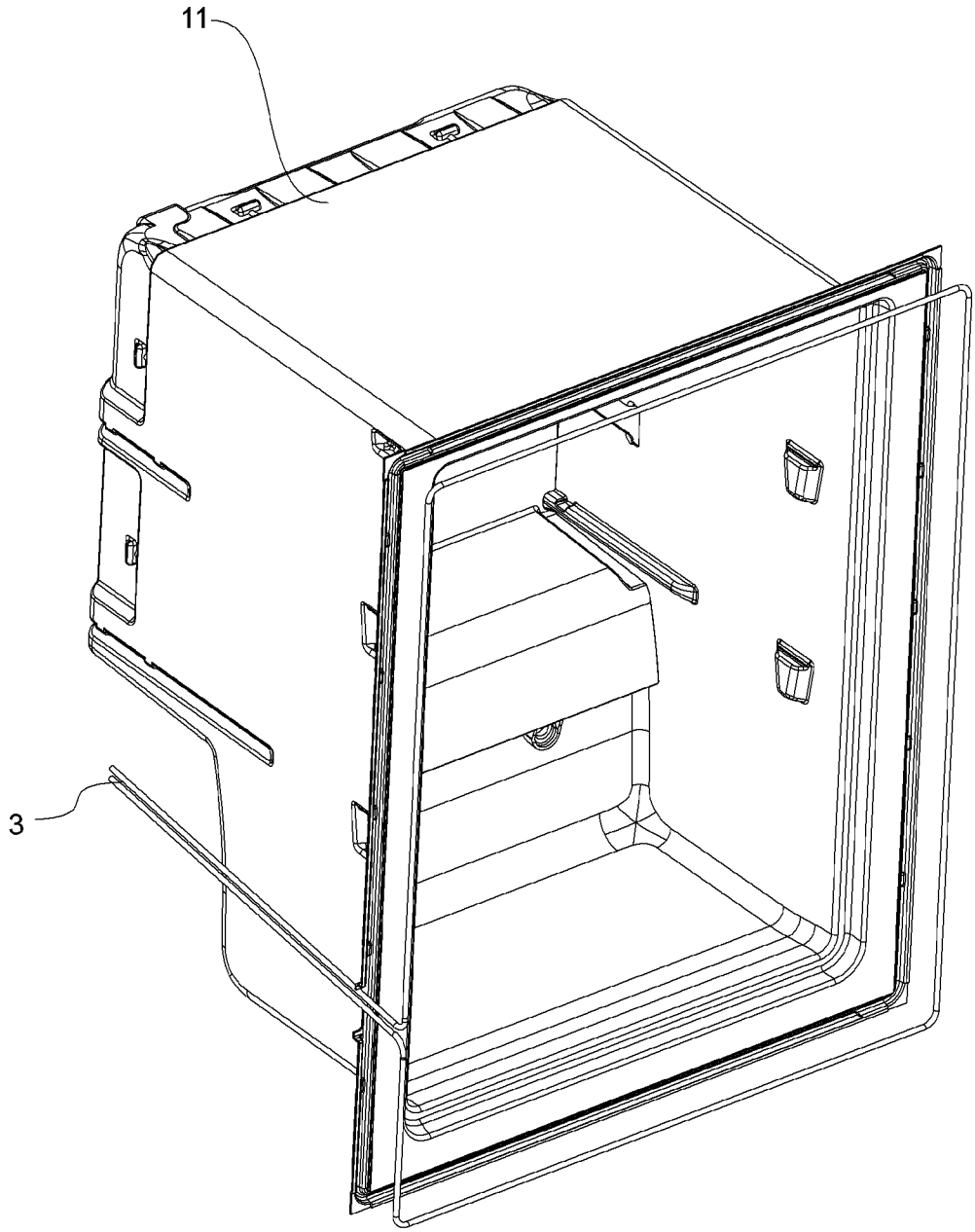


Fig. 3



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/065468

A. CLASSIFICATION OF SUBJECT MATTER
INV. F25D21/04 F25B5/04
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 F25B

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2002 195724 A (HITACHI LTD) 10 July 2002 (2002-07-10) abstract; figure 9 -----	1-5
X	EP 2 339 276 A2 (SAMSUNG ELECTRONICS CO LTD [KR]) 29 June 2011 (2011-06-29) paragraphs [0038] - [0051], [0065]; figures 1,2,3 -----	1-5
A	EP 3 006 871 A1 (WHIRLPOOL CO [US]) 13 April 2016 (2016-04-13) the whole document -----	1-5

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
20 February 2017	14/03/2017

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2016/065468

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2002195724 A	10-07-2002	NONE	
EP 2339276 A2	29-06-2011	CN 102102934 A	22-06-2011
		EP 2339276 A2	29-06-2011
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EP 3006871 A1	13-04-2016	NONE	