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(54) **Title**: METHOD FOR THE RECOGNITION OF CAPSULES FOR FOOD PREPARATIONS

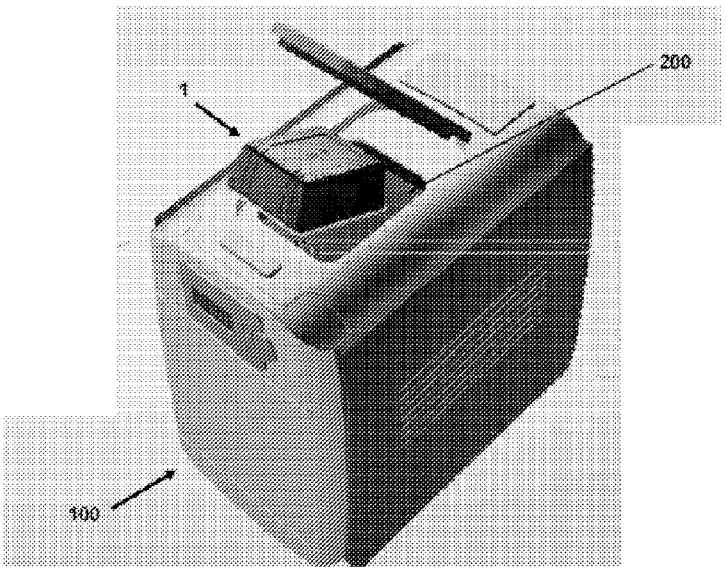

FIG. 1

(57) **Abstract**: The invention relates to a method for the recognition of a capsule (1) for food preparations within a machine (100) for the preparation of food products, said capsule (1) comprising an electric circuit (10) that includes at least one capacitive element (1 1) and one inductive element (12) electrically connected in series between a pair of electrical terminals (41, 42) of the capsule (1), said method comprising the following steps: i) applying an AC voltage to said electrical terminals (41, 42) and detecting a first impedance value of said electric circuit (10); ii) varying the frequency of said AC voltage applied to said electrical terminals (41, 42) and detecting at least one second impedance value of said electric circuit (10); iii) comparing all the impedance values so detected of said electric circuit (10) with corresponding reference values stored in lookup tables wherein the frequency of said AC voltage is the input variable, each lookup table being associated with a respective food preparation program that may be ran by the machine (100); iv) generating a recognition signal of the capsule (1) indicating that it is authentic if the impedance values so detected correspond to respective reference values contained in one of the lookup tables. The invention also relates to a capsule and to a machine configured to allow implementation of said method.

METHOD FOR THE RECOGNITION OF CAPSULES FOR FOOD PREPARATIONS

Technical field of the invention

The present invention relates to a method for the recognition of capsules for food preparations, such as e.g. bread or infused beverages like coffee or tea.

The invention also relates to a capsule and a machine for food preparations that are configured to allow implementation of the recognition method.

Background

There are known many machines for the preparation of foods such as bread or infused beverages starting from prepackaged single-use capsules containing a suitable food preparation. In the case of bread or other foods that require a mixing phase, a capsule typically contains a mixture of basic ingredients such as flour and yeast. In the case of beverages the capsule generally receives an granular infusion.

In the above mentioned known machines there is the need to recognize a capsule. Recognition serves to detect counterfeited capsules, as well as to prevent a machine from working with capsules that do not correspond to the preparation that has been programmed and that have been inserted therein by mistake.

A known approach to the solution of said recognition problem involves the use of protected memory means to be programmed and mounted on the object to be validated, i.e. the capsule in the present case. Various microprocessors (chips) suitable for this purpose have been proposed over time.

Although this approach is robust, it entails a certain complexity of implementation and processing relating to both the units involved, namely the machine and the single-use capsule. In particular, an encrypted transmission of data from the capsule to the machine is used to avoid easy copies by counterfeiters. Moreover, every single capsule needs to be individually programmed.

The so-called RFID technology also has this drawback and suffers from the further problem of a complex management of the related RF transmission.

Another known solution to the recognition problem mentioned above is to issue

serial numbers that are unique for each capsule and stored on a suitable chip associated thereto. However, this approach requires a complex management of an archive of approved numbers or codes. Moreover, this approach is poorly robust with respect to the copy of data by tracking. For this reason, this approach is not suited to machines randomly distributed on a territory as those considered here.

Summary of the invention

The technical problem tackled and solved by the present invention is therefore to provide a method for the recognition of single-use capsules allowing to overcome the drawbacks mentioned above with reference to the prior art, as well as a capsule and a machine which allow implementation of this method.

This problem is solved by a method according to claim 1, as well as by a corresponding capsule and machine according to claims 5 and 12, respectively.

The invention provides a method of identifying consumable capsules that allows to prevent the use of counterfeited capsules in machines for the preparation of foods, in particular machines for bread or infused beverages such as coffee and tea.

In addition to preventing the use of counterfeited capsules, the method may also be used to recognize and characterize different operation modes of a machine according to the content of the consumable capsule that is identified or to the geographical distribution. For example, the type of capsule identified may start a specific program for processing the preparation contained therein in machines that have different operating modes and/or that may prepare different types of food.

The invention makes it difficult to counterfeit capsules. The identification of a capsule in fact is related to the detection of one or a combination of electrical parameters read by a machine in response to one or more electrical inputs supplied to an electric circuit associated to the capsule.

The circuit of the capsule is selectively accessible by the machine through a pair of electrical terminals. Preferably, the combination of parameters comprises a capacitive, inductive or frequency parameter and/or a resistive and/or thermal parameter. As mentioned above, these parameters are detected in response to an electrical input or to a combination of electrical inputs provided by a machine. A

comparison between the measured parameters and corresponding reference values organized in lookup tables stored in a control system of the machine that receives the capsule allows to recognize the capsule and, consequently, to start an appropriate food preparation program.

The method of the invention thus represents a reliable solution to the aforementioned problem of counterfeiting capsules, and offers a good degree of robustness at a minimal cost. The proposed method is extremely simple to implement both considering the aspects related to machines and concerning the production of individual capsules.

Other advantages, features and the modes of employment of the present invention will become clear from the following detailed description of embodiments thereof, presented by way of non-limiting example.

Short description of the figures

Reference will be made to the figures of the accompanying drawings, wherein which:

- Figure 1 shows a perspective view of a preferred embodiment of a machine and a capsule according to the present invention;
- Figures 2A and 2B each show a perspective view of a detail of the machine and the capsule of Figure 1, respectively;
- Figures 3A and 3B each show a perspective view of the capsule of Figure 1, respectively closed and open;
- Figure 4 is another perspective view of the capsule of Figure 1, showing an circuit accommodated in its closure element; and
- Figure 5 shows a circuit diagram applicable in the capsule of Figure 1.

Detailed description of preferred embodiments

With reference initially to figure 1, a capsule containing a food preparation according to a preferred embodiment of the invention is generally indicated by 1. In this example, the capsule 1 contains a preparation for bread, in particular a mixture of flour and yeast. It will be understood, however, that this is not a limiting feature of the

invention and that the capsule and the machine according to the invention may also be used for other food preparations, such as for example in the form of infused beverages like coffee and tea.

The capsule 1 is adapted to be introduced into a machine 100 for the preparation of a food product, in the example considered here precisely a machine for making bread. The machine 100 may be configured for a kneading step only, but also for a cooking step.

With reference to figures 3A, 3B and 4, the capsule 1 comprises a main body 2, which in this example has a substantially parallelepiped shape, preferably with rounded edges. In particular, the main body 2 is defined by a bottom 21 and a peripheral wall 22 formed by four side walls. In the example shown in these figures, the main body 2 features a slight taper toward the bottom 21, which defines a pyramidal shape.

A compartment 20 suitable to contain a food preparation is formed within the main body 2.

The main body 2 (and its compartment 20) is closed at the top, i.e. the side opposite the bottom 21, by a closure element 3.

The closure element 3 is preferably in the form of a removable and/or pierceable tab or film. In general, the closure element 3 is a flat element, preferably flexible, e.g. hot applied on an upper peripheral zone of the peripheral wall 22 of the main body 2. The closure element 3 therefore has a lower face 30 that, when the capsule 1 is closed, faces the internal compartment 20, and an opposite upper face 31 exposed to the outside of the capsule 1. The upper outer face 31 is suitable for receiving prints indicating the content or the manufacturer of the capsule, as shown by way of example in the figures.

In correspondence of the lower face 30 of the closure element 3, the capsule 1 is provided with identification means. These identification means include an electric circuit 10. The electrical circuit 10 is generally configured to interact with corresponding recognition means 110 associated with the machine 100. In particular, as it will be illustrated in greater detail in the following, the recognition means 110 of the machine 100 are configured to provide predefined electrical inputs to the electric circuit 10 and read a response of the electric circuit 10 that allows to recognize the capsule 1.

The electric circuit 10 includes a capacitive element 11 and an inductive element

12 that are electrically connected in series between a pair of electrical terminals 41, 42 of the capsule 1.

Preferably, the electrical terminals 41 and 42 are also accessible from the outside of the capsule 1. In particular, in the present example the electrical terminals may be engaged at the outer face 31 of the closure element 3, as shown in Figure 3A.

Preferably, the electrical terminals 41 and 42 are arranged in a predetermined position, that is configured to be accessed at a standardized position.

Figure 5 schematically shows an embodiment of the electric circuit 10 wherein the capacitive element 11 and the inductive element 12 electrically connected in series between a pair of electrical terminals 41, 42 may clearly be seen.

The recognition method requires to apply an AC voltage between the electrical terminals 41, 42 and to detect a first impedance value of the electric circuit 10. The frequency of the alternating voltage applied to the electrical terminals 41, 42 is then varied and at least a second impedance value of the circuit 10 is detected.

The so detected impedance values of the electrical circuit 10 are then compared with corresponding reference values contained in lookup tables wherein the frequency of said alternating voltage is the input variable, each lookup table being associated with a respective food preparation program stored in a control unit of the machine 100.

If comparison is successful, i.e. if the detected impedance values correspond to the reference values contained in one of said lookup tables, a recognition signal of the capsule is generated confirming that the capsule is authentic. Consequently, the machine 100 automatically starts a food preparation program corresponding to the type of capsule that has been detected.

According to a preferred embodiment of the invention, the circuit 10 also comprises a resistive element 13 which, in the specific case, is arranged in series with the inductive element 12 and in parallel with the capacitive element 11.

The presence of a resistive element 13 provides the circuit 10 with a damping factor that contributes to further characterize its response to electrical inputs, thus making even more difficult the counterfeit a capsule.

To this aim, the method provides to repeat at least one second time the operations of applying an AC voltage between the electrical terminals 41, 42 and of detecting at

least two impedance values of said electrical circuit 10.

The resistive element 13 is preferably a thermistor, for example of the type called "ntc" ("Negative Temperature Coefficient"), which is well known in the field for its reliability and low cost. It is also possible to use "ptc" ("Positive Temperature Coefficient") thermistors.

The use of a thermistor is advantageous because it allows to provide the electrical circuit 10 not only with an electrical characteristic related to the impedance, but also with a thermal characteristic, which constitutes a further control, i.e. recognition, parameter of the capsules.

In order to allow recognition of this temperature characteristic, the method according to the invention comprises a step of applying a DC voltage to the electrical terminals 41, 42 and of detecting impedance values at zero-frequency, i.e. resistance values of the electric circuit 10. The variation of resistance values is indicative of the temperature of the thermistor. This step is performed subsequently to the step of identifying the circuit 10 by using AC voltage inputs.

Figure 5 also shows a schematic representation of recognition means 110 mounted on the machine. In particular some electronic circuit components and a pair of terminals 410 and 420 of the machine are shown, that are suitable to engage the respective electrical terminals 41 and 42 of the capsule circuit.

The machine 100 may advantageously comprise a control unit, in particular a microcontroller, typically provided with an analog-to-digital converter and capable of processing and sending said electrical inputs, as well as to analyze the related response of the circuit 10 based on lookup tables stored therein, the lookup table having the frequency of the alternating voltage as input variable. As explained above, each lookup table is associated with a respective preparation program, so that, once the recognition process is finished, the machine may automatically start a preparation program corresponding to the food product contained in the capsule.

The recognition preferably takes place in a predetermined time span, for example in the order of a few milliseconds.

The components 11, 12 and 13 of electric circuit 10 mentioned above may be discrete and connected by way of conventional techniques to a flexible substrate, or may

be more cheaply obtained as conductive traces formed within the closure element 3 or on one of its faces.

In any case, these components may be manufactured in a very thin fashion that can be easily integrated into the capsule. The circuit 10, when integrated and printed with conductive traces, reveals little information to a visual analysis.

Figures 1 and 2A show an embodiment of some components of the recognition means of the capsule 110 mounted on the machine.

In the present example, the means 110 comprise a pair of retractable elements, each bearing a respective terminal 410, 420 of the machine, one of which is shown in figure 2A and denoted by reference number 111. The element 111 is a needle or retractable pin, associated to an elastic urging member 112, in this example a helical compression spring. The needle or pin 111 is configured to automatically engage a respective electric terminal 41, 42 of the capsule 1 when the capsule is fitted in a suitable seat 200 of the machine 100 or as a result of a specific command.

It will be appreciated that the system of the invention allows to conceal the input or inputs provided by the machine and the correct answer (that is predetermined, and then awaited) of the consumable capsule to be recognized.

The system is electrically simple and does not require huge amounts of data to be stored on a machine. Furthermore, a pair of contact elements is sufficient to allow implementation of the recognition method.

Again, the recognition means of the capsule described above may be integrated in a thin plastic cover (i.e. the closure element 3 described above), for the sake of simplicity and minimum cost of the proposed solution.

The invention also relates to a capsule before it is filled with a food preparation. Alternative embodiments may provide that the capsule contains or is suitable to contain a food preparation other than that considered here, such as an infusion preparation for a beverage, in particular coffee, tea, chocolate or the like.

The present invention has hereto been disclosed with reference to preferred embodiments thereof. It is understood that there may be other embodiments relating to the same inventive idea, as defined by the scope of protection of the claims set forth below.

CLAIMS

1. A method for the recognition of a capsule (1) for food preparations within a machine (100) for the preparation of food products, said capsule (1) comprising an electric circuit (10) that includes at least one capacitive element (11) and one inductive element (12) electrically connected in series between a pair of electrical terminals (41, 42) of the capsule (1), said method comprising the following steps:

i) applying an AC voltage to said electrical terminals (41, 42) and detecting a first impedance value of said electric circuit (10);

ii) varying the frequency of said AC voltage applied to said electrical terminals (41, 42) and detecting at least one second impedance value of said electric circuit (10);

iii) comparing all the so detected impedance values of said electric circuit (10) with corresponding reference values stored in lookup tables wherein the frequency of said AC voltage is the input variable, each lookup table being associated with a respective food preparation program that may be run by the machine (100);

iv) generating a recognition signal of the capsule (1) indicating that it is authentic if the impedance values so detected correspond to respective reference values contained in one of the lookup tables.

2. A method according to claim 1, wherein said electric circuit (1) further comprises a resistive element (13) electrically connected in parallel to said capacitive element (11).

3. A method according to claim 2, wherein said resistive element (13) is a thermistor, and wherein said method comprises the following step carried out between steps ii) and iii):

v) repeating at least one second time the operations i) and ii) and detecting further impedance values of said electric circuit (10).

4. A method according to claim 3, wherein said resistive element (13) is a thermistor and wherein said method comprises the following operation carried out between steps ii) and iii):

vi) applying a DC voltage to said electrical terminals (41, 42) and detecting

impedance values at zero-frequency of said electric circuit (10).

5. A capsule (1) containing or suitable to contain a food preparation, said capsule being configured to be introduced into a machine (100) for the preparation of a food product and comprising:

- a main body (2) which defines a containment compartment (20) for the food preparation;
- a closure element (3) of said containment compartment (20), preferably in the form of a lid;
- identification means of said capsule, comprising an electric circuit (10) configured to provide at least one predetermined electrical and/or thermal recognition parameter in response to a predetermined input fed to said circuit (10) by said machine (100),

wherein said electric circuit (10) comprises a capacitive element (11) and an inductive element (12) electrically connected in series between a pair of electrical terminals (41, 42) of the capsule (1).

6. A capsule (1) according to claim 5, wherein said electric circuit (10) further comprises a resistive element (13) electrically connected in parallel to said capacitive element (11).

7. A capsule (1) according to claim 6, wherein said resistive element (13) is a thermistor.

8. A capsule (1) according to any one of the claims 5 to 7, wherein said electric circuit (10) is arranged at a face or surface (30) of said closure element (3) which is not accessible from the outside when the capsule is intact/closed.

9. A capsule (1) according to claim 8, wherein said electrical circuit (10) is integrated in said closing element (3), preferably according to a configuration wherein the circuit (10) is not accessible from the outside when the capsule is intact/closed.

10. A capsule (1) according to any one of the claims 5 to 9, said capsule containing a preparation for bread.

11. A capsule (1) according to any one of claims 5 to 9, said capsule containing an infused preparation for the preparation of a beverage, in particular coffee.

12. A machine (100) for the preparation of a food, for use with a capsule (1) according to any one of the claims 5 to 11, said machine (100) comprising recognition

means (110) of said capsule (1), said recognition means being configured to:

i) apply an AC voltage to electrical terminals (41, 42) of the capsule (1) and detect a first impedance value of said electric circuit (10);

ii) vary the frequency of said AC voltage applied to said electrical terminals (41, 42) and detect at least one second impedance value of said electric circuit (10);

iii) compare all the so detected impedance values of said electric circuit (10) with corresponding reference values stored in lookup tables wherein the frequency of said AC voltage is the input variable, each lookup table being associated with a respective food preparation program;

iv) generate a recognition signal of the capsule (1) indicating that it is authentic if the impedance values so detected correspond to respective reference values contained in one of the lookup tables;

v) start a food preparation program if recognition step iv) is successful.

13. A machine (100) according to claim 12, wherein said recognition means comprise one or more retractable members (111), in particular needles or pins, suitable to provide said predetermined inputs to said electric circuit (10).

14. A machine (100) according to claim 12 or 13, wherein said recognition means (110) are configured to automatically interact with the electric circuit (10) of the capsule (1) upon introduction of the latter into the machine.

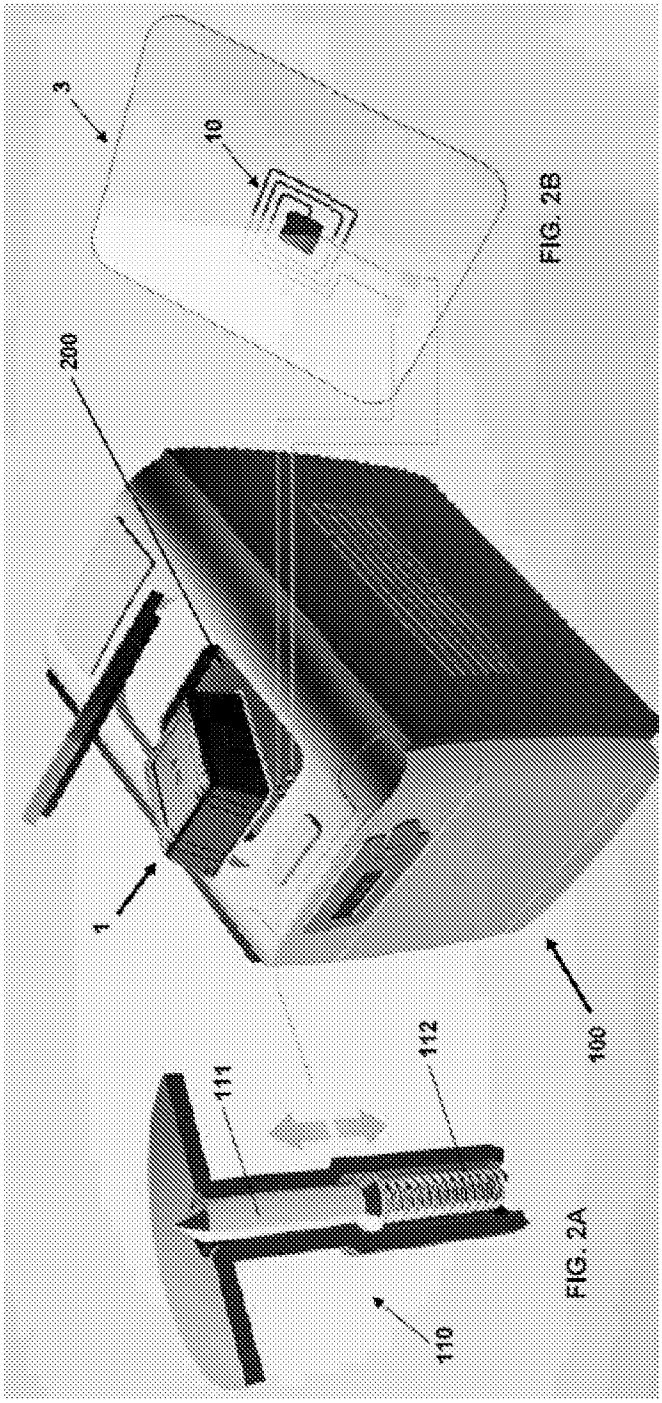

FIG. 2B

FIG. 1

FIG. 2A

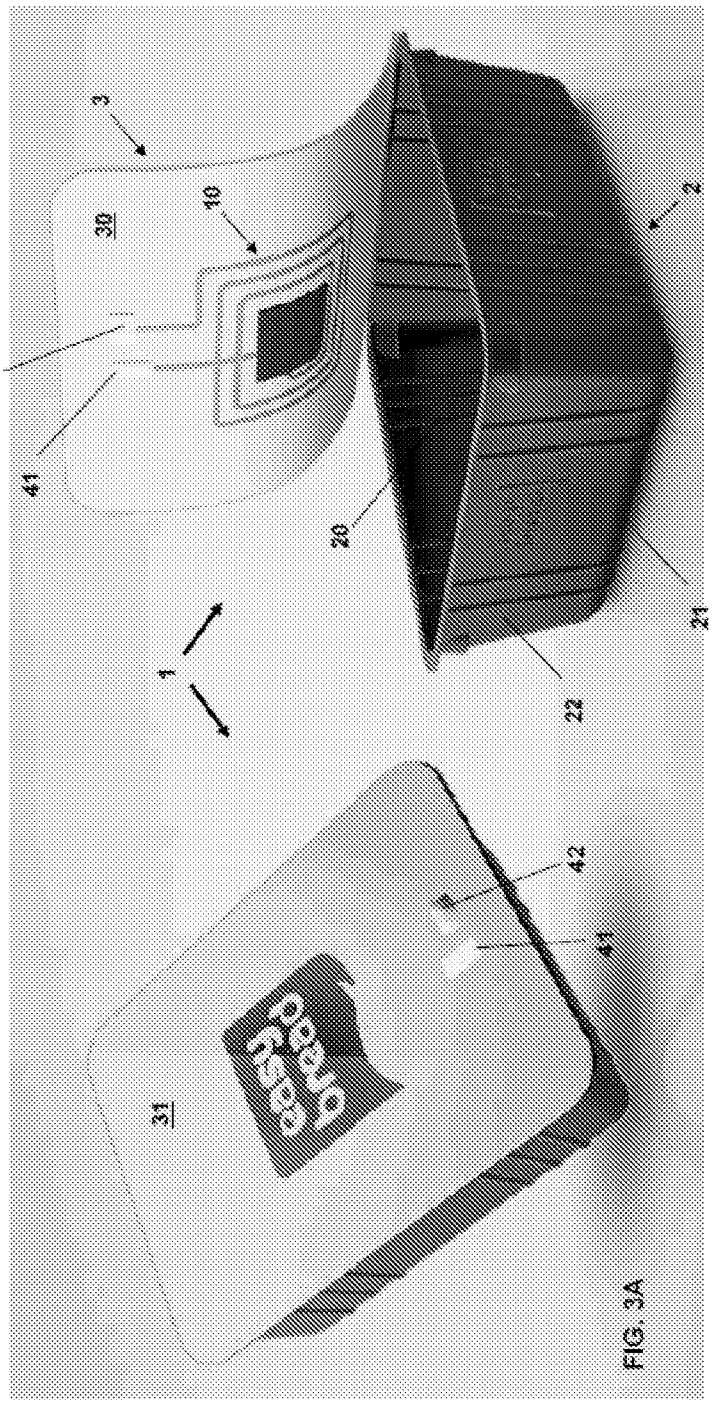

FIG. 3A

FIG. 3B

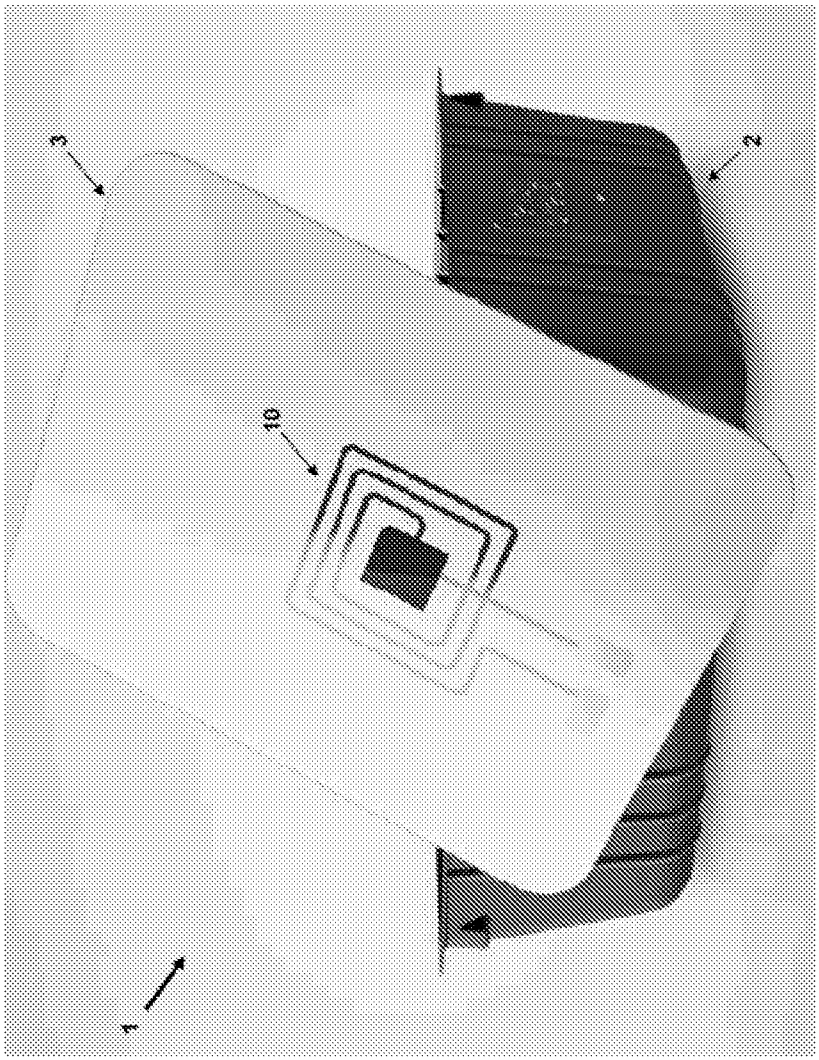

FIG. 4

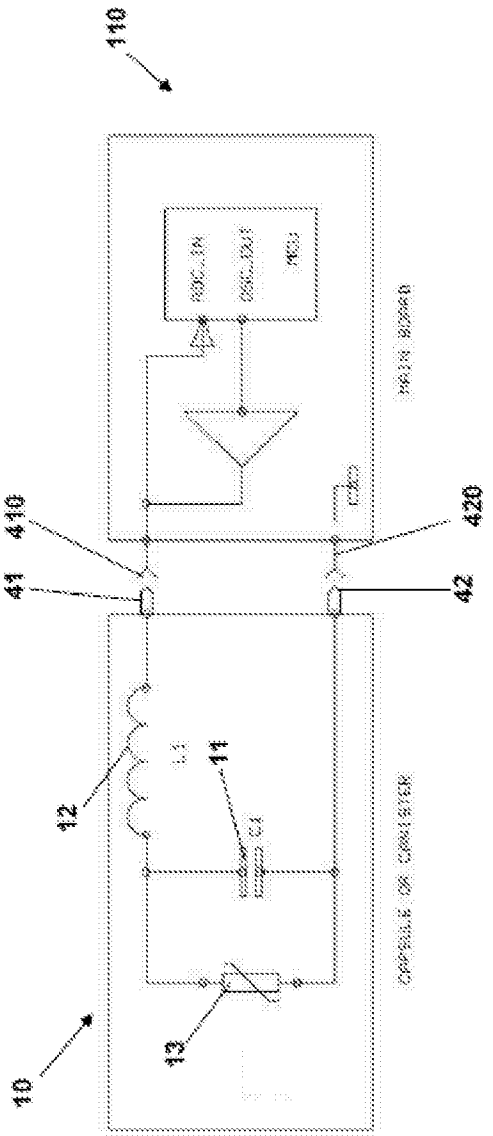

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/051770

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65D85/804
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2014/006048 A2 (UNILEVER PLC [GB]; UNILEVER NV [NL]; CONOPCO INC DBA UNILEVER [US]) 9 January 2014 (2014-01-09)	1,2,5,6, 8-12,14
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X	WO 2012/000878 A2 (NESTEC SA [CH]; PERENTES ALEXANDRE [CH]; YOAKIM ALFRED [CH]; AIT BOUZI) 5 January 2012 (2012-01-05)	1-6,8-14
A	the whole document	7

A	WO 2013/046149 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]) 4 April 2013 (2013-04-04) figure 6; example 11	1-14

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 May 2015	01/06/2015

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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