

(19)



(11)

EP 3 760 953 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.01.2021 Bulletin 2021/01

(51) Int Cl.:
F25D 21/02 (2006.01)

(21) Application number: **19184627.8**

(22) Date of filing: **05.07.2019**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Vestel Elektronik Sanayi ve Ticaret A.S.**
45030 Manisa (TR)

(72) Inventor: **TÜNAY, Erkan**
45030 Manisa (TR)

(74) Representative: **Maikowski & Ninnemann**
Patentanwälte Partnerschaft mbB
Postfach 15 09 20
10671 Berlin (DE)

(54) **APPARATUS AND METHOD FOR DETECTING A FORMATION OF ICE IN A HOUSEHOLD APPLIANCE**

(57) The present disclosure relates to an apparatus (100) for detecting a formation of ice in a household appliance, comprising: a container (110) configured to accommodate a fluid (1), the container (110) including an entry port (112) and an opening (114); a gas supply device (120) connected to the entry port (112) of the container (110) to supply a gas to the fluid (1) in the container

(110); a measurement device (130) covering at least a part of the opening (114) of the container (110), wherein the measurement device (130) includes a strain gauge; and a determination device (130) configured to determine the formation of ice in the fluid (1) based on measurement signals provided by the strain gauge.

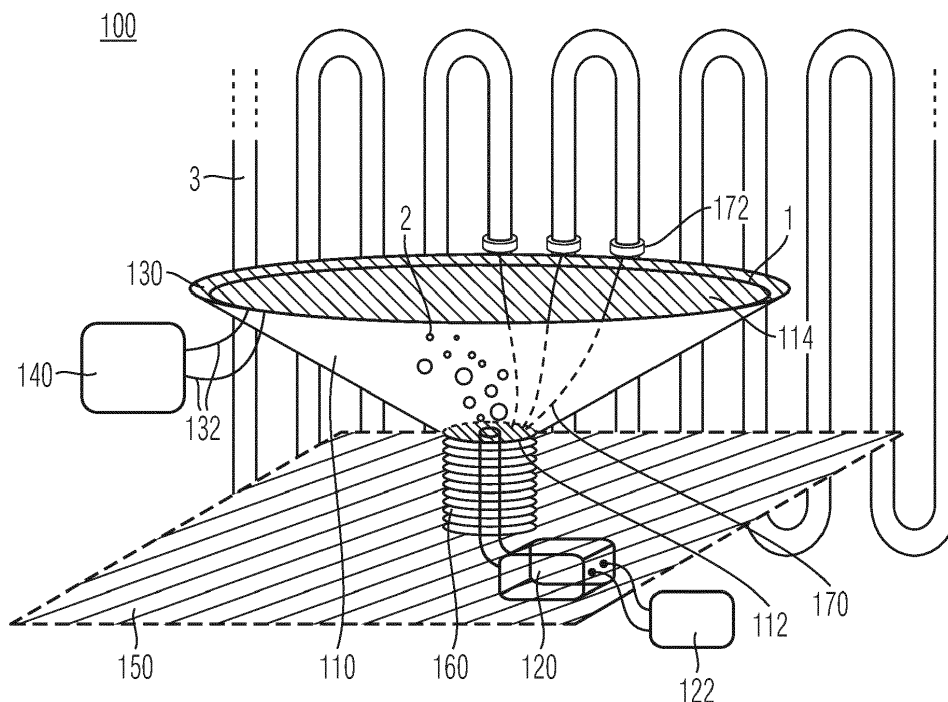


Fig. 1

EP 3 760 953 A1

Description

FIELD

[0001] Embodiments of the present disclosure relate to an apparatus for detecting a formation of ice in a household appliance, a household appliance having the apparatus, and a method for detecting a formation of ice in a household appliance. The present disclosure particularly relates to the control of a defrost operation in a household appliance, such as a refrigerator or freezer.

BACKGROUND

[0002] Defrosting is a technique which defrosts a cooling element in a household appliance, such as a refrigerator or freezer. The defrost mechanism heats the cooling element, such as an evaporator, and melts the ice that has formed thereon. Conventional defrost mechanisms start the defrosting automatically and periodically, i.e., in preset time intervals using a timer. For example, after a certain time after the start of the household appliance (e.g. 8 to 12 hours) has elapsed, the heater is activated and operated for a pretrimmed time (e.g. 5 to 10 minutes) to melt the ice on the cooling element.

[0003] However, such a periodic operation of the defrost mechanism does not take into account the amount of ice that has been formed on the cooling element. Therefore, the periodic operation of the defrost mechanism is inefficient and increases an energy consumption of the household appliance.

[0004] In view of the above, new apparatuses and methods for detecting a formation of ice in a household appliance that overcome at least some of the problems in the art are beneficial.

SUMMARY

[0005] In light of the above, an apparatus for detecting a formation of ice in a household appliance, a household appliance having the apparatus, and a method for detecting a formation of ice in a household appliance are provided.

[0006] It is an object of the present disclosure to reliably control a defrost operation of a household appliance. In particular, it is an object of the present application to control a defrost operation of the household appliance according to the actual amount of ice formed e.g. on a cooling device of the household appliance, such as an evaporator.

[0007] Further objects, aspects, benefits, and features of the present disclosure are apparent from the claims, the description, and the accompanying drawings.

[0008] According to an independent aspect of the present disclosure, an apparatus for detecting a formation of ice in a household appliance is provided. The apparatus includes a container configured to accommodate a fluid, the container including an entry port and an open-

ing; a gas supply device connected to the entry port of the container to supply a gas to the fluid in the container; a measurement device covering at least a part of the opening of the container, wherein the measurement device includes a strain gauge; and a determination device configured to determine the formation of ice in the fluid based on measurement signals provided by the strain gauge.

[0009] According to another independent aspect of the present disclosure, a household appliance, such as a refrigerator or freezer, is provided. The household appliance includes an apparatus for detecting a formation of ice, wherein the apparatus includes a container configured to accommodate a fluid, the container including an entry port and an opening; a gas supply device connected to the entry port of the container to supply a gas to the fluid in the container; a measurement device covering at least a part of the opening of the container, wherein the measurement device includes a strain gauge; and a determination device configured to determine the formation of ice in the fluid based on measurement signals provided by the strain gauge.

[0010] According to another independent aspect of the present disclosure, a method for detecting a formation of ice in a household appliance is provided. The method includes supplying air to a fluid in a container to generate bubbles in the fluid; recording measurement signals of a strain gauge covering at least a part of an opening of the container above a surface of the fluid; and determining a presence of ice in the fluid based on the measurement signals provided by the strain gauge.

[0011] Embodiments are also directed at apparatuses for carrying out the disclosed methods and include apparatus parts for performing each described method aspect. These method aspects may be performed by way of hardware components, a computer programmed by appropriate software, by any combination of the two or in any other manner. Furthermore, embodiments according to the disclosure are also directed at methods for operating the described apparatus. The methods include method aspects for carrying out every function of the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] So that the manner in which the above recited features of the present disclosure can be understood in detail, a more particular description of the disclosure, briefly summarized above, may be had by reference to embodiments. The accompanying drawings relate to embodiments of the disclosure and are described in the following:

FIG. 1 shows a schematic view of an apparatus for detecting a formation of ice in a household appliance according to embodiments described herein;

FIG. 2 shows a flowchart of a method for detecting a formation of ice in a household appliance according to embodiments described herein; and

FIG. 3 shows a schematic configuration of a determination device of the apparatus for detecting a formation of ice in a household appliance according to embodiments described herein.

DETAILED DESCRIPTION OF EMBODIMENTS

[0013] Reference will now be made in detail to the various embodiments of the disclosure, one or more examples of which are illustrated in the figures. Within the following description of the drawings, the same reference numbers refer to same components. Generally, only the differences with respect to individual embodiments are described. Each example is provided by way of explanation of the disclosure and is not meant as a limitation of the disclosure. Further, features illustrated or described as part of one embodiment can be used on or in conjunction with other embodiments to yield yet a further embodiment. It is intended that the description includes such modifications and variations.

[0014] A defrost mechanism heats a cooling element, such as an evaporator, and melts the ice that has formed thereon. Conventional defrost mechanisms start the defrosting automatically and periodically, i.e., in preset time intervals. However, such a periodic operation of the defrost mechanism is inefficient and increases an energy consumption of the household appliance.

[0015] The present disclosure overcomes these drawbacks by providing an apparatus which determines whether ice has formed on a cooling device, and operates the defrost mechanism only when it is determined that there is ice on the cooling device. The apparatus uses a strain gauge which senses a generation of air bubbles in a fluid, such as water. When the fluid starts to freeze, i.e., when ice is formed in the fluid, the characteristics of the generation of the bubbles change. This change is detected by the strain gauge. Since the ice formation in the fluid is indicative of an ice formation in the household appliance, such as on a cooling device, the detected change can be used to control the defrosting operation of the cooling device.

[0016] Accordingly, the defrosting is performed only when there is ice on the cooling device, whereby an efficient defrosting can be provided and an energy consumption of the household appliance, such as a refrigerator or freezer, can be reduced.

[0017] Figure 1 shows a schematic view of an apparatus 100 for detecting a formation of ice in a household appliance according to embodiments described herein.

[0018] The apparatus 100 can be mounted inside the household appliance, such as inside of a refrigerator or freezer. The apparatus 100 can be mounted adjacent and/or in close proximity to a cooling device 3 of the household appliance, such as an evaporator. However,

the use of the apparatus 100 is not limited to cooling devices and can be used in combination with other devices or elements of a household appliance which are subject to ice formation.

[0019] The apparatus 100 includes a container 110 configured to accommodate a fluid 1, such as water, wherein the container 110 includes an entry port 112 and an opening 114; a gas supply device 120 connected to the entry port 112 of the container 110 to supply a gas to the fluid 1 in the container 110; a measurement device 130 covering at least a part of the opening 114 of the container 110, wherein the measurement device 130 includes a strain gauge; and a determination device 140 configured to determine the formation of ice in the fluid 1 based on measurement signals provided by the strain gauge.

[0020] The apparatus 100 uses the strain gauge to senses air bubbles escaping from a surface of the fluid. When the fluid starts to freeze, i.e., when ice is formed in the fluid, the characteristics of the generation of the bubbles change. Based on this change or difference in the bubble generation, an ice formation in the fluid can be detected. Since the apparatus 100 is inside the household appliance, the ice formation in the fluid is indicative of an ice formation e.g. on a cooling device 3, such as an evaporator. Thus, a defrosting mechanism of the household appliance can be controlled in an efficient and energy saving manner.

[0021] The container 110 has a top side and a bottom side. The terms "top" and "bottom" are defined with respect to the vertical direction. The term "vertical direction" is understood to distinguish over "horizontal direction". The vertical direction can be substantially parallel to the force of gravity.

[0022] In some implementations, the opening 114 of the container 110 can be provided at the top side of the container 110. For example, the top side of the container 110 can be open to air. In particular, the container 110 can include an accommodation space configured to accommodate the fluid 1, such as water, wherein the accommodation space is open at the top such that the fluid in the accommodation space is exposed to the outside.

[0023] According to some embodiments, the container 110 is configured such that the opening 114 thereof is located adjacent to a surface of the fluid 1 in the container 110. The upper surface of the fluid 1 in the container 110 can be located adjacent to the opening 114 such that the upper surface of the fluid 1 is exposed to the outside of the container 114. In particular, the upper surface of the fluid 1 can face the strain gauge of the measurement device 130 without contacting the strain gauge of the measurement device 130. In other words, the fluid 1 is not in direct contact with the strain gauge.

[0024] In some implementations, the container 110 has a cone shape having a narrow portion and a wide portion. The narrow portion can be provided at the bottom side of the cone shape, and the wide portion can be provided at the top side of the cone shape. The entry port

112 of the container 110 can be provided at the narrow portion of the cone shape, and may for instance correspond to the narrow portion of the cone shape. The opening 114 of the container 110 can be provided at the wide portion of the cone shape, and may for instance correspond to an uppermost part of the wide portion of the cone shape.

[0025] According to some embodiments, the cone shape corresponds to, or is, a funnel or hopper.

[0026] The measurement device 130, and in particular the strain gauge thereof, covers at least a part of the opening 114 of the container 110. In some embodiments, the measurement device 130, and in particular the strain gauge thereof, covers the opening 114 entirely. The strain gauge may have one or more openings such that air can pass through the strain gauge from the container 110 to the outside.

[0027] In some embodiments, the measurement device 130, and in particular the strain gauge thereof, may cover at least a part of the opening 114 at the wide portion of the cone shape. For example, the measurement device 130, and in particular the strain gauge thereof, may entirely cover the opening 114 at the wide portion of the cone shape.

[0028] The measurement device 130, and in particular the strain gauge thereof, may be connected to the determination device 140 by one or more connection elements 132, such as wires and/or strain gauge pins. The measurement signals of the strain gauge can be provided to the determination device 140 via the one or more connection elements 132 for analysis.

[0029] According to some embodiments, the entry port 112 is provided at a portion of the container 110 below a fluid level of the fluid 1 in the container 110. The gas supply device 120, which is connected to the entry port 112 of the container 110, can thus supply a gas, and in particular air, to the fluid 1 in the container 110. In particular, the gas supply device 120 is configured to generate bubbles in the fluid 1. The gas supply device 120 can thus also be referred to as "bubble creator".

[0030] According to some embodiments, the gas supply device 120 is an air pump or a compressor. The gas supply device 120 can be connected to an external power source 122 to operate the gas supply device 120, such as the air pump or compressor to generate bubbles 2 in the fluid 1 in the container 110.

[0031] The gas supply device 120 generates bubbles 2 in the fluid 1, which escape from the surface of the fluid 1 and reach the strain gauge which faces the surface of the fluid 1. In some embodiments, a gap is provided between the surface of the fluid 1 and the strain gauge. The gap can be 5cm or less, 3cm or less, or 1cm or less. The gap can be sufficiently large to ensure that the bubbles 2 can escape from the surface of the liquid 1 and reach the strain gauge to generate the measurement signals which are indicative of ice formation in the fluid 1 and thus on a cooling device 3 of the household appliance.

[0032] In more detail, the bubbles 2, which reach the

strain gauge, exert a mechanical force on the strain gauge and generate measurement signals. In other words, the measurement signals of the strain gauge are indicative of bubbles 2 exiting the surface of the fluid. When the fluid 1 starts to freeze, i.e., when ice is formed in the fluid 1, the characteristics of the generation of the bubbles 2 change. This change is detected by the determination device 140. Based on the change, the determination device 140 can determine the formation of ice in the fluid 1 and control a defrosting of the household appliance.

[0033] In some implementations, a defrosting mechanism of the household appliance, such as a heater, is controlled based on the determination results provided by the determination device 140. In particular, the defrosting mechanism can be operated when it is determined that there is ice in the fluid 1 or that the amount of ice is above a predetermined threshold. Further, the defrosting mechanism is not operated when it is determined that there is no ice in the fluid 1 or the amount of ice is below the predetermined threshold. It is noted that the apparatus 100 is inside the household appliance and thus, the ice formation in the fluid is indicative of an ice formation e.g. on a cooling device 3, such as an evaporator.

[0034] A detailed example of the determination device 140 and an operation of the defrosting mechanism based on an output of said determination device 140 is described later with reference to figure 3.

[0035] According to some embodiments, the apparatus 100 further includes a base 150 supporting at least the container 110. The base 150 can be a plate or other element on which the container 110 is mounted. The base 150 can stabilize the container 110 and thus the strain gauge mounted on top of the container 110 to improve an accuracy of the measurement signals provided by the strain gauge.

[0036] In some implementations, at least one elastic element 160 is provided between the base 150 and the container 110. The at least one elastic element 160 may be a spring, and in particular a coil spring. The at least one elastic element 160 can prevent vibrations from being transferred from the gas supply device 120, such as the air pump, to the strain gauge. Thereby, a measurement accuracy of the measurement device 130 can be further improved.

[0037] In some implementations, the apparatus 100 further includes at least one thermally conductive element 170, such as a wire. The apparatus 100 may include a plurality of conductive elements 170, such as a plurality of wires. The at least one thermally conductive element 170 can be made of a material having a high thermal conduction coefficient, such as copper. The at least one thermally conductive element 170 is configured to provide thermal conduction between the household appliance, and in particular the cooling device 3, and the fluid 1 in the container 110. The apparatus 100, and in particular the container 110, may be located adjacent to the

cooling device 3 of the household appliance.

[0038] For example, a first end of the at least one thermally conductive element 170 is connectable to the household appliance, and in particular the cooling device 3 of the household appliance. The cooling device 3 may be an evaporator. The first end of the at least one thermally conductive element 170 may be connectable to the household appliance by at least one clamp 172, such as at least one copper clamp. A second end of the at least one thermally conductive element 170 may be connected to the container 110 and/or may extend into the container 110 to be immersed in the fluid 1.

[0039] The at least one thermally conductive element 170 provides thermal transfer between the cooling device 3 and the fluid 1 in the container 110. Thus, the formation of ice in the fluid 1 is related to the formation of ice on the cooling device 3. The apparatus 100, and in particular the container 110, may be located adjacent to the cooling device 3 to further improve the correspondence between the formation of ice in the fluid 1 and the formation of ice on the cooling device 3. Accordingly, a defrosting of the cooling device 3 can be controlled efficiently and with reduced power consumption.

[0040] Figure 2 shows a flowchart of a method 200 for detecting a formation of ice in a household appliance according to embodiments described herein.

[0041] The method 200 includes in block 210 a supplying of air to a fluid in a container to generate bubbles in the fluid; in block 220 a recording of measurement signals of a strain gauge covering at least a part of an opening of the container above a surface of the fluid; and in block 230 a determining of a presence of ice in the fluid based on the measurement signals provided by the strain gauge.

[0042] According to some embodiments, the method 200 further includes operating a defrost heater of the household appliance if it is determined that ice is present in the fluid.

[0043] According to embodiments described herein, the method for detecting a formation of ice in a household appliance can be conducted by means of computer programs, software, computer software products and the interrelated controllers, which can have a CPU, a memory, a user interface, and input and output means being in communication with the corresponding components of the apparatus for detecting a formation of ice in a household appliance.

[0044] However, the present disclosure is not limited thereto and the method for detecting a formation of ice in a household appliance can be conducted by means of a simplified structure without the use of a CPU or software. An example of such a controller-less structure is described in the following.

[0045] Figure 3 shows a schematic configuration of a determination device 300 according to embodiments described herein.

[0046] The determination device 300 does not require a microcontroller and determines a formation of ice in the

fluid and thus on the cooling device using collected strain gauge data, which are indicative of bubble bursts.

[0047] The determination device 300 includes in particular a comparator 310, a first trigger 320, a second trigger 330, a switch 340, and a memristor 350.

[0048] The comparator 310 includes a first input 312, a second input 314, and an output 316. The output 316 of the comparator may be connectable to a defrost heater of the household appliance. The first trigger 320 has a first trigger period t_1 . The second trigger 330 has a second trigger period t_2 longer than the first trigger period t_1 . For example, the first trigger period t_1 can be 10 minutes and/or the second trigger period t_2 can be 20 minutes.

[0049] The switch 340 is operable by the second trigger 330 and has an input connected to the measurement device 130 to receive the measurement signals provided by the strain gauge. A first output of the switch 340 is connected to the first input 312 of the comparator 310. The switch can be a two-way switch.

[0050] The memristor 350 is connected between a second output of the switch 340 and the second input 314 of the comparator 310. The memristor is configured to store the measurement signals provided by the strain gauge according to the first trigger period t_1 .

[0051] The example of the determination device 300 in figure 3 includes two different timers, namely the short-time timer 320 (e.g. 10 minutes) and the long-time timer 330 (e.g. 20 minutes), the memristor 350 for storing a previous state, the two-way switch 340 for having measurement data of two different times, and the comparator 310 which is triggered by the long-time timer 330.

[0052] Accordingly, the determination device 300 reads or detects bubble bursts with the first trigger period t_1 of, for example, 10 minutes. The strain gauge data (or value) is saved e.g. at $t = 10$ minutes in the memristor 350 and the memristor 350 keeps this strain gauge data (or value) for the second input 314 of the comparator 310, until the second trigger 330 triggers. When a trigger pulse of the second trigger 330 reaches the two-way switch 340, the first input 312 of the comparator receives current data (or a current value) e.g. at $t = 20$ minutes, and the comparator 310 compares the current value and the value of 10 minutes before stored in the memristor 350. In some implementations, the gas supply device, such as the air pump may, be triggered by the first trigger 320 every 10 minutes.

[0053] If only water is in the container, the bubble bursts generate a pressure effect at the strain gauge. If there is ice in the container, the effects of the bubble bursts are weakened. Thus, a difference between pure water and a water-ice mixture can be detected. A defrost mechanism, such as a defrost heater, can be operated according to an output of the comparator 310, which can be a logic value of 1 or 0.

[0054] The present disclosure provides an apparatus which determines whether ice has formed on a cooling device, and operates the defrost mechanism only when

it is determined that there is ice on the cooling device. The apparatus uses a strain gauge which senses a generation of air bubbles in a fluid, such as water. When the fluid starts to freeze, i.e., when ice is formed in the fluid, the characteristics of the generation of the bubbles change. This change is detected by the strain gauge and used to control the defrosting. Accordingly, the defrosting is performed only when there is ice on the cooling device, whereby an efficient defrosting can be provided and an energy consumption of the household appliance, such as a refrigerator or freezer, can be reduced

[0055] Further, the apparatus requires neither a micro-controller nor a complex structure. The container can be manufactured as one piece and act as a sensor. A reliability of the apparatus is improved compared to capacitive or mechanical sensing techniques because ice formation is detected in water. Further, the defrost operation may start when food freezes and does not rely on independently operated fixed triggers.

[0056] While the foregoing is directed to embodiments of the disclosure, other and further embodiments of the disclosure may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

Claims

1. An apparatus (100) for detecting a formation of ice in a household appliance, comprising:
 - a container (110) configured to accommodate a fluid (1), the container (110) including an entry port (112) and an opening (114);
 - a gas supply device (120) connected to the entry port (112) of the container (110) to supply a gas to the fluid (1) in the container (110);
 - a measurement device (130, 300) covering at least a part of the opening (114) of the container (110), wherein the measurement device (130) includes a strain gauge; and
 - a determination device (140) configured to determine the formation of ice in the fluid (1) based on measurement signals provided by the strain gauge.
2. The apparatus (100) of claim 1, wherein the container (110) is configured such that the opening (114) thereof is located adjacent to a surface of the fluid (1).
3. The apparatus (100) of claim 1 or 2, wherein the gas supply device (120) is configured to generate bubbles (2) in the fluid (1), and wherein the measurement signals of the strain gauge are indicative of bubbles (2) exiting the surface of the fluid (1).
4. The apparatus (100) of any one of claims 1 to 3, wherein the container (110) has a cone shape,

wherein the entry port (112) is provided at a narrow portion of the cone shape, and wherein the opening (114) is provided at a wide portion of the cone shape.

5. The apparatus (100) of claim 4, wherein the strain gauge of the measurement device (130, 300) covers the opening (114) at the wide portion of the cone shape.
6. The apparatus (100) of any one of claims 1 to 5, further including a base (150) supporting at least the container (110), wherein at least one elastic element (160) is provided between the base (150) and the container (110).
7. The apparatus (100) of claim 6, wherein the at least one elastic element (160) is a spring, and in particular a coil spring.
8. The apparatus (100) of any one of claims 1 to 7, further comprising at least one thermally conductive element (170), wherein a first end of the at least one thermally conductive element (170) is connectable to the household appliance, and in particular a cooling device (3) of the household appliance.
9. The apparatus (100) of claim 8, wherein a second end of the at least one thermally conductive element (170) is connected to the container (110) and/or extends into the container (110) to be immersed in the fluid (1).
10. The apparatus (100) of any one of claims 1 to 9, wherein the gas supply device (120) is an air pump or a compressor.
11. The apparatus (100) of any one of claims 1 to 10, wherein the determination device (300) includes:
 - a comparator (310) having a first input (312), a second input (314), and an output (316);
 - a first trigger (320) having a first trigger period (t1);
 - a second trigger (330) having a second trigger period (t2) longer than the first trigger period (t1);
 - a switch (340) operable by the second trigger (330) and having an input connected to the measurement device (130) to receive the measurement signals provided by the strain gauge, wherein a first output of the switch (340) is connected to the first input (312) of the comparator (310); and
 - a memristor (350) connected between a second output of the switch (340) and the second input (314) of the comparator (310), wherein the memristor (350) is configured to store the measurement signals provided by the strain gauge according to the first trigger period (t1).

12. The apparatus (100) of claim 11, wherein the output (316) of the comparator (310) is connectable to a defrost mechanism of the household appliance.
13. A household appliance, comprising the apparatus (100) of any one of claims 1 to 12. 5
14. A method (200) for detecting a formation of ice in a household appliance, comprising: 10
- supplying (210) air to a fluid (1) in a container (110) to generate bubbles (2) in the fluid (1); recording (220) measurement signals of a strain gauge covering at least a part of an opening (114) of the container (310) above a surface of the fluid (1); and 15
- determining (230) a presence of ice in the fluid (1) based on the measurement signals provided by the strain gauge. 20
15. The method (200) of claim 14, further comprising: operating a defrost mechanism of the household appliance if it is determined that ice is present in the fluid (1). 25
- 30
- 35
- 40
- 45
- 50
- 55

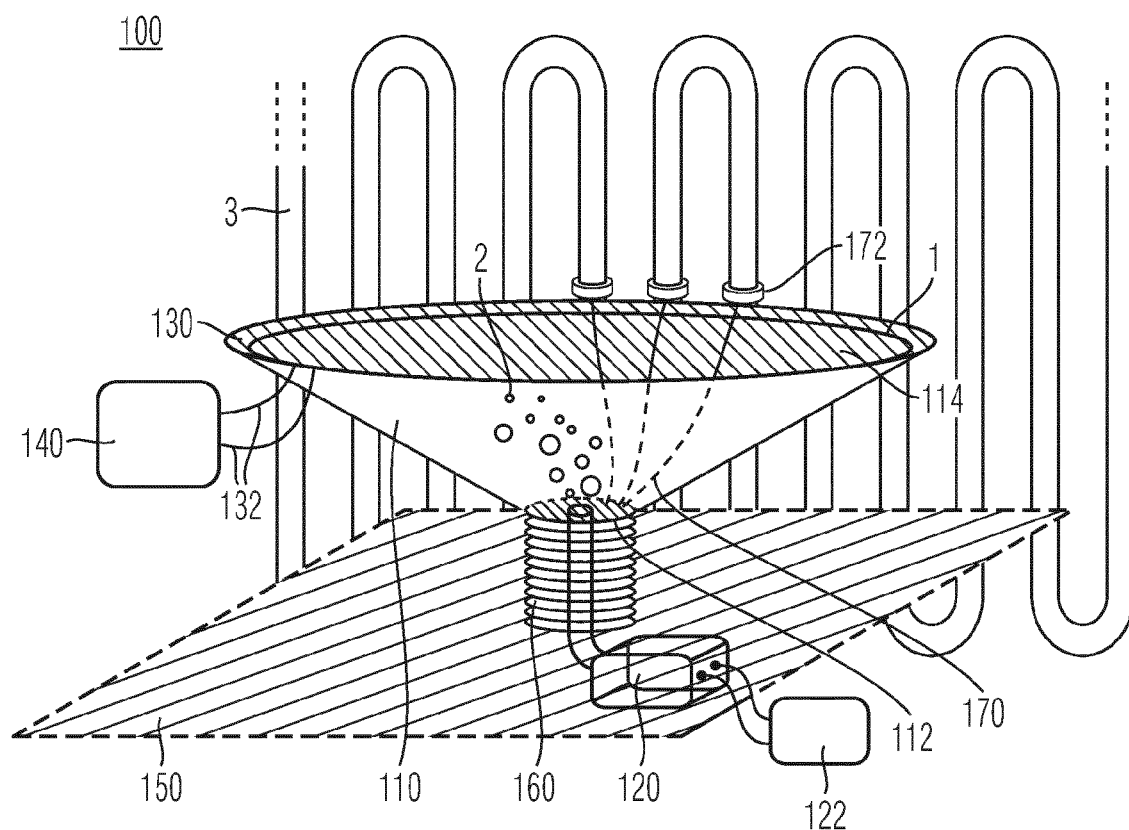


Fig. 1

200

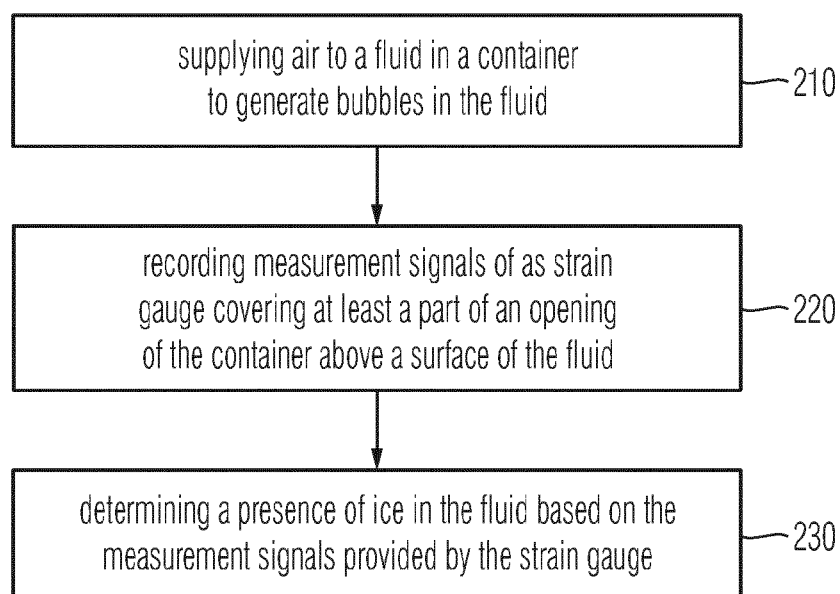


Fig. 2

300

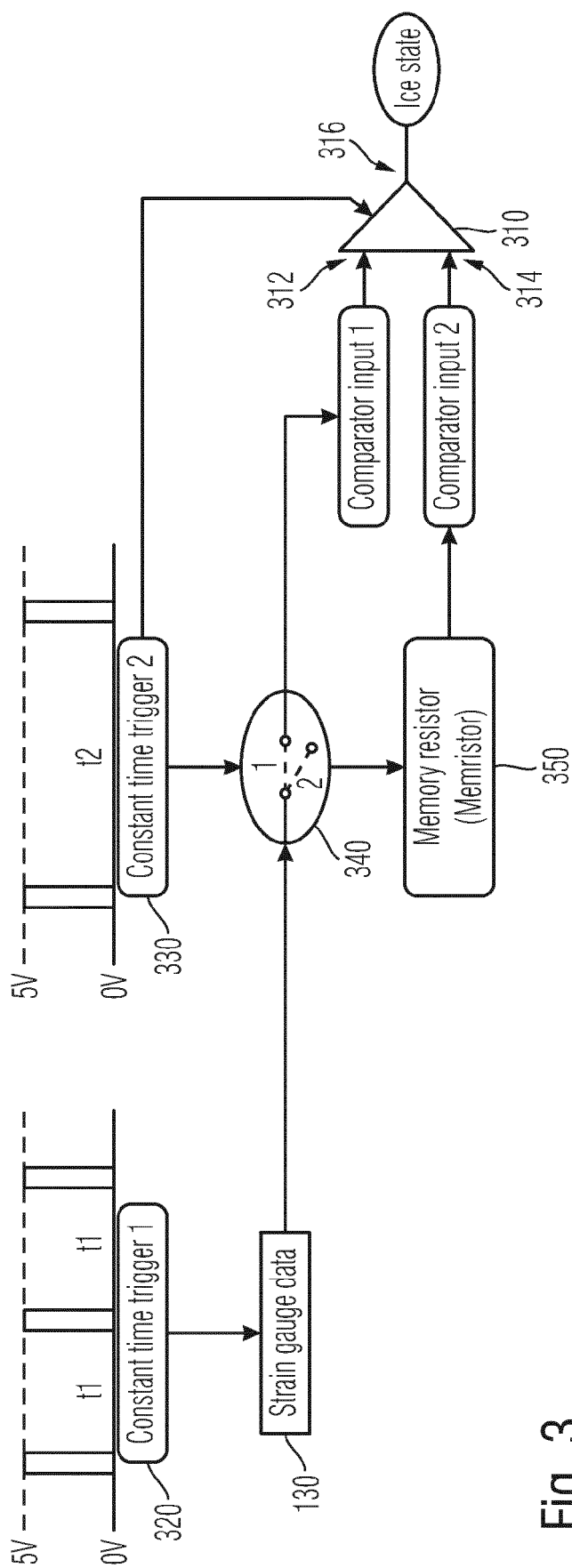


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 19 18 4627

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)
A	WO 2008/108757 A1 (CARRIER CORP [US]; LIFSON ALEXANDER [US] ET AL.) 12 September 2008 (2008-09-12) * paragraph [0027] * -----	1-15	INV. F25D21/02
A	DE 31 16 361 A1 (PIFFL ERNST) 23 December 1982 (1982-12-23) * the whole document * -----	1,14	
			TECHNICAL FIELDS SEARCHED (IPC)
			F25D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 11 December 2019	Examiner de Graaf, Jan Douwe
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			

 1
EPO FORM 1503 03/02 (P04C01)

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

EP 19 18 4627

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.

11-12-2019

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008108757 A1	12-09-2008	CN 101688731 A	31-03-2010
		EP 2135020 A1	23-12-2009
		US 2010024452 A1	04-02-2010
		WO 2008108757 A1	12-09-2008

DE 3116361 A1	23-12-1982	NONE	

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