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(54) **COOLING APPARATUS FOR DEFROSTING**

(57) The present invention refers to a cooling apparatus for defrosting after detecting frost. The cooling apparatus according to the present invention preferably comprises of an evaporator 1, an evaporator coil 2, a compressor 4, a condenser 5, a condenser coil 6 and a receiver dryer 7. The cooling apparatus further includes plurality of bimetals 3, wherein the bimetals 3 are placed on the evaporator coil 2. The bimetals 3 are activated by applying voltage from a power supply 10. The bimetals 3 are configured to bend according to the application of voltage and thereby applying pressure on frosted surface formed on the evaporator coil 2 and breaking the ice formed on the evaporator coil 2.

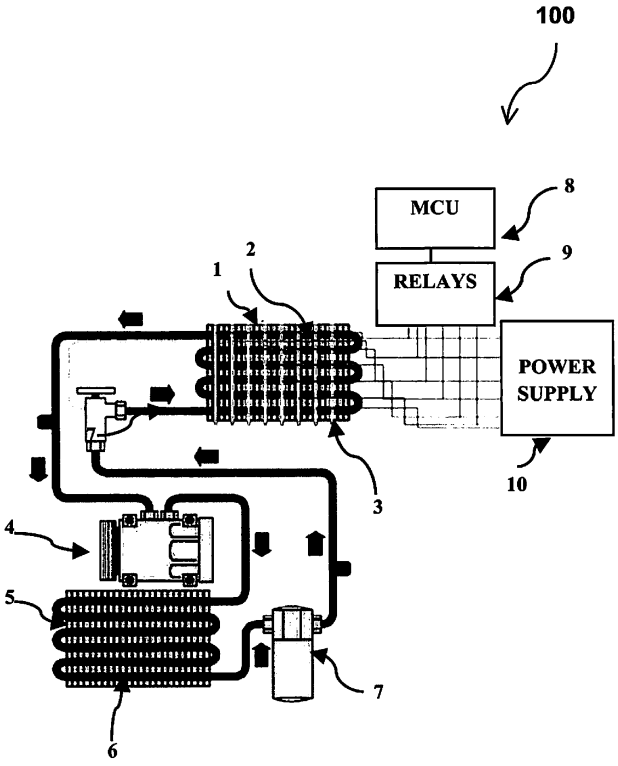

Fig. 1

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Description

[0001] This invention refers to a cooling apparatus for defrosting after detecting frost according to claim 1.

Background of the Invention

[0002] White goods are electronic devices such as air conditioners and refrigerators that are mostly used to reduce temperature. A common problem experienced by such white goods is the formation of frost on the indoor unit coil. Defrosting is the process of removing or freeing the frost formed on the indoor unit coil. Various methods for defrosting are known in the prior art such as providing separate evaporator coils, reversing the cooling cycle, wherein the indoor unit is heated instead of cooled and outdoor unit is cooled instead of heating. However, reversing of the cooling cycle manually causes increase in power consumption over the time and reversing of the cooling cycle automatically increases electrical and mechanical complexity. The defrosting method has to avoid the reversing of the cooling cycle manually or automatically.

[0003] Prior art US 4741175 A discloses a refrigerator that includes a freezer compartment, a fresh food compartment and an evaporator chamber. Air is circulated between the chamber and each compartment. Air from the fresh food compartment is returned through a return duct. The evaporator has one section in the evaporator chamber and another section in the return air duct so that the fresh food compartment return air passes over both of the evaporator sections while the freezer return air passes over only the evaporator section in the evaporator chamber.

[0004] Another prior art US 6266969 B1 relates to a device for rapidly defrosting a refrigerator compartment, such as a freezer compartment or the like, said compartment comprising a plurality of adjacent walls, in correspondence with at least one of said walls there being arranged a hairpin coil evaporator for a static refrigerator, or a part of an evaporator of forced-air type, within a refrigeration circuit comprising a motor-compressor unit, said device comprising heating means arranged in correspondence with at least one of said walls and/or with the evaporator, said heating means being electrically powered via an electrical supply circuit associated with the refrigerator; the heating means are at least one resistance element of PTF (polymer thin/thick film) type.

Object of the Invention

[0005] It is therefore the object of the present invention to provide a cooling apparatus for defrosting that enables breaking of the frost formed on the evaporator coil after detecting the frost and thereby avoiding reversing of the cooling cycle manually or automatically.

Description of the Invention

[0006] The before mentioned object is solved by a cooling apparatus for defrosting that enables breaking of the frost formed on the evaporator coil after detecting the frost and thereby avoiding reversing of the cooling cycle manually or automatically according to claim 1. The present invention refers to a cooling apparatus for defrosting after detecting frost. The cooling apparatus according to the present invention preferably comprises of an evaporator, an evaporator coil, a compressor, a condenser, a condenser coil and a receiver dryer. The cooling apparatus further includes plurality of bimetals, wherein the bimetals are placed on the evaporator coil. The bimetals are activated by applying voltage from a power supply. Further, the bimetals are configured to bend according to the application of voltage and thereby applying pressure on frosted surface formed on the evaporator coil and breaking the frost formed on the evaporator coil.

[0007] This solution is beneficial since such a cooling apparatus enables breaking of the frost on the evaporator coil and thereby avoids reversing of the cooling cycle manually. The application of voltage on the bimetals causes the bimetals to bend accordingly and thereby applies pressure on the frosted surface of the evaporator coil and breaks the frost formed on the evaporator coil and hence reversing of the cooling cycle manually or automatically for defrosting is avoided. Additionally, implementation of such a cooling apparatus is simple and effective.

[0008] Further preferred embodiments are subject-matter of dependent claims and/or of the following specification parts.

[0009] According to a preferred embodiment of the present invention the bimetals and evaporator coil are perpendicular to each other. The bimetals are arranged in the form of loop. The application of voltage on the bimetals is controlled by a microcontroller unit and the application of voltage on the bimetals varies according to degree of frosting.

[0010] Further benefits, goals and features of the present invention will be described by the following specification of the attached figures, in which components of the invention are exemplarily illustrated. Components of the devices and method according to the inventions, which match at least essentially with respect to their function, can be marked with the same reference sign, wherein such components do not have to be marked or described in all figures.

[0011] The invention is just exemplarily described with respect to the attached figures in the following.

Brief Description of the Drawings

[0012]

Fig. 1 illustrates an exemplary model of a cooling

apparatus 100 that shows position of bimetals when there is no frost, according to the present invention;

Fig. 1 (a) illustrates an exemplary model of a cooling apparatus 100 (a) that shows bending of bimetals when low voltage is applied, according to the present invention;

Fig. 1(b) illustrates an exemplary model of a cooling apparatus 100 (b) that shows bending of bimetals when medium voltage is applied, according to the present invention;

Fig. 1(c) illustrates an exemplary model of a cooling apparatus 100 (c) that shows bending of bimetals when high voltage is applied, according to the present invention; and

Fig. 2 illustrates a block diagram of a defrosting method 200, according to the present invention.

Detailed Description of the Drawings

[0013] Fig. 1 illustrates exemplary model of a cooling apparatus 100 that indicates position of bimetals when there is no frost, according to the present invention. The present invention preferably comprises of an evaporator 1, an evaporator coil, a compressor 4, a condenser 5, a condenser coil 6 and a receiver dryer 7. According to the embodiment of the invention, the cooling apparatus further includes plurality of bimetals 3, wherein the bimetals are placed on the evaporator coil 2. In an embodiment, the bimetals 3 and the evaporator coil 2 are perpendicular to each other and the bimetals 3 are arranged in the form of loop. The bimetals 3 are activated by applying voltage from a power supply 10. The bimetals 3 are configured to bend according to the application of voltage and thereby applying pressure on frosted surface formed on the evaporator coil 2 and breaking the ice formed on the evaporator coil 2.

[0014] In particular, the application of the voltage on the evaporator coil is controlled by a microcontroller unit (MCU) 8 and the application of the voltage on the evaporator coil varies according to the degree of icing. The MCU 8 triggers relays 9 and thereby activates bimetals by applying constant voltage according to the degree of frosting. Fig. 1 shows the position of the bimetals 3 when there is no frost on the evaporator coil 2. Since no frost is detected on the evaporator coil 2, voltage is not applied on the bimetals 3 and therefore bimetals 3 remain in the same position without any bending.

[0015] Fig. 1(a) illustrates an exemplary model of a cooling apparatus 100 (a) that shows bending of bimetals when low voltage is applied, according to the present invention. A frost breaking is performed automatically only after detecting frosting instead of melting the frost. That is, the cooling cycle is not reversed manually or automatically for defrosting. In order to achieve this, the cooling apparatus utilizes bimetals 3, MCU 8, relays 9 and power supply 10. After detecting low degree of frost on the evaporator coil 2, the MCU 8 triggers the relays 9 and thereby activates bimetals 3(a) by applying a low voltage 10(a) on the bimetals 3(a). The bimetals 3 are heat sensitive material and have a certain resistance value and therefore start bending 3 (a) with the application of low voltage 10(a). The bimetals 3 (a) applies pressure on frost on the evaporator coil 2 and breaks the frost. The bending of bimetals is less 3(a) as the applied voltage 10 (a) and the degree of frosting is less.

[0016] When the presence of frost is detected even after applying a low voltage 10(a) then the application of voltage is varied 10(b). Fig. 1(b) illustrates an exemplary model of a cooling apparatus 100 (b) that shows bending of bimetals when medium voltage is applied, according to the present invention. After detecting frost on the evaporator coil even after applying voltage 10(a) on the bimetals, the MCU 8 triggers the relays 9 and thereby activates bimetals 3 (b) by applying slightly greater voltage 10(b) on the bimetals 3(b). The bimetals starts bending 3(b) more with the application of voltage 10(b) in a curved manner. Therefore, the bimetals 3(b) apply more pressure on frost on the evaporator coil 2 and thereby breaking the frost. The bending of bimetals 3(b) seems to be more compared to the bending of bimetals 3(a) applied with low voltage 10 (a).

[0017] If the frosting sensation continues, voltage is further increased and a high voltage 10(c) is applied on the bimetals 3(c). Fig. 1 (c) illustrates an exemplary model of a cooling apparatus 100 (c) that shows bending of bimetals when high voltage is applied in a circular manner, according to the present invention. When the frosting sensation continues, the MCU 8 triggers the relays 9 and thereby activates bimetals 3 (c) by applying high voltage 10(c) on the bimetals 3(c) in a circular manner. The bimetals starts bending 3(c) deeper with the application of voltage 10(c). Therefore, the bimetals 3(c) applies high pressure on frost on the evaporator coil 2 and thereby breaks the frost. Therefore, depending upon the degree of frosting detected the voltage is controlled by the MCU and voltage is applied according on the bimetals for breaking the frost.

[0018] This solution is beneficial since such a cooling apparatus 100(a, b, c) enables breaking of the frost on the evaporator coil 2 and thereby avoids reversing of the cooling cycle manually. The application of voltage on the bimetals 10(a, b, c) causes the bimetals to bend 3(a, b, c) accordingly and thereby applies pressure on the frosted surface of the evaporator coil 2 and breaks the frost formed on the evaporator coil 2. Thus, the bimetals 3 are arranged in such a form on the evaporator coil (2) that the bimetals can change its form from straight to curved and into circular depending on the applied voltage. Hence reversing of the cooling cycle manually or automatically for defrosting is avoided. Additionally, implementation of such a cooling apparatus is simple and effective.

[0019] Fig. 2 illustrates a block diagram of a defrosting

method 200, according to the present invention. The frost condition is detected 11 and depending upon the degree of frosting the MCU starts defrost algorithm 12. The relays are triggered by the MCU 13 and the bimetals are activated 14. The bimetals bends according to the applied voltage 15 and applies pressure on frost on the evaporator coil and thereby breaks the frost 16.

[0020] Thus, the present invention that provides a cooling apparatus for defrosting after detecting the frost enables breaking of the frost formed on the evaporator coil by avoiding reversing of the cooling cycle manually or automatically. The cooling apparatus according to the present invention preferably comprises of an evaporator 1, an evaporator coil 2, a compressor 4, a condenser 5, a condenser coil 6 and receiver dryer 7. The cooling apparatus further includes plurality of bimetals 3, wherein the bimetals 3 are placed on the evaporator coil 2. The bimetals 3 are activated by applying voltage from a power supply 10. The bimetals 3 are configured to bend according to the application of voltage and thereby applying pressure on frosted surface formed on the evaporator coil 2 and breaking the ice formed on the evaporator coil 2.

[0021] The subject-matter of the application provides a defrosting method without melting of the frost and without avoiding reversing of the cooling cycle manually or automatically.

List of reference numbers

[0022]

1	Evaporator
2	Evaporator coil
3	Bimetals
3(a)	Less bending of the bimetals
3(b)	Medium bending of the bimetals
3(c)	High bending of the bimetals
4	Compressor
5	Condenser
6	Condenser coil
7	Receiver dryer
8	Microcontroller unit (MCU)
9	Relays
10	Power supply
10(a)	Low power supply
10(b)	Medium power supply
10(c)	High power supply
11	Frost condition is detected
12	MCU starts defrosting algorithm
13	Relays triggered by MCU
14	Bimetals are activated
15	Bimetals bends according to voltage level
16	Ice breaking performed using bimetals

Claims

1. A cooling apparatus for defrosting after detecting frost, wherein the cooling apparatus comprising of:

   an evaporator 1, an evaporator coil 2, a compressor 4, a condenser 5, a condenser coil 6 and a receiver dryer 7,
   characterized in that
   the cooling apparatus further includes plurality of bimetals 3, wherein the bimetals 3 are placed on the evaporator coil 2,
   wherein the bimetals 3 are activated by applying voltage from a power supply 10, and
   wherein the bimetals are configured to bend according to the application of voltage and thereby applying pressure on frosted surface formed on the evaporator coil 2 and breaking the ice formed on the evaporator coil 2.

2. The cooling apparatus as claimed in claim 1, wherein the bimetals 3 and the evaporator coil 2 are perpendicular to each other.

3. The cooling apparatus as claimed in claim 2, wherein the bimetals 3 are arranged in such a form on the evaporator coil (2) that the bimetals can change its form from straight to curved and into circular depending on the applied voltage.

4. The cooling apparatus as claimed in claim 1, wherein the application of voltage on the bimetals 3 controlled by a microcontroller unit 8.

5. The cooling apparatus as claimed in claim 4, wherein the application of voltage on the bimetals 3 varies according to degree of icing.

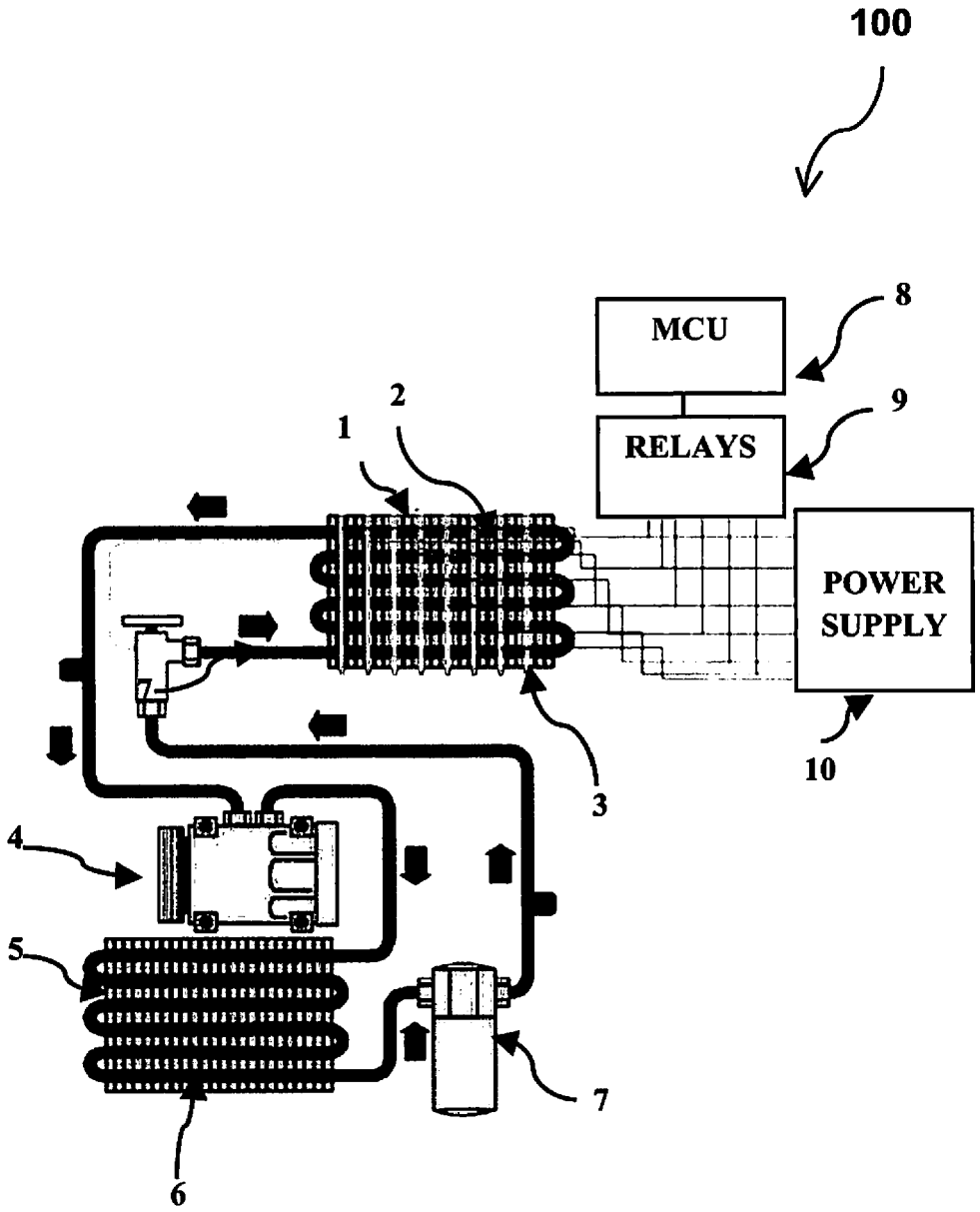

Fig. 1

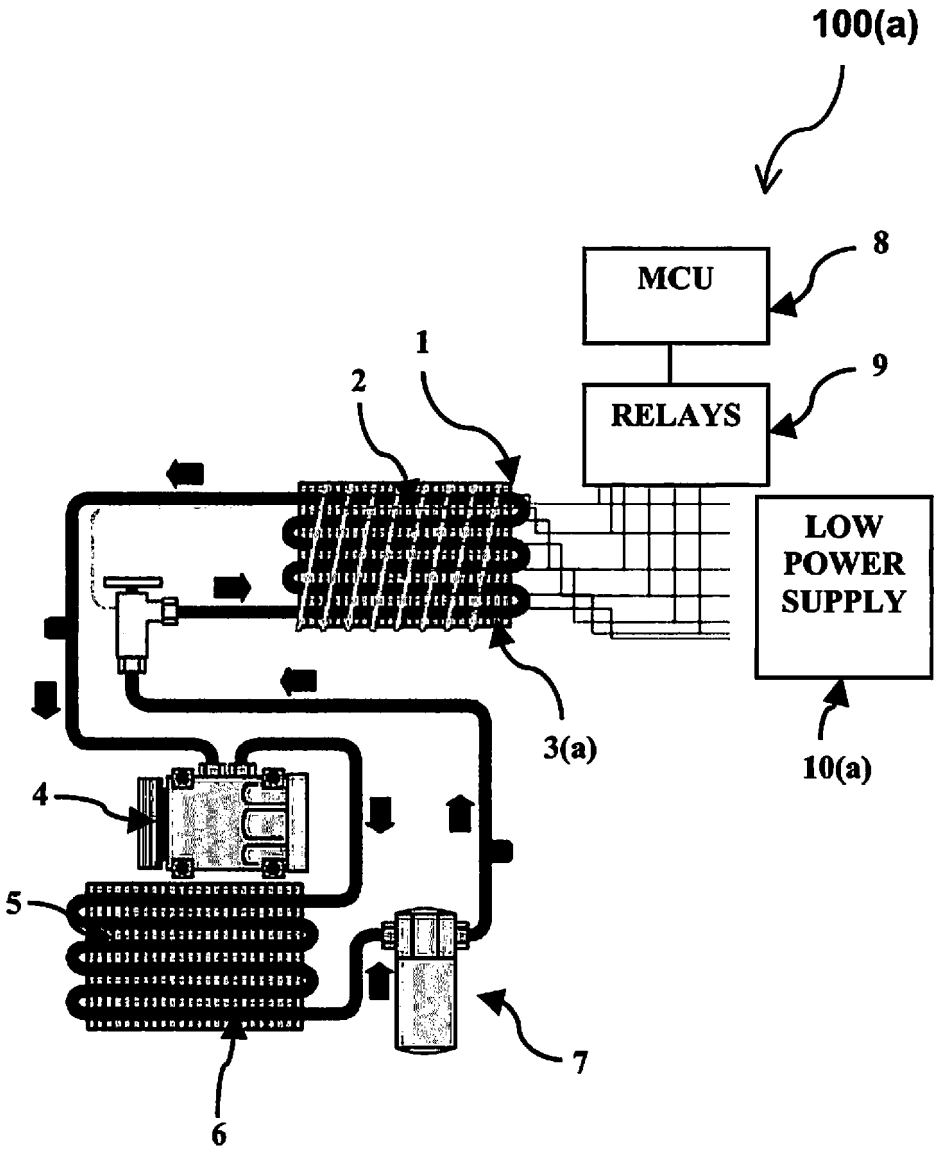

Fig. 1(a)

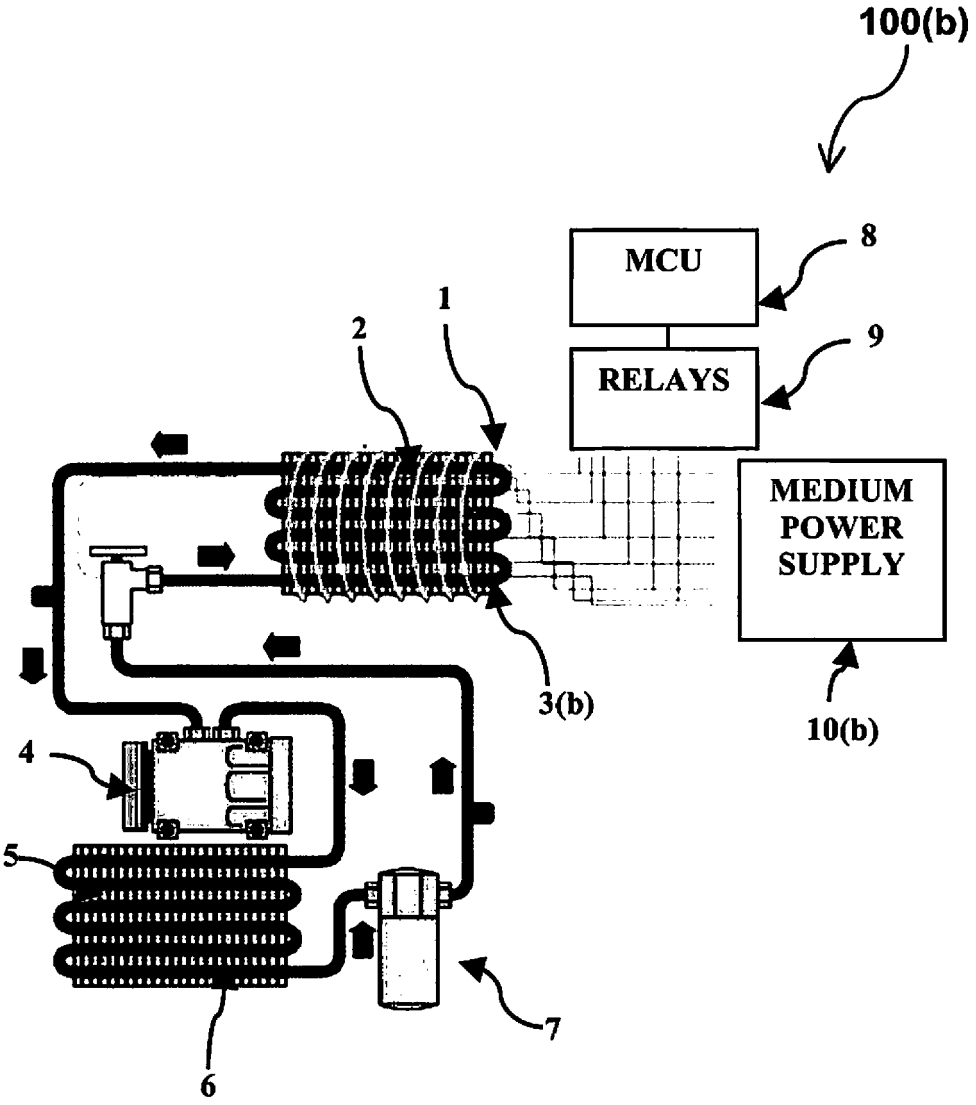

Fig. 1(b)

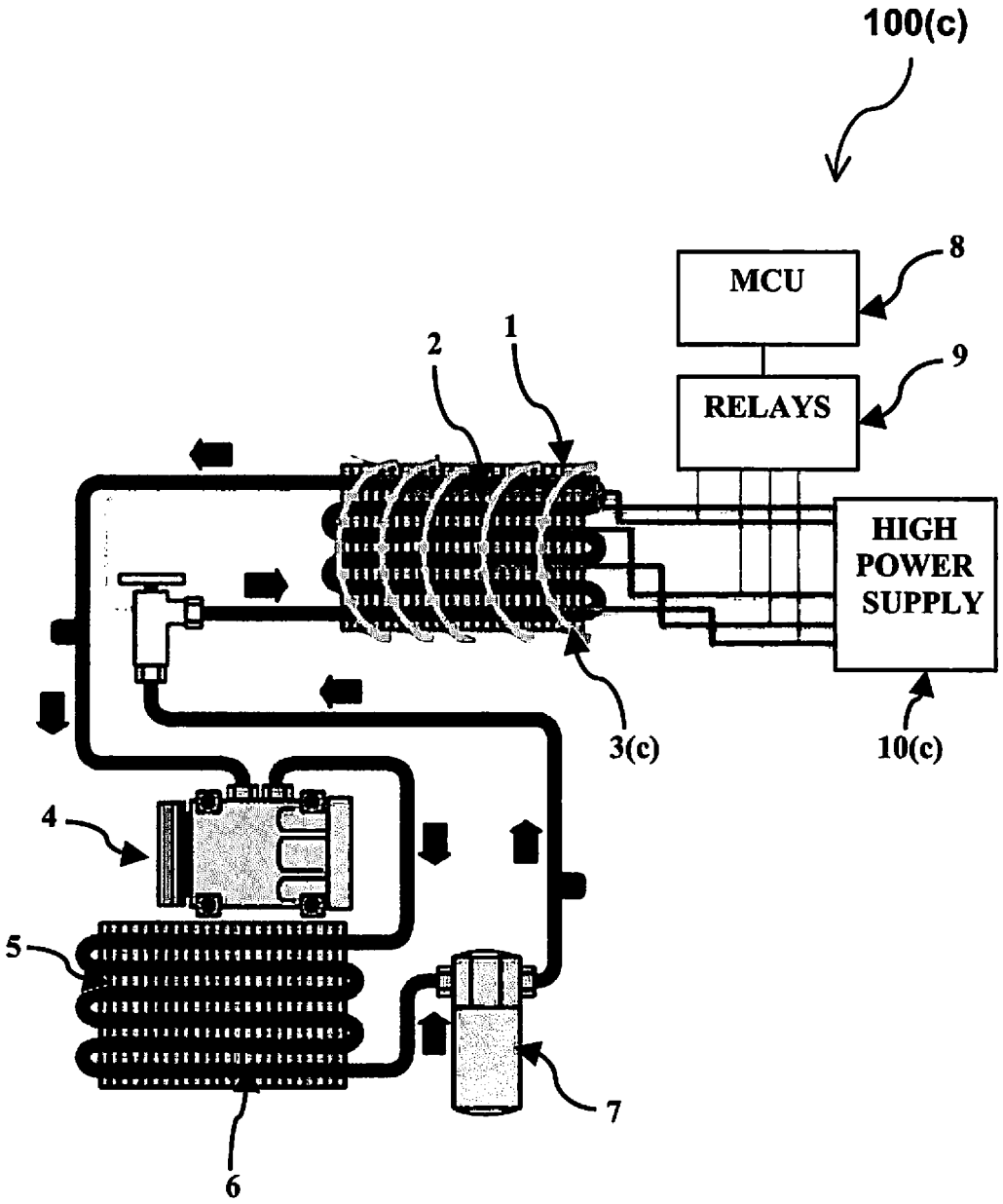

Fig. 1(c)

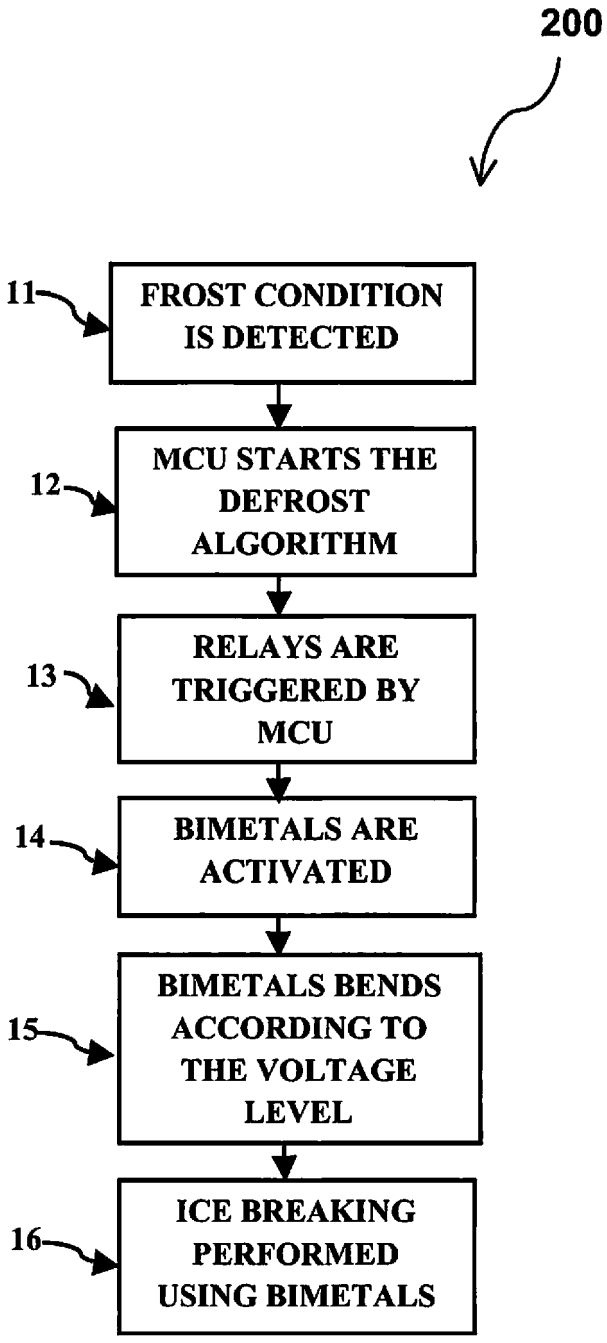
200
11
FROST CONDITION IS DETECTED
12
MCU STARTS THE DEFROST ALGORITHM
13
RELAYS ARE TRIGGERED BY MCU
14
BIMETALS ARE ACTIVATED
15
BIMETALS BENDS ACCORDING TO THE VOLTAGE LEVEL
16
ICE BREAKING PERFORMED USING BIMETALS

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 18 15 7172

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y A	WO 2017/192568 A1 (CARRIER CORP [US]) 9 November 2017 (2017-11-09) * paragraph [0034] - paragraph [0039]; figure 1 *	1,2 3-5	INV. F25D21/06
Y A	RU 2 193 933 C2 (RAKETNO KOSM AOOT; ESKAJA KORPORATSIJA EHNERGIJA) 10 December 2002 (2002-12-10) * the whole document *	1,2 3-5	
A	EP 3 012 187 A1 (BOEING CO [US]) 27 April 2016 (2016-04-27) * paragraph [0031] *	1	
A	WO 2006/081180 A2 (TRUSTEES OF DARTMOUTN COLLEGE [US]; PETRENKO VICTOR [US]) 3 August 2006 (2006-08-03) * the whole document *	1-5	
A	DE 75 07 775 U (R. RAUTENBACH) 21 September 1978 (1978-09-21) * the whole document *	1	TECHNICAL FIELDS SEARCHED (IPC) F25D B64D
A	DD 117 279 A1 (K.H. JUNGE) 5 January 1976 (1976-01-05) * the whole document *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 July 2018	de Graaf, Jan Douwe

CATEGORY OF CITED DOCUMENTS

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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
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17-07-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2017192568 A1	09-11-2017	NONE	
RU 2193933 C2	10-12-2002	NONE	
EP 3012187 A1	27-04-2016	CN 105539817 A	04-05-2016
		EP 3012187 A1	27-04-2016
		US 2016114883 A1	28-04-2016
WO 2006081180 A2	03-08-2006	CA 2593805 A1	03-08-2006
		CN 101120217 A	06-02-2008
		EP 1842015 A2	10-10-2007
		JP 2008528916 A	31-07-2008
		KR 20070101345 A	16-10-2007
		WO 2006081180 A2	03-08-2006
DE 7507775 U	21-09-1978	NONE	
DD 117279 A1	05-01-1976	NONE	

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

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Patent documents cited in the description

- US 4741175 A **[0003]**
- US 6266969 B1 **[0004]**