(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 431 905 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
23.01.2019 Bulletin 2019/04

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

(21) Application number: **17182095.4**

(22) Date of filing: **19.07.2017**

(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:
MA MD

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

(72) Inventor: **ÜNVER,, Burak**
45030 Manisa (TR)

(74) Representative: **Flint, Adam**
Page White & Farrer
Bedford House
John Street
London WC1N 2BF (GB)

(54) AN APPARATUS AND METHOD FOR DETECTING FREEZING OF A SUBSTANCE

(57) An apparatus (200) for detecting freezing of a substance comprises a first member (202) which has at least one container (204), the container (204) having flexible walls and containing a substance which has a freezing temperature below which the substance is solid, and above which it is fluid. The apparatus (200) also comprises a second member (206), the first member (202) and second member (206) being arranged to bring the container (204) of the first member (202) into contact with the second member (206). The engagement between the first member (202) and the second member (206) is detected when the substance in the container (204) is solid at the time that the container (204) of the first member (202) is brought into contact with the second member (206).

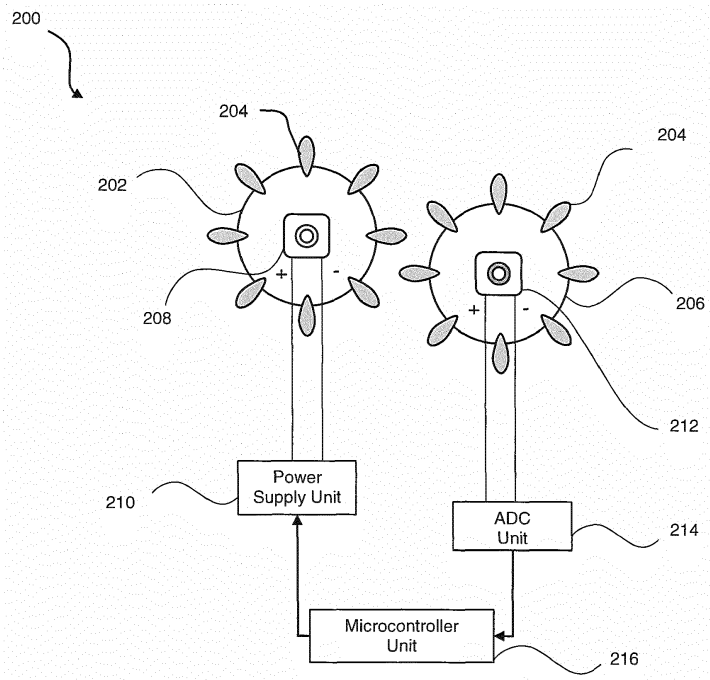

Figure 2

EP 3 431 905 A1

Description

Technical Field

[0001] The present disclosure relates to an apparatus and method for detecting freezing of a substance.

Background

[0002] So-called frost-free refrigeration apparatus, such as freezers and refrigerators and the like, employ various complex methods for preventing a build up of ice. One example of such a method is periodically heating the freezer or refrigerator to melt any ice that may have formed inside. This process can be wasteful and inefficient.

Summary

[0003] According to a first aspect disclosed herein, there is provided an apparatus for detecting freezing of a substance, the apparatus comprising:

a first member comprising at least one container, the container having flexible walls and containing a substance which has a freezing temperature below which the substance is solid and above which the substance is fluid; and
a second member;
the first and second members being arranged such that the container of the first member can be brought into contact with the second member;
the arrangement being such that engagement between the first and second members is detected when the substance in the container is solid at the time that the container of the first member is brought into contact with the second member.

[0004] In an example, the first member is rotatable such that rotation of the first member brings the container of the first member into contact with the second member.
[0005] In an example, the apparatus comprises an electric motor for driving the first member to bring the container of the first member into contact with the second member.
[0006] In an example, the apparatus comprises a current monitor for detecting a surge in the motor drive current at the time that the container is brought into contact with the second member when the substance in the container is solid.
[0007] In an example, the second member is arranged to be driven to move when the container is brought into contact with the second member when the substance in the container is solid, the apparatus comprising a generator which is drivable by the second member and which produces a current when driven by the second member.
[0008] In an example, the second member comprises at least one container, the container having flexible walls and containing a substance which has a freezing temperature below which the substance is solid and above which the substance is fluid.
[0009] In an example, the first member comprises plural containers, each container having flexible walls and containing a substance which has a freezing temperature below which the substance is solid and above which the substance is fluid.
[0010] In an example, the substance is water which in its fluid state is water or steam and in its solid state it is ice.
[0011] In an example, there is provided refrigeration apparatus comprising apparatus as described above. The refrigeration apparatus may be for example a refrigerator or a freezer.
[0012] According to a second aspect disclosed herein, there is provided a method for detecting freezing of a substance, the method comprising:

moving a first member, the first member comprising at least one container, the container having flexible walls and containing a substance which has a freezing temperature below which the substance is solid and above which the substance is fluid;
bringing the container of the first member into contact with a second member; and
receiving an indication that the substance in the container is solid at the time that the container of the first member is brought into contact with the second member.

[0013] In an example, the method comprises rotating the first member such that the rotation of the first member brings the container of the first member into contact with the second member.
[0014] In an example, the method comprises an electric motor which drives the first member to move to bring the container of the first member into contact with the second member.
[0015] In an example, the method comprises an indication received by a current monitor, wherein the indication is a surge in the motor drive current at the time that the container is brought into contact with the second member when the substance in the container is solid.
[0016] In an example, the second member is driven to move when the container is brought into contact with the second member when the substance in the container is solid, and wherein the second member is able to drive a generator, the generator being arranged to produce a current when driven by the second member.
[0017] In an example, the second member comprises at least one container, the container having flexible walls and containing a substance which has a freezing temperature below which the substance is solid and above which the substance is fluid.

Brief Description of the Drawings

[0018] To assist understanding of the present disclo-

sure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows schematically a first example of apparatus for detecting freezing of a substance; and

Figure 2 shows schematically a second example of apparatus for detecting freezing of a substance.

Detailed Description

[0019] As mentioned previously, refrigeration apparatus, such as for example frost-free freezers and refrigerators and the like, prevent a build-up of ice, particularly on for example the heat exchanger, using relatively complex or inefficient methods. One such method is periodically heating a heater that is located on or near the heat exchanger to melt any ice that may have formed. Often these methods are wasteful, particularly if heaters are used excessively, and inefficient. These methods have no regard for whether ice has actually formed, and simply periodically heat the heat exchanger regardless.

[0020] According to examples described herein, an apparatus is arranged to detect the freezing of a substance, which may be for example water/ice. The apparatus has a first member comprising a container. The container has flexible walls. The container contains a substance which has a freezing temperature below which the substance is solid, and above which the substance is a fluid. The apparatus also has a second member. The first member and second member are arranged such that when the substance in the container of the first member is solid at a time that the container makes contact with the second member, an engagement between the first and second members is detected. Such apparatus may be used in a refrigeration apparatus, such as a refrigerator or a freezer or the like. Such apparatus may also be used in other applications where it may be useful to determine or detect that a substance has solidified.

[0021] Figure 1 shows a first example of an apparatus 100 for detecting that a substance has solidified. A first member 102 has one or more containers 104 attached to it or integrally formed with it. The or each container 102 contains a substance for which it is desired to detect that it has frozen. The or each container 102 has flexible walls. The or each container 102 may be in the form of a balloon, and may be made of for example a synthetic or natural rubber or other elastomeric or plastics material.

[0022] The first member 102 is movable to bring the one or more containers 104 into contact with a second member 106. The first member 102 may be rotatable to bring the containers 104 in contact with the second member 106. In the example shown, the first member 106 is a wheel. However, in other examples, other shapes may be used. For example, the first member 102 may be a rod, an example of which will be discussed further below.

[0023] The first member 102 may be driven to move by an electric motor 108. In this example, the second member 106 is static. The second member 106 may be for example a wall or the like against which the container 104 can strike. The second member 106 may have a protrusion 110 against which the container 104 can strike.

[0024] The first member 102 and the second member 106 are arranged such that when the substance in a container 104 of the first member 102 is solid. i.e. has frozen, the contact between the container 104 and the second member 106 can be detected, whereas when the substance in a container 104 of the first member 102 is not solid, any contact between the container 104 and the second member 106 is not detected. This can be done in a number of ways. In one example, a sharp increase in the current that is driving the motor 108 may be observed when movement of the motor 108 is inhibited, i. e. when a container 104 containing the substance in solid form strikes the second member 106. In particular, when a container 104 of the first member 102 is brought into contact with the second member 106 and the substance in the container 104 is solid, the motion of the first member 102 is dampened or supressed. As is known per se, this has the effect of causing the drive current in the motor 108 to rise sharply, which can be detected by a current monitoring circuit.

[0025] In another example (not shown), the first member may be in the shape or a rod, which can be brought into engagement with a second member, such as the second member 106 described above. The rod may carry at least one container, such as a container 104 described above, wherein the container has flexible walls and contains a substance. The rod may be arranged to move in a rotating or reciprocating or translational movement so as to bring the container(s) into contact with a static second member.

[0026] A second example of apparatus 200 for detecting freezing of a substance is shown in Figure 2. In this example, similarly to the first example, a first member 202 has one or more containers 204 attached to it or integrally formed with it. The or each container 204 contains a substance for which it is desired to detect that it has frozen. The or each container 204 has flexible walls. The or each container 204 may be in the form of a balloon, and may be made of for example a synthetic or natural rubber or other elastomeric or plastics material. The first member 202 is movable to bring the one or more containers 204 into contact with a second member 206, in particular in contact with the containers 204 of the second member 206. In the example shown, the first member 206 is a wheel. The first member 202 may be driven to move by an electric motor 208. A first member is connected to a motor 208.

[0027] In this example, the second member 206 is also rotatable and is in the form of a wheel. However, in other examples, other shapes may be used. The second member 206 has the one or more containers 204 attached to it or integrally formed with it. The containers 204 have

flexible walls. The containers 204 of the second member 206 contain a substance which has a freezing temperature below which the substance is solid, and above which the substance is a fluid.

[0028] The first member 202 and the second member 206 are arranged such that when a substance in a container 204 of the first member 202 is solid, the contact between the container(s) 204 of the first member 202 and the container(s) 204 of the second member 206 can be detected. To achieve this, in this example the second member 206 is connected to a generator 212.

[0029] In the example shown in Figure 2, the first member 202 is driven to rotate by the motor 208. A power supply unit 210 drives the motor 208. When the substance in the containers 204 is fluid, the containers 204 of the first member 202 are not stiff or rigid enough to connect with the containers 204 of the second member 206 in a manner that causes the second member 206 to move. When the substance in the containers 204 is solid, the first member 202 causes the second member 206 to move.

[0030] In this example, the movement of the second member 206 is a rotational movement. The movement of the second member may drive a generator 212. The output of the generator is connected to an ADC (analogue to digital conversion) unit 214. An output of the ADC unit 204 is passed to a microcontroller unit 216. In use, the microcontroller unit 216 receives an indication that the second member 206 has driven the generator 212 to move. The microcontroller unit 216 in this example is connected to the power supply unit 210 which drives the motor 208 for the first member 202.

[0031] Additionally, the frictional force associated with movement of the generator 212 may be relatively high. This may help to ensure that movement of the second member 208 is minimized or prevented altogether when the substance in the containers 204 of the first member 202 is a fluid. The frictional force associated with movement of the motor 208 may be low.

[0032] In an example embodiment, the microcontroller unit 216 may be arranged to control a component to heat the environment in which the first member and second member reside. The microcontroller unit may be arranged to continue to provide this control signal until the generator stops generating a current. Additionally or alternatively, the heating component may be arranged to heat the environment until the substance in the container returns to a fluid state. Additionally or alternatively, the heating component may be arranged to heat the environment up to a maximum period of time. Additionally or alternatively the heating component may be arrange to heat the environment for a fixed period of time. In the specific example here, the microcontroller unit 216 may trigger an environmental change to cause the substance in the containers 206 to return to a fluid state.

[0033] In one specific application of the examples of the apparatus 100, 200 described herein, the apparatus may be used in a refrigerator or freezer. The apparatus may be used to detect a build up of ice, especially in heat exchangers. In this example, the substance in the container(s) will be water or steam in the fluid state and ice when in the solid state. The apparatus 100, 200 may trigger heating of one or more components of the refrigerator or freezer, or the region near the one or more components of the refrigerator or freezer, so as to melt any ice that has built up on the one or more components. This includes particularly heating the heat exchanger or the region near the heat exchanger of the refrigerator or freezer so as to melt any ice that has built up on the heat exchanger. Known apparatus that is designed to reduce the build up of ice in refrigerators and freezers heat the environment regardless of whether ice is actually present or not in the appliance. The apparatus described herein allows the build up of ice to be detected first, thereby allowing heating to occur only when necessary. Therefore the solution presented by this apparatus to the problem of ice build up is more efficient than prior art techniques that periodically heat the appliance, or other such environment in which the apparatus can be used.

[0034] The examples described herein are to be understood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one example or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and modifications not described herein may also be employed within the scope of the invention, which is defined in the claims.

Claims

1. An apparatus for detecting freezing of a substance, the apparatus comprising:

a first member (102, 202) comprising at least one container (104, 204), the container (104, 204) having flexible walls and containing a substance which has a freezing temperature below which the substance is solid and above which the substance is fluid; and

a second member (106, 206);

the first and second members (104, 204, 106, 206) being arranged such that the container (104, 204) of the first member (102, 202) can be brought into contact with the second member (106, 206);

the arrangement being such that engagement between the first (102, 202) and second members (106, 206) is detected when the substance in the container (104, 204) is solid at the time that the container (104, 204) of the first member

(102, 202) is brought into contact with the second member (106, 206).

2. An apparatus according to claim 1, wherein the first member (102, 202) is rotatable such that rotation of the first member (102, 202) brings the container (104, 204) of the first member (102, 202) into contact with the second member (106, 206).

3. An apparatus according to claim 1 or claim 2, comprising an electric motor (108, 208) for driving the first member (102, 202) to bring the container (104, 204) of the first member (102, 202) into contact with the second member (106, 206).

4. An apparatus according to claim 3, comprising a current monitor for detecting a surge in the motor (108, 208) drive current at the time that the container (104, 204) is brought into contact with the second member (106, 206) when the substance in the container (104, 204) is solid.

5. An apparatus according to any of claims 1 to 4, wherein the second member (106, 206) is arranged to be driven to move when the container (104, 204) is brought into contact with the second member (106, 206) when the substance in the container (104, 204) is solid, the apparatus comprising a generator which is drivable by the second member (106, 206) and which produces a current when driven by the second member (106, 206).

6. An apparatus according to any of claims 1 to 5, wherein the second member (106, 206) comprises at least one container (104, 204), the container (104, 204) having flexible walls and containing a substance which has a freezing temperature below which the substance is solid and above which the substance is fluid.

7. An apparatus according to any of claims 1 to 6, wherein the first member (102, 202) comprises plural containers (104, 204), each container (104, 204) having flexible walls and containing a substance which has a freezing temperature below which the substance is solid and above which the substance is fluid.

8. An apparatus according to any of claims 1 to 7, wherein the substance is water which in its fluid state is water or steam and in its solid state it is ice.

9. A refrigeration apparatus comprising apparatus according to any of claims 1 to 8.

10. A method for detecting freezing of a substance, the method comprising:

moving a first member (102, 202), the first member (102, 202) comprising at least one container (104, 204), the container (104, 204) having flexible walls and containing a substance which has a freezing temperature below which the substance is solid and above which the substance is fluid;

bringing the container (104, 204) of the first member (102, 202) into contact with a second member (106, 206); and

receiving an indication that the substance in the container (104, 204) is solid at the time that the container (104, 204) of the first member (102, 202) is brought into contact with the second member (106, 206).

11. A method according to claim 10, comprising rotating the first member (102, 202) such that the rotation of the first member (102, 202) brings the container (104, 204) of the first member (102, 202) into contact with the second member (106, 206).

12. A method according to claim 10 or claim 11, wherein an electric motor (108, 208) drives the first member (102, 202) to move to bring the container (104, 204) of the first member (102, 202) into contact with the second member (106, 206).

13. A method according to claim 12, wherein the indication is received by a current monitor, wherein the indication is a surge in the motor (108, 208) drive current at the time that the container (104, 204) is brought into contact with the second member (106, 206) when the substance in the container (104, 204) is solid.

14. A method according to any of claims 10 to 13, wherein the second member (106, 206) is driven to move when the container (104, 204) is brought into contact with the second member (106, 206) when the substance in the container (104, 204) is solid, and wherein the second member (106, 206) is able to drive a generator (212), the generator (212) being arranged to produce a current when driven by the second member (106, 206).

15. A method according to any of claims 10 to 14, wherein the second member (106, 206) comprises at least one container (104, 204), the container (104, 204) having flexible walls and containing a substance which has a freezing temperature below which the substance is solid and above which the substance is fluid.

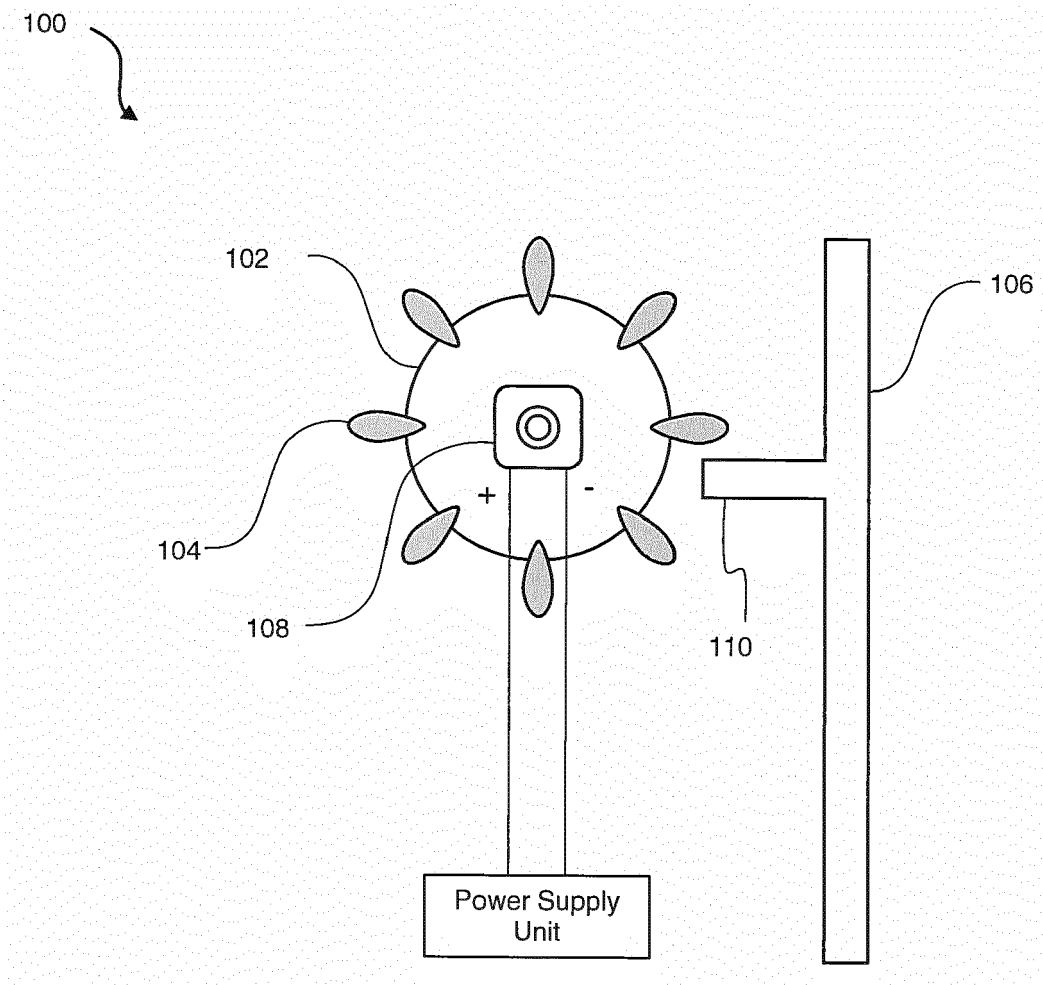

Figure 1

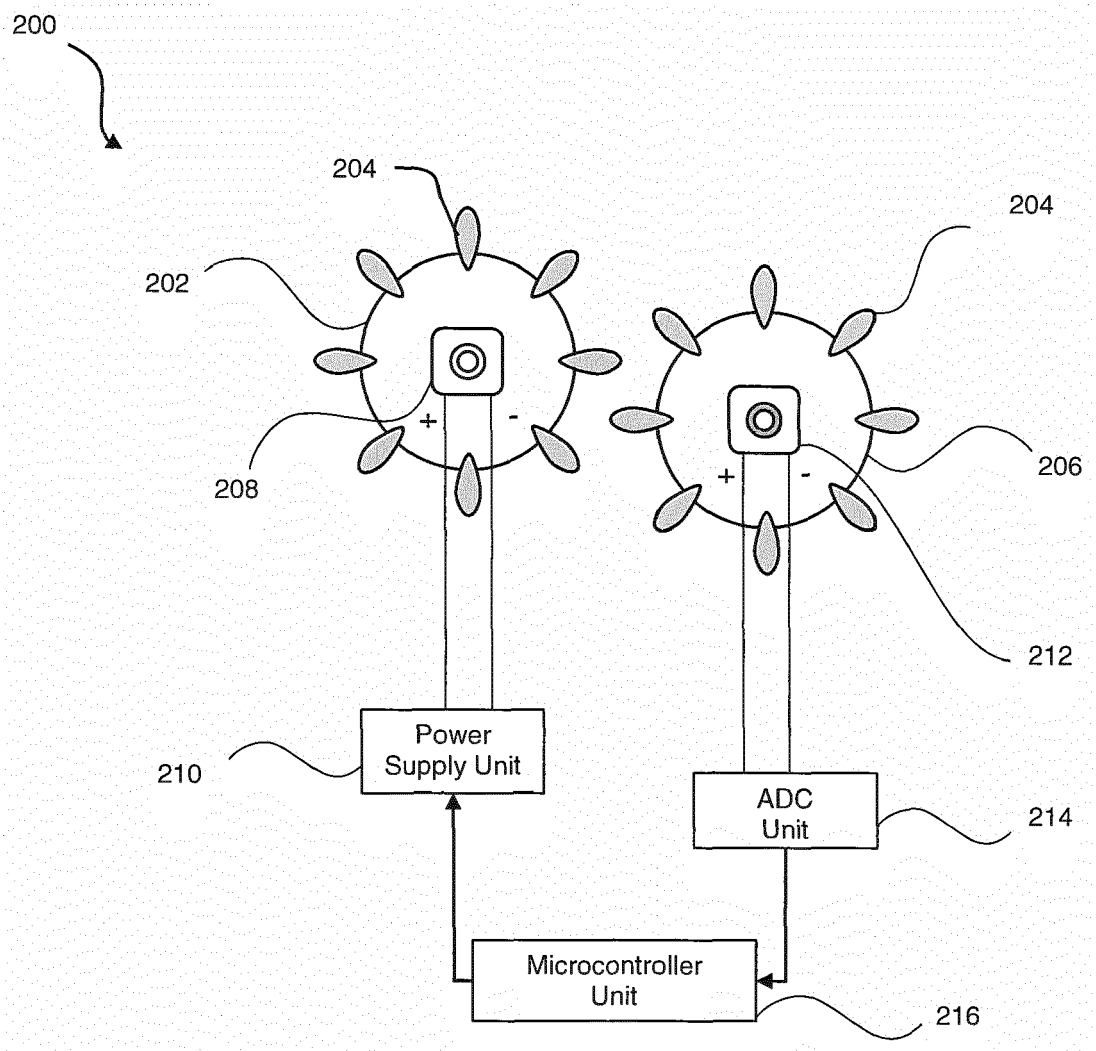
200
204
202
204
208
206
212
Power Supply Unit
210
ADC Unit
214
Microcontroller Unit
216

Figure 2

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 17 18 2095

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	US 2 622 923 A (COBB CLIFTON A) 23 December 1952 (1952-12-23) * the whole document *	1-15	INV. F25D21/02
A	DE 656 208 C (ELEKTROLUX AG) 1 February 1938 (1938-02-01) * the whole document *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

F25D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 January 2018	Bidet, Sébastien

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 18 2095

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.

15-01-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2622923 A	23-12-1952	NONE	
DE 656208 C	01-02-1938	NONE	

EPO FORM P0459

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