

(22) Date of filing: **27.11.2020**

(72) Inventors:

- KAPICI, Erhan
34445 ISTANBUL (TR)
- TOSUN, Mert
34445 ISTANBUL (TR)
- BIRICIK, Serdar
34445 ISTANBUL (TR)
- AKSIN, Yasin
34445 ISTANBUL (TR)
- KAYALI, Tayfun
34445 ISTANBUL (TR)

(71) Applicant: **Arçelik Anonim Sirketi**
34445 Istanbul (TR)

which cools the fresh food compartment (2), an expansion member (8) provided between the condenser (5) and the first evaporator (6), a refrigerant line (9) which enables the refrigerant fluid to be transferred, and a heating tube (10) enabling the fresh food compartment (2) to be heated at low ambient temperatures.

The diagram shows a closed-loop system with two heat exchangers (5 and 7) and two pumps (4 and 12). A dashed box 2 encloses a component 10, which is connected to a reservoir 13. A resistor 8 is connected to the loop. Arrows indicate the flow direction: clockwise from the top heat exchanger 5, through the resistor 8, the bottom heat exchanger 7, and the pumps 4 and 12, returning to the top heat exchanger 5. Labels 14 and 15 point to specific components in the loop.

Description

[0001] The present invention relates to a refrigerator wherein the foodstuff in the fresh food compartment is prevented from freezing when the ambient temperature is low.

[0002] In cases when the ambient temperature is low, for example in cold ambient conditions where the temperature drops below 5 °C, the temperature of the fresh food compartment may drop below 0 °C and the foodstuff may freeze. Furthermore, when the ambient temperature is between -15 °C and +5 °C, the temperature of the freezer compartment is expected to be below -15 °C under old ambient conditions. In the refrigerator, the cooling system operates to cool the freezer compartment but since the refrigerant passes through the evaporator in the fresh food compartment, and the refrigeration system try to cool the fresh food compartment which is already cooler than normal due to the ambient conditions. Thus, in cold environments, the fresh food compartment may have to be heated. In some embodiments, an electrical heater is operated in the fresh food compartment. In this case, energy is consumed both to cool and to heat the fresh food compartment, and the electricity consumption increases.

[0003] The International Patent Application No. WO2004020920 (A1) relates to a refrigerator which operates in low temperature environments and a control method thereof.

[0004] The International Patent Application No. WO2016071051 (A1) relates to a refrigerator which operates in low temperature environments. In the refrigerator, a heater is provided on the refrigerant tube, and the heater is activated or deactivated based on the changes in the ambient temperature.

[0005] The United States Patent No. US7191827 (B2) relates to a refrigerator which is adapted to operate in low ambient temperature.

[0006] The aim of the present invention is the realization of a refrigerator wherein the foodstuff in the fresh food compartment is prevented from freezing in low ambient temperature conditions.

[0007] The refrigerator realized in order to attain the aim of the present invention comprises a heating tube which is provided in the fresh food compartment and which is connected to the refrigerant line, and through which the refrigerant fluid which is in gas form and at high temperature leaving the compressor and separated partially from refrigerant line by means of a solenoid valve and a branch line flows, and which enables the fresh food compartment to be heated and preventing the foodstuff from being frozen at low ambient temperatures, for example between -15 °C and +5 °C.

[0008] In the refrigerator of the present invention, the ambient temperature is detected by means of a temperature sensor, and the control unit, upon detecting that the ambient temperature is low, activates the solenoid valve and enables the refrigerant in the form of a hot gas

to be directed to the heating tube.

[0009] The refrigerator realized in order to attain the aim of the present invention is illustrated in the attached figures, where:

Figure 1 - is the schematic view of a refrigerator.

Figure 2 - is the schematic view of the refrigerator refrigeration system of the present invention.

[0010] The elements illustrated in the figures are numbered as follows:

1. Refrigerator
2. Fresh food compartment
3. Freezer compartment
4. Compressor
5. Condenser
6. First evaporator
7. Second evaporator
8. Expansion member
9. Refrigerant line
10. Heating tube
11. Branch line
12. Solenoid valve
13. Temperature sensor
14. Connection line
15. Flange heater

[0011] The refrigerator (1) comprises a fresh food compartment (2) wherein the foodstuff is stored at around +5 °C, a freezer compartment (3) wherein the foodstuff is frozen to be stored at around -18 °C, a compressor (4) performing the refrigeration cycle, a condenser (5), a first evaporator (6) which cools the freezer compartment (3), a second evaporator (7) which cools the fresh food compartment (2), an expansion member (8) such as a capillary tube or an expansion valve which is placed between the condenser (5) and the first evaporator (6), and a refrigerant line (9) which provides the transfer of the refrigerant fluid between the refrigeration cycle components.

[0012] The refrigerator (1) of the present invention comprises a heating tube 10)

- which is provided in the fresh food compartment (2), and
- through which the refrigerant fluid which is in gas form and at high temperature leaving the compressor (4) and separated partially from the refrigerant line (9) by means of a branch line (11) flows, and
- which enables the fresh food compartment (2) to be heated at low ambient temperatures, for example between -15 °C and +5 °C.

[0013] The refrigerator (1) comprises a solenoid valve (12) which is provided on the part of the refrigerant line (9) located at the exit of the compressor (4), which is connected to the branch line (11), and which, at low ambient temperatures, guides the refrigerant fluid which is

in hot gas form leaving the compressor (4) to the heating tube (10) in the fresh food compartment (2) via the branch line (11).

[0014] The refrigerator (1) further comprises at least one temperature sensor (13) which detects the ambient temperature and/or the temperature of the fresh food compartment (2), and a control unit which enables the refrigerant in the hot gas form at the exit of the compressor (4) to be guided to the heating tube (10) by activating the solenoid valve (12) when the ambient temperature is detected to be low, for example between - 15 °C and +5 °C based on the data received from the temperature sensor (13).

[0015] In an embodiment of the present invention, the refrigerator (1) comprises a connection line (14) which enables the refrigerant fluid leaving the heating tube (10) to be delivered to the refrigerant line (9) so as to reenter the refrigeration cycle.

[0016] The refrigerant in the hot gas form which leaves the refrigerant line (9) by means of the solenoid valve (12) which is activated by the control unit when the ambient temperature is low is directed to the heating tube (10) by means of the branch line (11). The refrigerant fluid, after passing through the heating tube (10), returns to the refrigerant line (9) at the exit of the condenser (5) by means of the connection line (14). In other words, the refrigerant which leaves the refrigeration cycle returns to the refrigeration cycle after passing through the heating tube (10) and heating the fresh food compartment (2).

[0017] In another embodiment of the present invention, the heating tube (10) is connected to the refrigerant line (9) at a point between the condenser (5) and the expansion member (8) by means of the connection line (14).

[0018] In another embodiment of the present invention, the refrigerator (1) comprises a flange heater (15) which prevents condensation in the flange region where the sealing gasket contacts the body and which is composed of refrigerant fluid tubes. In this embodiment, the heating tube (10) is connected to the refrigerant line (9) from a point after said flange heater (15) by means of the connection line (14).

[0019] In the refrigerator (1), in low ambient temperatures, the foodstuff in the fresh food compartment (2) is prevented from freezing, the need for heating the fresh food compartment (2) by means of an electric heater is eliminated and the energy consumption is decreased.

Claims

1. A refrigerator (1) **comprising** a fresh food compartment (2), a freezer compartment (3), a compressor (4) providing the refrigeration cycle, a condenser (5), a first evaporator (6) which cools the freezer compartment (3), a second evaporator (7) which cools the fresh food compartment (2), an expansion member (8) provided between the condenser (5) and the first evaporator (6), and a refrigerant line (9), **characterized by**

acterized by

- a heating tube (10) which is provided in the fresh food compartment (2), through which the refrigerant fluid which is in gas form and at high temperature leaving the compressor (4) and which is separated partially from the refrigerant line (9) by means of a branch line (11) flows, and which enables the fresh food compartment (2) to be heated at low ambient temperatures.

2. A refrigerator (1) as in Claim 1, **characterized by** a solenoid valve (12) which is provided on the part of the refrigerant line (9) located at the exit of the compressor (4), which is connected to the branch line (11), and which, at low ambient temperatures, guides the refrigerant fluid which is in hot gas form leaving the compressor (4) to the heating tube (10).
3. A refrigerator (1) as in Claim 1 or Claim 2, **characterized by** at least one temperature sensor (13) which detects the ambient temperature and/or the temperature of the fresh food compartment (2), and a control unit which enables the refrigerant in the hot gas form at the exit of the compressor (4) to be guided to the heating tube (10) by activating the solenoid valve (12) when the ambient temperature is detected to be low based on the data received from the temperature sensor (13).
4. A refrigerator (1) as in Claim 1 or Claim 2, **characterized by** a connection line (14) which enables the refrigerant fluid leaving the heating tube (10) to be delivered to the refrigerant line (9) so as to reenter the refrigeration cycle.
5. A refrigerator (1) as in Claim 4, **characterized by** the heating tube (10) which is connected to the refrigerant line (9) at a point between the condenser (5) and the expansion member (8) by means of the connection line (14).

Figure 1

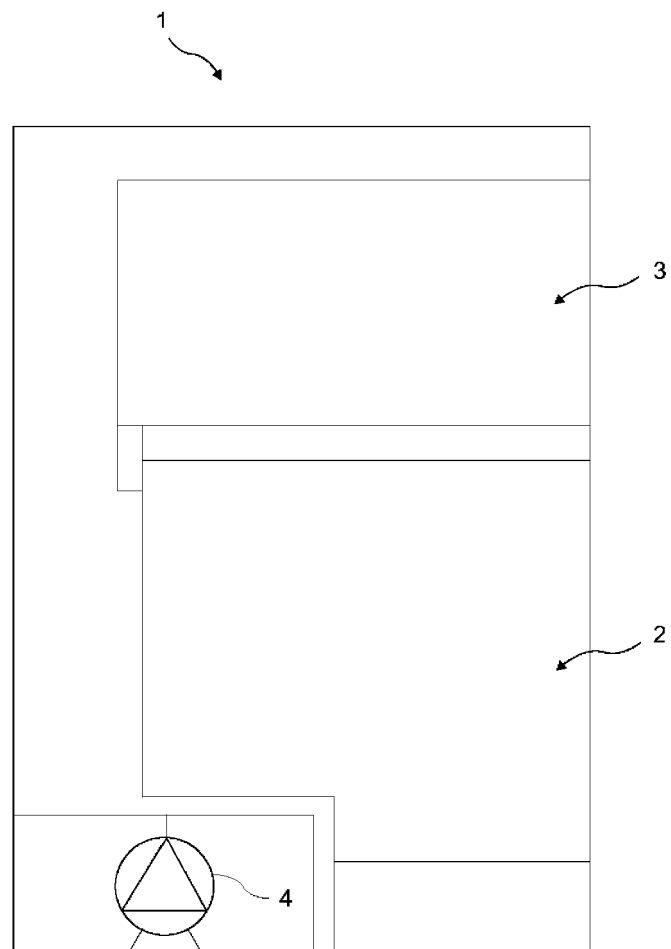
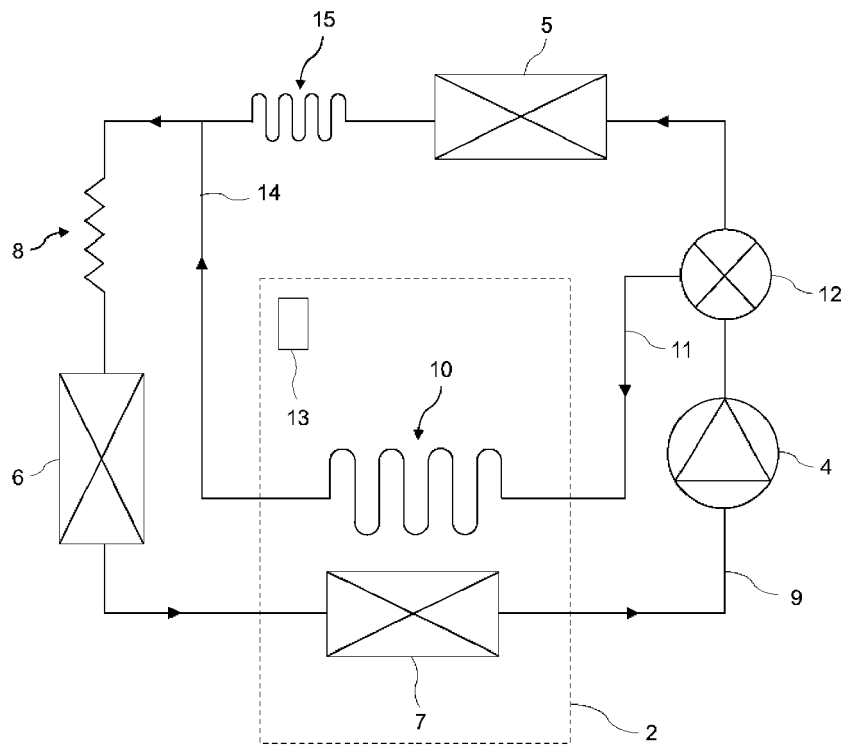


Figure 2





EUROPEAN SEARCH REPORT

Application Number
EP 20 21 0277

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2013 019598 A (HITACHI APPLIANCES INC) 31 January 2013 (2013-01-31) * abstract; figures 1-6 * * paragraphs [0033], [0051], [0059] * -----	1-5	INV. F25D21/04 F25B47/02
X	DE 10 2015 014759 A1 (LIEBHERR-HAUSGERÄTE LIENZ GMBH [AT]) 27 April 2017 (2017-04-27) * abstract; figures 1-4 * * paragraphs [0004], [0011], [0048] * -----	1-5	ADD. F25B5/04 F25B6/04
A	EP 0 178 226 A1 (SELNOR [FR]) 16 April 1986 (1986-04-16) * abstract; figures 1,2 * -----	1-5	
			TECHNICAL FIELDS SEARCHED (IPC)
			F25B F25D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 23 April 2021	Examiner Yousufi, Stefanie
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 20 21 0277

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-04-2021

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2013019598 A	31-01-2013	NONE	
DE 102015014759 A1	27-04-2017	NONE	
EP 0178226 A1	16-04-1986	EP 0178226 A1	16-04-1986
		FR 2571480 A1	11-04-1986

15

20

25

30

35

40

45

50

55

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2004020920 A1 [0003]
- WO 2016071051 A1 [0004]
- US 7191827 B2 [0005]