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### (54) **EXCITATION BASED ICE DETECTION UNIT, REFRIGERATOR WITH ICE DETECTION UNIT AND METHOD FOR DEFROSTING OF A REFRIGERATOR**

(57) The before mentioned invention refers to an ice detection unit (1), at least comprising a channeling element (2) for guiding water and for holding ice (4), an excitation means (6) for exciting said channeling element (2) and an excitation detection means (8) for detecting excitations of the channeling element (2),

wherein a mechanical connection between the channeling element (2) and at least the excitation means (6) and/or the excitation detection means (8) establishes due to a solidification of fluid, in particular water, inside the channeling element (2), wherein the mechanical connection transfers excitations from the excitation means (2) to the excitation detection means (8).

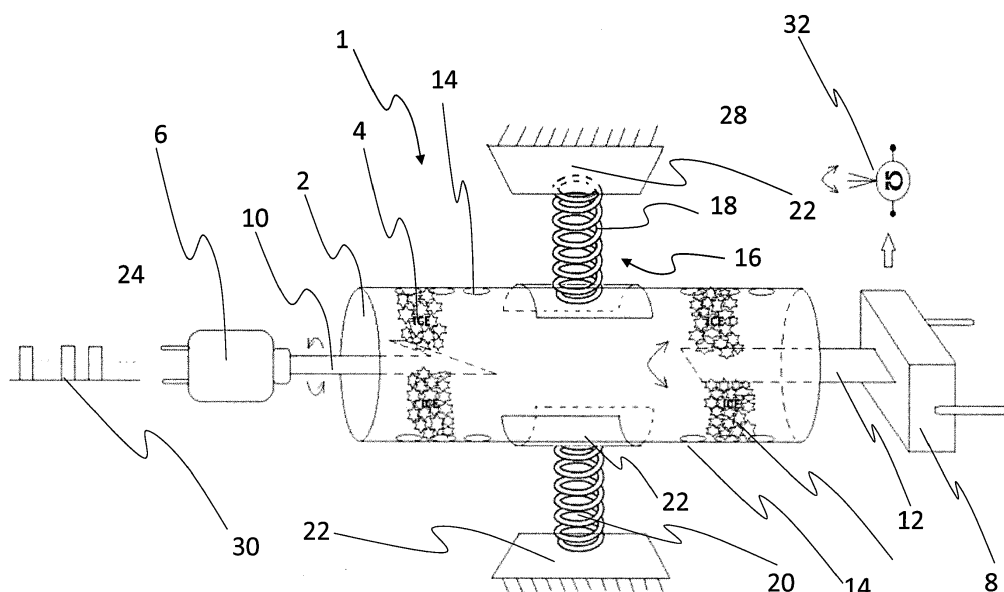


Fig. 1

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## Description

**[0001]** The present invention refers to an ice detection unit according to claim 1, a refrigerator according to claim 12 and a method for operating a refrigerator according to claim 13.

### Background of the Invention

**[0002]** In all no-frost refrigerators, there is a heater on the heat-exchanger for prevent icing. After starting of refrigerator, heat-exchanger starts cooling and icing. This is unwelcome situation by user and inefficient situation by cooling performance of refrigerator. So, there is located a heater on the heat-exchanger in all no-frost refrigerators to prevent icing. After a long certain time (8-12 hours) starting of the refrigerator, the heater works a small certain time (5-10 minutes) for the reason to melt the ice. This operation is called as defrost.

**[0003]** Document US4843830A discloses a differential ice sensing system and method for a cold drink beverage dispenser or the like. The beverage dispenser has an ice bath cooling tank containing a supply of water. A refrigerated cooling surface is provided within the tank so as to freeze a portion of the water into a body of ice. The beverage dispenser has a beverage flow path which is cooled by the liquid in the ice bath. The differential ice sensing system comprises a first conductivity (or impedance) probe which is disposed in the water of the ice bath at a position where it will sense the conductivity of the ice when the body of ice formed on the refrigerated surface attains a predetermined size. A second conductivity probe is disposed within the liquid so that it is maintained in conductivity sensing relationship with the liquid. Each of the probes is responsive to an electric current supplied thereto to measure the electrical conductivity in its vicinity. A system is provided for detecting conductivity differences between the first and second probes indicative of the presence of ice at the first probe and for generating a signal indicating presence of ice at the first probe. This signal may be utilized to block the flow of refrigerant to the refrigerated surface when the body of ice formed has reached a pre-determined size and to initiate the flow of refrigerant when the body of ice is less than a desired size.

**[0004]** Document WO0009960A2 discloses an apparatus and method that regulates the size of an ice bank and that prevents short cycling of the compressor therefor and operation thereof at undesired voltages. A microprocessor based control circuit includes a circuit for sensing line voltage combined with an ice bank sensing circuit. The ice bank sensing circuit is of the conductivity sensing type wherein the electrical conductivity between two probes is sensed. The microprocessor continually monitors the probes to determine if refrigeration is needed or not, and continually senses the line voltage to determine if that voltage is within the design limits of the refrigeration compressor. The voltage sensing circuit can also sense

if power has been interrupted where the voltage drops to zero.

**[0005]** Document US3782130A discloses a refrigerator, said refrigerator is arranged to cool part of an area for which an indication of the imminence of ice-formation is required. A first temperature sensitive circuit and a first conductivity probe are situated in that part of the area while a second temperature sensitive circuit and a second conductivity probe are situated outside it. A first differential amplifier compares the conductivities of the conductivity probes and a second differential amplifier compares the outputs of the temperature sensitive circuits. The outputs of one of the differential amplifiers controls the refrigerator while the output of the other differential amplifier provides the said indication.

**[0006]** Document DE2641600A1 discloses the initiator of a deicing system is used in an evaporator, especially in a heat pump. The initiator has electrode scanning the evaporator surface. The conductivity increased by ice formation switches the deicing device on by a discriminator circuit. The deicing device is started only if the evaporator is actually covered with ice. The deicer is not connected when the environment is cold but dry, nor when the electrode gap is subjected to droplets. The electrode is arranged in front of the end edge of the air baffle plates connected to the evaporator pipe. The effective length of the electrode is short in relation to the end edge. The discriminator circuit switches the deicer on only if the higher conductivity is still present after a delay time. The electrode consists of a head held on a rod fixed on an insulating support on the baffle plate. Thus, the main problem is that the presence and amount of ice on the heat-exchanger is not detected simultaneously without sensors. Defrost operation is done automatically with help of periodic programming. Existence of ice and need of heating to melt the ice is unknown. So this periodic defrost operation causes inefficient situation by energy consume and cooling performance of No-frost refrigerators.

### Object of the Invention

**[0007]** Therefore, it is the object of the present invention to provide an advanced ice detection unit, a refrigerator with such an advanced ice detection unit and a method for operating such a refrigerator.

### Description of the Invention

**[0008]** The before mentioned object is solved by an ice detection unit according to claim 1. The term ice preferably comprises besides ice also snow or the like, but it is possible to limit the term ice also to ice only.

**[0009]** Said ice detection unit preferably comprises at least a channeling element for guiding water and/or for holding ice, said channeling element can be a tube or hose and preferably extends straight in one direction. It is also conceivable that the channeling element has a

varying diameter or a constant diameter, in particular the outer surface of the channeling element has a constant diameter. The channeling element has preferably a circular shape or a shape differing from a circular shape. The diameter of said channeling element is preferably between 0,5mm and 20cm, in particular between 5mm and 10cm or between 10 mm and 5cm or between 1 mm and 20mm or between 5mm and 15mm. The channeling element preferably has a length of preferably between 0,5mm and 20cm, in particular between 5mm and 10cm or between 10 mm and 5cm or between 1 mm and 20mm or between 5mm and 15mm. The ice detection unit further comprises an excitation means for exciting said channeling element. Excitations are preferably vibrations, in particular caused by a vibration source like an ultra sonic unit. An excitation detection means for detecting excitations of the channeling element is also provided, wherein a mechanical connection between the channeling element and at least the excitation means and/or the excitation detection means establishes due to a solidification of a fluid substance, in particular a liquid substance, in particular water, inside the channeling element. The mechanical connection preferably transfers excitations from the excitation means to the excitation detection means.

**[0010]** This solution is beneficial, since the mechanical connection represents the ice or snow situation in the environment of said ice detection unit. Thus, in case the ice detection unit is part of a cooling room of a refrigerator the growth or accumulation of ice and/or snow happens simultaneously. Since the mechanical connection appears in dependency of ice and/or snow growth respectively accumulation triggering of an counter effect, like switching on a heating unit, can be established in close relationship.

**[0011]** Further preferred embodiments of the present invention are subject-matter of the dependent claims and/or of the following parts of the specification.

**[0012]** According to a preferred embodiment of the present invention the channeling element has at least to axial ends and at least in sections and preferably completely a tube-like shape. At least the excitation means has an excitation part reaching on one side of the channeling element into the inside of a tube-like shaped section without contacting said channeling element. Additionally, or alternatively at least the excitation detection means has an excitation detection part reaching on the other side of the channeling element into the inside of a tube-like shaped section without contacting said channeling element.

**[0013]** It is hereby conceivable that the excitation part or the excitation detection part is rigidly coupled with said channeling element.

**[0014]** Thus, it is important in case no ice or snow is present no mechanical connection between the excitation part and the excitation detection part is established.

**[0015]** The channeling element comprises according to a further preferred embodiment of the present invention at least a grid, in particular for water flow, or a struc-

tured inner surface to allow solidificated water (ice particles) to grow respectively to accumulate into radial direction. This embodiment is beneficial since an ice and/or snow growth or accumulation in radial direction is supported.

**[0016]** At least or exactly one holding means for holding said channeling element in a predefined position is provided, wherein said holding means comprises at least one and preferably at least or exactly two spring elements. Thus, the holding means comprises at least two spring elements, wherein one first spring element is preferably arranged on a topside of a tube-like shaped connection section of the channeling element and wherein one second spring element is preferably arranged on a bottom side of said tube-like shaped connection section, wherein the tube-like shaped connection section is positioned between the axial ends of said channeling element, wherein each of said spring elements has one further end to be coupled with a surrounding, in particular stationary, wall member, in particular of a refrigerator. This embodiment is beneficial since said channeling element is arranged movable, in particular in one direction respectively up and down or at least partially in a rotating direction. Thus, also very slight excitations can be detected, this allows or supports a stepwise actuation of further means, in particular a heater of a refrigerator.

**[0017]** According to a further preferred embodiment of the present invention the excitation means for exciting said channeling element comprises a vibration motor, wherein said excitation part is preferably a rotatable pivot, wherein said rotatable pivot is preferably actuated by means of an actuation of said vibration motor. Additionally or alternatively the excitation detection means for detecting excitations of the channeling element is preferably a vibration sensor, wherein the excitation detection part is preferably connected to said vibration sensor and transfers vibrations of the channeling element to the vibration sensor. Said pivot preferably has a spoon-like or scraper-like or stirrer-like shape and is preferably rotated in one direction. It is also conceivable that said pivot is rotated between a first and a second position and vice versa. Due to this embodiment and in dependency of the length of the time slots between each actuation of said excitation means different level excitation intensity can be determined.

**[0018]** A control unit is according to a further preferred embodiment also provided respectively also part of said ice detection unit. However, it is also conceivable that said control unit is a control unit of a refrigerator. Said control unit preferably operates the excitation means due to predefined rules, wherein the excitation detection means outputs excitation signals in dependency of detected excitations. The control unit preferably provides control signals in dependency of the detected excitation signals for operating of at least one further means. Thus, the excitation detection means preferably detects value changes in resistance and/or voltage and/or current. A first value range represents a low level excitation inten-

sity, wherein preferably no signals or a signal up to a threshold A for operating the further means is provided by the control means if a low level excitation intensity is determined. A second value range represents a mid level excitation intensity, in particular between threshold A and B, wherein threshold B represents more respectively stronger excitations than threshold A. Signals for operating the further means are preferably provided by the control means if a mid level excitation intensity is determined. Highly preferably also a third value range is present and represents a high level excitation intensity, in particular between threshold B and C, wherein threshold C represents more respectively stronger excitations than threshold B wherein signals for operating the further means are provided by the control means if a high level excitation intensity is determined. The signals for operating the further means are causing a longer operation of the further means in case a high level excitation intensity is determined in comparison to a case in which a mid level excitation intensity is determined. It is also conceivable that one two levels of excitation intensity are present, thus on one side of a specific threshold no actuation of a further means, in particular heater, takes place and on the other side of that threshold an actuation of said further means takes place. This embodiment is beneficial since the heating can be adapted due to the needs and/or requirements of a specific device or user or environment.

**[0019]** The excitation means and the excitation detection means are according to a preferred embodiment of the present invention electrically isolated from each other. This solution is beneficial since the detection of excitations is a very exact value for the detection of ice and/or snow. The fluid, in particular water, freezes below 5°, in particular below 1° or below 0°, and ambient pressure of 10.1 N/cm<sup>2</sup>.

**[0020]** The above mentioned object is also solved by a refrigerator, in particular no frost refrigerator. Said refrigerator preferably comprises a least a cooling means for cooling down the atmosphere inside the refrigerator, a heater means for melting of accumulated ice or snow inside the refrigerator, an ice detection unit according to any of the before mentioned claims for detecting ice or snow inside the refrigerator and for actuating the heater means in dependency of detected ice or snow. This embodiment is beneficial since ice or snow can be detected and reduced respectively removed whenever detected and thus not just in dependency of a predefined time slot. The above mentioned object is solved by using properties of solidification of water and good transmission of vibration by solid materials. Generally speaking, the inventive system includes a solid pipe with grid surface for transmission of vibration (grid surface for liquid form of water flowing and solid form of water as ice standing), a vibration motor for excitation the system, a vibration sensor for sensing the excitation and two or more springs for flexible fixing the solid pipe.

**[0021]** The above mentioned object is also solved by a method for operating a refrigerator. Said method pref-

erably comprises at least the steps: Cooling down a food storage section by means of a cooling means, Detecting ice or snow inside the food storage section by means of operating an ice detection unit according to any of claims 1 to 11, Operating an ice reduction respectively removing means, in particular a heating means, in case the presence of ice or snow is detected. This embodiment is beneficial since ice or snow can be detected and reduced respectively removed whenever detected and thus not just in dependency of a predefined time slot. This method can be used in all cooler devices that include heat-exchanger part. The inventive method and unit, respectively system, can be used for all ice detection application.

**[0022]** According to a preferred embodiment of the present invention the heating means is operated as long as a mechanical coupling between the excitation means and the excitation detection means is present. Alternatively, the heating means is operated for a predetermined time, wherein the predetermined time depends on the determined level of excitation intensity.

**[0023]** The control unit further computes at least on further parameter, in particular an average number of door openings in dependency of daytime and/or calendar day, in particular in dependency of a day planner, and/or a moist sensor, inside and/or outside the refrigerator, and/or a selected temperature or cooling program.

**[0024]** Further benefits, goals and features of the present invention will be described by the following specification of the attached figures, in which exemplarily components of the invention is illustrated. Components of the systems and methods 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 multiple times with respect to said figures.

**[0025]** In the following the invention is just exemplarily described with respect to the attached figures.

#### Brief Description of the Drawing

#### **[0026]**

Fig. 1 shows a schematic illustration of the ice detection unit according to the present invention and

Fig. 2 shows a schematic illustration of a refrigerator having an ice detection unit according to fig. 1.

**[0027]** Fig. 1 shows an ice detection unit 1 according to the present invention. Said ice detection unit 1 preferably comprises at least a channeling element 2 for guiding water and for holding ice 4, an excitation means 6 for exciting said channeling element 2 and an excitation detection means 8 for detecting excitations of the channeling element 2, wherein a mechanical connection between the channeling element 2 and at least the excitation means 6 and/or the excitation detection means 8 establishes due to a solidification of fluid, in particular

water, inside the channeling element 2, wherein the mechanical connection transfers excitations from the excitation means 2 to the excitation detection means 8.

**[0028]** Excitation means 6 preferably comprises an excitation part 10, in particular a pivotable longitudinal element. The excitation detection means 8 preferably comprises an excitation detection part 12, which is preferably a longitudinal, in particular flat, element that extends into channeling element 2.

**[0029]** Reference number 16 indicates a holding means. Said holding means 16 preferably comprises a first spring 18 and a second spring 20, wherein the first spring 16 is preferably coupled with the top side of channeling element 2 and wherein the second spring 18 is preferably coupled with the bottom side of channeling element 2. Both springs 16, 18 are preferably coupled with a wall member 22, in particular of a refrigerator 25 (cf. Fig. 2). Holding means 16 allows a defined positioning and excitation of channeling element 2.

**[0030]** Reference number 30 indicates an operation scheme for operating excitation means 6. Said operation scheme can be provided as data. Said operation scheme is preferably provided and executed respectively processed by control unit 24. Therefore, control unit 24 is preferably connected for signal and/or data exchange with excitation means 6 and/or excitation detection means 8. Excitation detection means 8 preferably directly actuates a further means, in particular heater means 26 (cf. fig. 2). It is also conceivable that excitation detection means 8 provides data and/or signals representative for detected excitation respectively vibration. Said data and/or signals can be processed or evaluated by control unit 24 and can be used for actuating said further means, in particular heater means 26 (cf. fig. 1).

**[0031]** As shown in fig. 2 the working principle is based on excitation and sensing. After starting of refrigerator 25, heat-exchanger respectively cooling means 26 starts cooling and icing. The vibration motor respectively excitation means 6 is excited by certain time intervals with excitation of ice control signal when heat-exchanger 26 starts cooling. Firstly, if there is no ice 4 or snow occurs inside of grid 14 surfaced solid pipe respectively channeling element 2, the excitations of vibration motor 6 cannot create any vibration on the solid pipe 2 and/or on vibration sensor respectively vibration detection means 8. Vibrator leg respectively excitation part 10 of motor 6 cannot hit the solid pipe 2. When icing occurs on heat-exchanger surface and after a certain time, thick layer of ice 4 fills the inside of the solid pipe 2 which preferably has a grid 14 surface. At this condition ice filled solid pipe 2 starts the vibration transfer from vibration motor 6 side to vibration sensor side respectively excitation detection means 8. Vibrator leg 10 of motor 6 hit the ice 4 that occurs inside of pipe 2. So excited vibration reaches the inside surface of pipe 2 with help of good transmission of vibration by solid materials (ice). When icing full filled inside of the solid pipe 2, excited vibration reaches perfectly to vibration sensor 8. There are different type vi-

bration sensor 8 that returns from vibration to voltage, current or resistance. The resistance, voltage or current of vibration sensor changes with respect to perceived vibration intensity.

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Low level vibration intensity = Low level icing (no need defrost)

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Mid level vibration intensity = Mid level icing (need standard time defrost)

High level vibration intensity = High level icing (need long time defrost)

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**[0032]** This system can be used both with microcontroller respectively control unit 24 or directly hardware system with no microcontroller. This system is also perfectly isolated. There is highly preferably no electrical conductivity between excitation side and sensor side.

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**[0033]** The invention describes an ice detection unit 1, which at least comprises a channeling element 2 for guiding water and for holding ice 4, an excitation means 6 for exciting said channeling element 2 and an excitation detection means 8 for detecting excitations of the channeling element 2, wherein a mechanical connection between the channeling element 2 and at least the excitation means 6 and/or the excitation detection means 8 establishes due to a solidification of fluid, in particular water, inside the channeling element 2, wherein the mechanical connection transfers excitations from the excitation means 2 to the excitation detection means 8.

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#### List of reference numbers

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#### **[0034]**

- 1 ice detection unit
- 2 channeling element
- 4 ice
- 6 excitation means
- 8 excitation detection means
- 10 excitation part
- 12 excitation detection part
- 14 grid
- 16 holding means
- 18 first spring element
- 20 second spring element
- 22 wall member
- 24 control unit
- 25 refrigerator
- 26 cooling means
- 28 heating means
- 30 data
- 32 output signal

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## Claims

1. Ice detection unit (1),  
at least comprising  
a channeling element (2) for guiding water and for holding ice (4),  
an excitation means (6) for exciting said channeling element (2) and  
an excitation detection means (8) for detecting excitations of the channeling element (2),  
wherein a mechanical connection between the channeling element (2) and at least the excitation means (6) and/or the excitation detection means (8) establishes due to a solidification of fluid, in particular water, inside the channeling element (2),  
wherein the mechanical connection transfers excitations from the excitation means (2) to the excitation detection means (8). 5
2. Ice detection unit according to claim 1,  
**characterized in that**  
the channeling element (2) has at least to axial ends and at least in sections a tube-like shape,  
wherein at least the excitation means (6) has an excitation part (10) reaching on one side of the channeling element (2) into the inside of a tube-like shaped section without contacting said channeling element (2). 10
3. Ice detection unit according to claim 1 or 2,  
**characterized in that**  
the channeling element (2) has at least to axial ends and at least in sections a tube-like shape,  
wherein at least the excitation detection means (8) has an excitation detection part (12) reaching on the other side of the channeling element (2) into the inside of a tube-like shaped section without contacting said channeling element (2). 15
4. Ice detection unit according to claim 2 or 3,  
**characterized in that**  
the channeling element (2) comprises at least a grid (14) or structured inner surface to allow solidified water (ice particles) to grow into radial direction. 20
5. Ice detection unit according to any of claims 1 to 4,  
**characterized by**  
a holding means (16) for holding said channeling element (2) in a predefined position,  
wherein said holding means (16) comprises at least one spring element (18). 25
6. Ice detection unit according to claim 5,  
**characterized in that**  
the holding means (16) comprises at least two spring elements (18, 20), wherein one first spring element (18) is arranged on a topside of a tube-like shaped connection section of the channeling element (2) and  
wherein one second spring element (20) is arranged on a bottom side of said tube-like shaped connection section, wherein the tube-like shaped connection section is positioned between the axial ends of said channeling element (2), wherein each of said spring elements (18, 20) has one further end to be coupled with a surrounding, in particular stationary, wall member (22). 30
7. Ice detection unit according to any of claims 1 to 6,  
**characterized in that**  
the excitation means (6) for exciting said channeling element (2) comprises a vibration motor,  
wherein said excitation part (10) is a rotatable pivot, wherein said rotatable pivot is actuated by means of an actuation of said vibration motor,  
the excitation detection means (12) for detecting excitations of the channeling element (2) is a vibration sensor,  
wherein the excitation detection part (12) is connected to said vibration sensor and transfers vibrations of the channeling element (2) to the vibration sensor. 35
8. Ice detection unit according to any of the proceeding claims,  
**characterized by**  
a control unit (24),  
wherein the control unit (24) operates the excitation means (6) due to predefined rules,  
wherein the excitation detection means (8) outputs excitation signals in dependency of detected excitations,  
wherein the control unit (24) provides control signals in dependency of the detected excitation signals for operating of at least one further means. 40
9. Ice detection unit according to claim 7,  
**characterized in that**  
the excitation detection means (8) detects value changes in resistance and/or voltage and/or current, wherein a first value range represents a low level excitation intensity,  
wherein no signals for operating the further means are provided by the control means (24) if a low level excitation intensity is determined  
wherein a second value range represents a mid level excitation intensity,  
wherein signals for operating the further means are provided by the control means (24) if a mid level excitation intensity is determined,  
wherein a third value range represents a high level excitation intensity,  
wherein signals for operating the further means 45

are provided by the control means (24) if a high level excitation intensity is determined, wherein the signals for operating the further means are causing a longer operation of the further means in case a high level excitation intensity is determined in comparison to a case in which a mid level excitation intensity is determined. 5

10. Ice detection unit according to any of the proceeding claims, 10  
**characterized in that**  
 the excitation means (6) and the excitation detection means (8) are electrically isolated from each other. 15

11. Ice detection unit according to any of the proceeding claims, 15  
**characterized in that**  
 the fluid, in particular water, freezes below 5°, in particular below 1° or below 0°, and ambient pressure of 10.1 N/cm<sup>2</sup>. 20

12. Refrigerator (25), in particular no frost refrigerator, at least comprising 25  
 a cooling means (26) for cooling down the atmosphere inside the refrigerator (25),  
 a heater means (28) for melting of accumulated ice or snow inside said refrigerator (25),  
 an ice detection unit (19) according to any of the before mentioned claims for detecting ice (4) or snow inside the refrigerator (25) and for actuating the heater means (28) in dependency of detected ice (4) or snow. 30

13. Method for operating a refrigerator (25), 35  
 at least comprising the steps:

Cooling down a food storage section by means of a cooling means (26),  
 Detecting ice (4) or snow inside the food storage section by means of operating an ice detection unit (1) according to any of claims 1 to 11,  
 Operating a heating means (28) in case the presence of ice (4) or snow is detected. 40

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14. Method according to claim 13, 45  
**characterized in that**  
 the heating means (28) is operated as long as a mechanical coupling between the excitation means (6) and the excitation detection means (8) is present. 50

15. Method according to claim 13, 55  
**characterized in that**  
 the heating means (28) is operated for a predetermined time,  
 wherein the predetermined time depends on the determined level of excitation intensity.

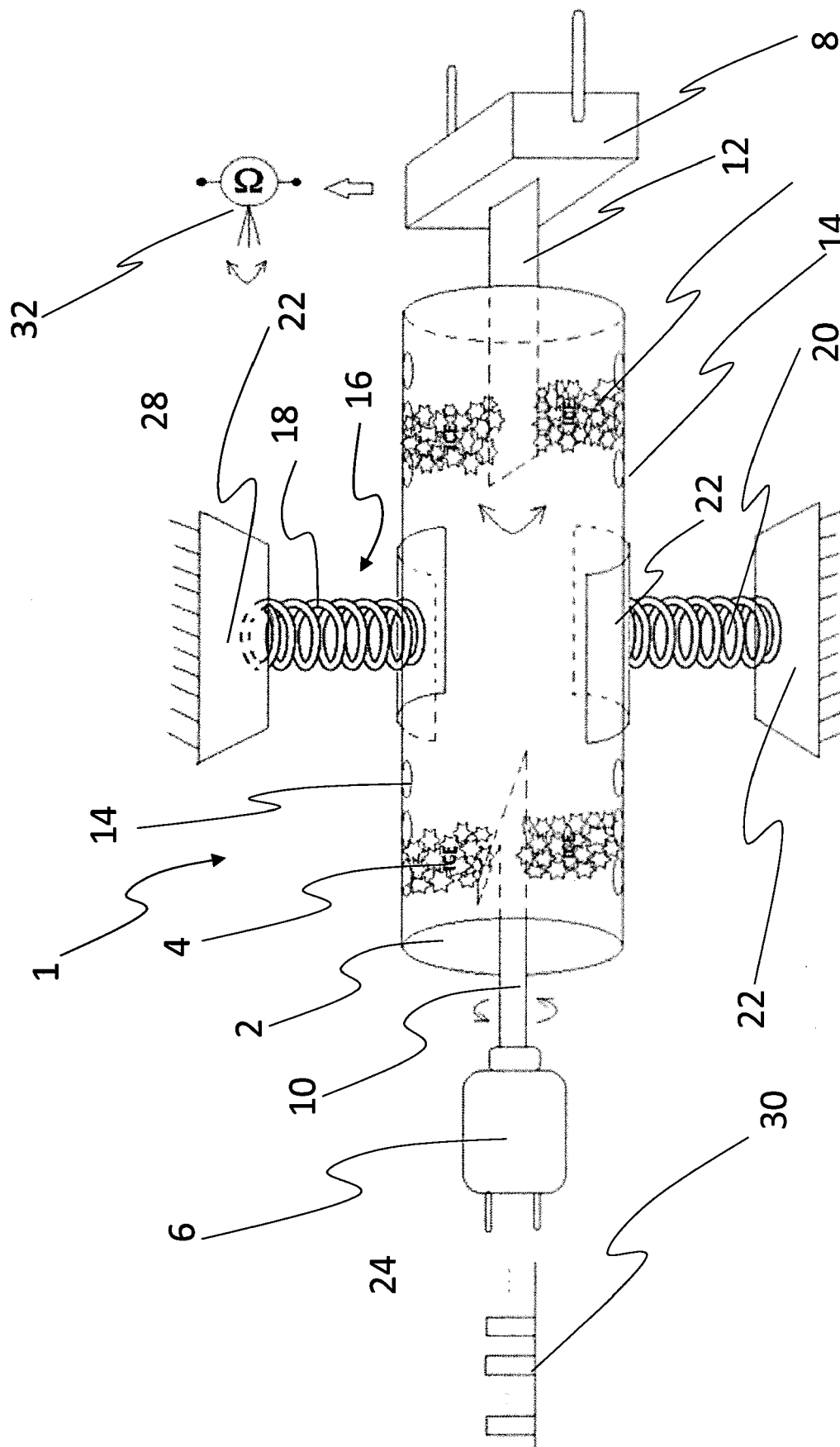


Fig. 1



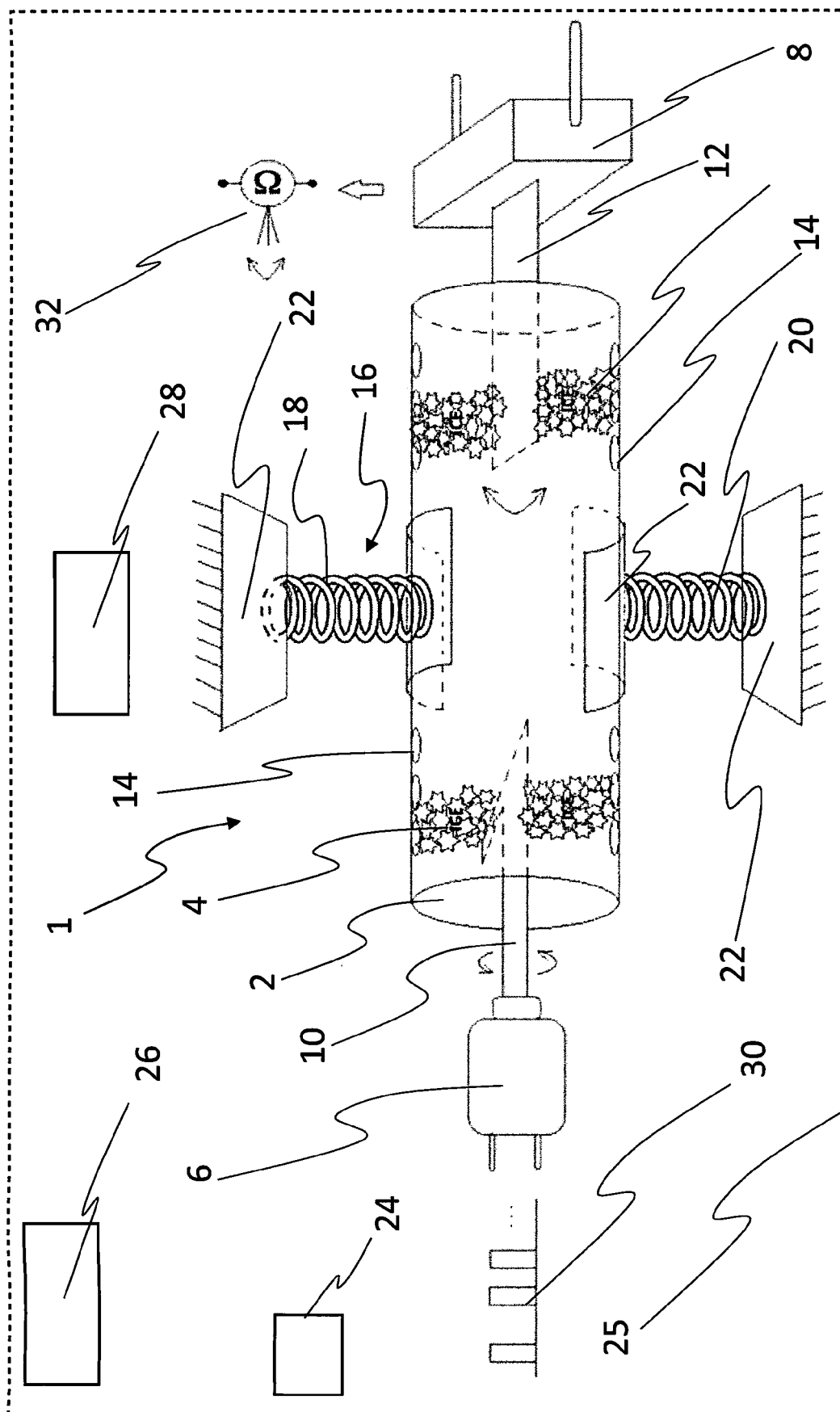


Fig. 2



## EUROPEAN SEARCH REPORT

Application Number  
EP 16 20 6196

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| 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 3 641 781 A (NIJO KIYOICHI)<br>15 February 1972 (1972-02-15)<br>* figures 1-3 *<br>* abstract *                                    | 1                                                 | INV.<br>F25D21/02                       |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 4 176 524 A (KAMIYAMA TOSHIBUMI [JP] ET AL)<br>4 December 1979 (1979-12-04)<br>* figures 1-14 *<br>* column 3, line 56 - line 63 * | 1-15                                              |                                         |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                       |                                                   | TECHNICAL FIELDS SEARCHED (IPC)         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                       |                                                   | F25D                                    |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                       |                                                   |                                         |
| Place of search<br>The Hague                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                       | Date of completion of the search<br>18 April 2017 | Examiner<br>Dezso, Gabor                |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                       |                                                   |                                         |

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

EP 16 20 6196

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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