

(19)



(11)

EP 2 733 250 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.05.2014 Bulletin 2014/21

(51) Int Cl.:
D06F 39/08 (2006.01)
D06F 58/28 (2006.01)
D06F 58/24 (2006.01)
D06F 35/00 (2006.01)

(21) Application number: **13193074.5**

(22) Date of filing: **15.11.2013**

(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

(72) Inventors:
• **Zimar, Alessio**
60030 Castelbellino (AN) (IT)
• **Colucci, Nicola**
60044 Fabriano (AN) (IT)

(30) Priority: **19.11.2012 IT PR20120078**

(74) Representative: **Santonicola, Paolo**
Indesit Company S.p.A.
Industrial Property Management Team
Via Lamberto Corsi, 55
60044 Fabriano (AN) (IT)

(71) Applicant: **Indesit Company S.p.A.**
60044 Fabriano (AN) (IT)

(54) **Method of activation of a solenoid valve**

(57) A method of activation of a solenoid valve (2) for loading a liquid into a washing and/or drying compartment (3). The method comprises the step of causing a

first series of openings in succession of the solenoid valve (2) in order to allow the passage of a liquid. The openings of the first series each last less than 0.5 seconds.

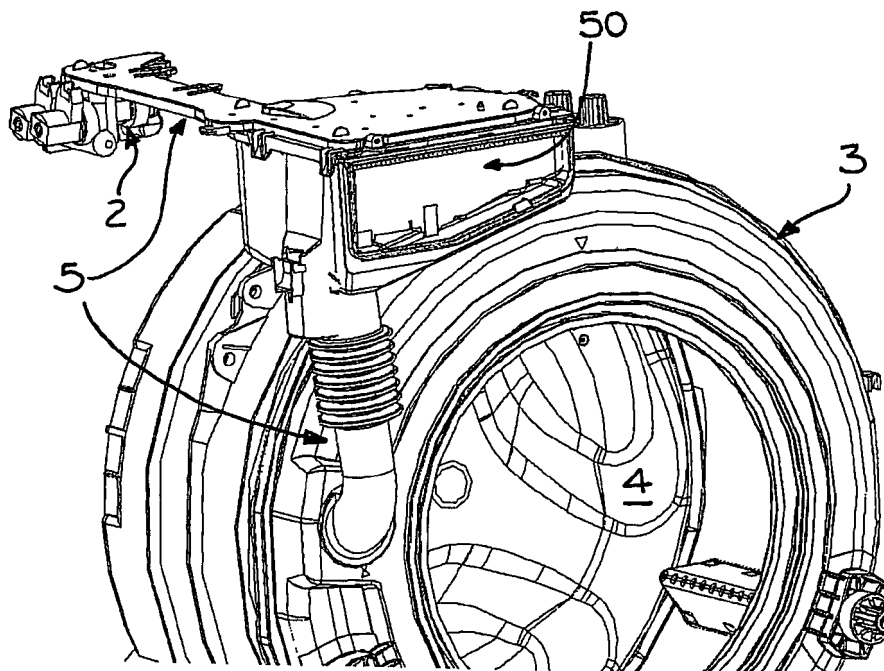


Fig. 2

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Description

[0001] The present invention relates to a method of activation of a solenoid valve for loading a liquid into a washing and/or drying compartment, said compartment being part of a domestic laundry washing and/or drying machine.

[0002] A method is known that envisages the activation of a solenoid valve of a washing machine in predetermined steps of the washing cycle. Such activation typically occurs at the start of the washing cycle during the washing liquid loading step. The activation also takes place at the start of every rinse.

[0003] In that case the solenoid valve remains open for a plurality of seconds (e.g. 15-40 seconds). This data may vary according to the type of cycle selected, the washing machine in use and whether it is in the washing or the rinsing step. In that case, the water of the solenoid valve flows into a washing compartment from above, wetting a rotating drum contained in the compartment (and the laundry contained in the drum). The water accumulates on the bottom of the compartment determining an increase in the water level up to a pre-established value. In this way at the start of the wash or rinse, various litres of water are introduced.

[0004] In this context, the object of the present invention is to provide a method of activation of a solenoid valve for loading a liquid into a washing and/or rinsing compartment that prevents wetting the laundry contained in the washing compartment.

[0005] The stated technical objective and the specified aims are substantially attained by a method of activation of a solenoid valve, comprising the technical characteristics set forth in one or more of the appended claims. Further characteristics and advantages of the present invention will become more apparent from the following indicative, and hence non-limiting, description of a preferred, but not exclusive, embodiment of a household electrical appliance implementing a method according to the present invention and illustrated in the appended drawings, in which:

- Figure 1 shows a perspective view of a household electrical appliance that implements the method according to the present invention;
- Figure 2 shows a perspective view of some components of the household electrical appliance of Figure 1;
- Figure 3 shows a section view of some components of Figure 2.

[0006] The subject matter of the present invention is a method of activation of a solenoid valve 2 for loading a liquid into a washing and/or drying compartment 3, said compartment 3 being part of a domestic laundry washing and/or drying machine 1. In particular the household electrical appliance 1 comprises a rotating drum 4 for housing the laundry. The drum 4 is placed inside the compartment

3. Appropriately the drum 4 is perforated.

[0007] The method comprises the step of determining a first series of openings in succession of the solenoid valve 2 to allow the transit through the solenoid valve 2 of a liquid (normally water; in some cases water with chemical detergents added to aid the washing). The step of determining a first series of openings envisages sending predetermined electric pulses for opening the solenoid valve 2. Every opening of said first series is associated with one of said predetermined electric pulses. Without said predetermined electric pulses the solenoid valve 2 closes. Each of said predetermined electric pulses that determine the first series of openings lasts less than 0.5 seconds, preferably less than 0.3 seconds. The effective opening duration of the solenoid valve 2 may differ from the duration of the electric pulse due to the inertia of the solenoid valve 2. In particular, upon receipt of the pulse the solenoid valve 2 may have an opening delay and when the pulse stops it may have a closing delay. Preferably the openings of the first series each last less than 0.5 seconds. Appropriately the openings of the first series last less than 0.3 seconds; preferably the openings of said first series last 0.2 seconds. Preferably, but not necessarily, the openings of the first series have the same duration. In the expression "opening of the first series" the adjective "first" has the sole purpose of identifying a group of predetermined openings without excluding the fact that such openings may be subsequent to other openings.

[0008] Preferably there are at least three openings in the first series (but there could also be many more). The opportunity to repeatedly open the solenoid valve 2 is connected with the fact that it is necessary to introduce a substantial predetermined quantity of liquid in small doses. As will be more fully explained below, by introducing the liquid in small doses it is possible to prevent a trickle of water being introduced into the tank in the form of a cascade with the risk that it hits the laundry contained in the compartment 3. In particular the detachment of the confined flow running along the walls of the compartment 3 is prevented (with small doses of liquid the surface tension makes the confined flow adhere to the walls of the compartment 3).

[0009] Each of said openings in said first series determines the passage of a quantity of liquid less than 1 decilitre, preferably less than 0.5 decilitres. Preferably the closing intervals of the solenoid valve 2 have the same duration.

[0010] The liquid that transits through the solenoid valve 2 in each opening of the first series flows along at least one delimitation wall 30 of the compartment 3. In this way it enters the compartment 3 but without wetting the rotating drum 4 for housing laundry contained in the compartment 3 and/or the laundry contained in the drum 4. In fact, by introducing the liquid in small quantities the surface tension contributes to keeping the liquid adherent to the delimitation wall 30.

[0011] The step of determining a first series of open-

ings in succession of the solenoid valve 2 envisages actuating the same solenoid valve 2 also used for loading the washing liquid during a previous implementation of a washing cycle.

[0012] In the preferred solution the solenoid valve 2 is placed along a conduit 5 which leads into said compartment 3. Appropriately the liquid dispensed by the solenoid valve 2 flows along said conduit 5 to the compartment 3 due to gravity. Appropriately along the conduit 5 between the solenoid valve 2 and the compartment 3 there is a drawer for introducing detergents and aiding agents for the washing, accessible by the user (Figure 2 illustrates a housing 50 of the drawer). In an alternative non-preferred solution, the solenoid valve 2 could however also lead directly into the compartment 3. There are many applications of the activation method of the solenoid valve 2. For example a first application allows the drying of laundry through the household electrical appliance 1 to be facilitated. On this point, the subject matter of the present invention is also a laundry drying method comprising the step of implementing the activation method of a solenoid valve 2 having one or more of the characteristics described above. The liquid introduced in the step of determining a first series of openings in succession of the solenoid valve 2 determines the cooling of said at least one delimitation wall 30 of the compartment 3. Consequently the condensation of at least a part of the moisture contained in the compartment 3 occurs. Typically said moisture is caused by the presence in the drum 4 of damp laundry. The, at least partial, condensation of moisture on the wall 30 therefore facilitates the drying of the laundry to the extent as to make a condenser placed along an extraction conduit of a fluid from the compartment 3 useless (or at least allowing it to be made smaller with respect to the solution wherein there is no condensation in the compartment 3; in particular, condensation in the compartment 3 allows the use of a solenoid valve to regulate the supply of a coolant into a dedicated condenser to be prevented). In such an embodiment the openings of said first series are staggered by closing intervals of the solenoid valve 2 lasting between 45 and 75 seconds. Appropriately the openings of said first series affect the whole duration of the drying cycle (staggered by closing periods of the solenoid valve 2).

[0013] A further application of the method of activation of the solenoid valve is that of allowing the cooling of the compartment 3. Such a situation could be useful in the event of a fault that leads to the overheating of the compartment 3. On this point part of the present invention is a cooling method of the compartment 3 comprising the step of implementing the method of activation of a solenoid valve 2 having one or more of the characteristics described above.

[0014] Appropriately such a cooling method may be activated by the detection, through a sensor, of a temperature in the compartment 3 over a predetermined value. Such a temperature could therefore be associated

with an operating fault. Appropriately in some cases the detection of such temperature value could also cause the rotation of the drum 4 to stop.

[0015] A further application of the method of activation of the solenoid valve 2 could be the implementation of special garment treatment cycles.

[0016] On this point, the subject matter of the present invention is a method for treating garments. This method comprises the step of implementing the activation method of a solenoid valve 2 having one or more of the characteristics indicated above. The step of implementing the method of activation of the solenoid valve 2 allows a quantity of liquid to be introduced into the compartment 3 such that:

- the level covers an electric heating resistance of the liquid, the resistance being inside the compartment 3;
- the level does not reach the rotating drum 4.

[0017] Preferably, the openings of said first series are staggered by closing intervals of the solenoid valve 2 lasting less than 2 seconds. Appropriately, this corresponds to the fact that the predetermined opening pulses of the solenoid valve 2 are staggered by intervals lasting less than 2 seconds. The garment treatment method further comprises the step of vaporising the liquid loaded into the compartment 3 during said first series of openings. The step of vaporising the liquid comprises the step of heating the liquid contained in the compartment 3 using the above-indicated resistance.

[0018] The step of heating the liquid takes place after the liquid has been introduced through the solenoid valve 2. The treatment method of the garments advantageously comprises the step of causing a second series of openings of the solenoid valve 2 to introduce a further quantity of liquid for the purpose of compensating for the vaporisation of the liquid contained in the compartment 3 by the resistance. Appropriately the step of performing a second series of openings is controlled by a temperature sensor. In fact, when the level of liquid in the compartment 3 drops, the temperature detected by the temperature sensor increases (the liquid contained in the container allows the heat generated by the resistance to be absorbed). Appropriately also during the second series of openings, the activation pulses of the solenoid valve 2 last less than 0.5 seconds. Appropriately the treatment method of the garments indicated above allows a treatment method to be performed for removing odours from garments. For example, it allows garments to be refreshed without performing an actual wash (in particular without immersing the garments in a liquid). This makes such a treatment particularly effective for delicate garments.

[0019] The invention as it is conceived enables multiple advantages to be attained.

[0020] In particular, it allows a liquid to be introduced into the compartment 3 without it wetting the laundry. It

allows a gentle treatment to be performed on the garments while preventing them from getting wet, but simply allowing a light dampening thereof for the purpose of refreshing and/or deodorising them.

[0021] Furthermore, the introduction of liquid into the compartment 3 without it wetting the laundry may be advantageously used to facilitate condensation in the compartment 3 (allowing savings to be made on the costs of the condenser, but also on the necessary energy for cooling a coolant inside the condenser).

[0022] The invention as conceived is susceptible to numerous modifications and variants, all falling within the scope of the inventive concept characterised thereby. Furthermore all the details can be replaced by other technically equivalent elements. In practice, all the materials used, as well as the dimensions, can be any according to requirements.

Claims

1. A method of activation of a solenoid valve (2) for loading a liquid into a washing and/or drying compartment (3), said compartment being part of a domestic laundry washing and/or drying machine (1) and containing a rotating drum (4) for housing the laundry; said method being **characterised in that** it comprises the step of determining a first series of openings in succession of the solenoid valve (2) so as to allow the transit through the solenoid valve (2) of a liquid; the step of determining a first series of openings envisaging sending predetermined electric pulses to open the solenoid valve (2); each opening in said first series being associated with one of said predetermined electric pulses, without said predetermined electric pulses the solenoid valve (2) closing; each of said predetermined electric pulses lasting less than 0.5 seconds.
2. The method according to claim 1, **characterised in that** there are at least three openings in said first series; the openings in the first series each lasting less than 0.5 seconds.
3. The method according to any of the previous claims, **characterised in that** each of said openings in said first series determines the passage of a quantity of liquid less than 1 decilitre.
4. The method according to any one of the previous claims, **characterised in that** said step of determining a first series of openings in succession of the solenoid valve (2) envisages actuating the same solenoid valve (2) also used for loading a washing liquid during a previous implementation of a washing cycle.
5. The method according to any one of the previous claims, **characterised in that** the solenoid valve (2) is positioned along a conduit (5) that leads into said compartment (3).
6. The method according to any one of the previous claims, **characterised in that** the liquid that flows through the solenoid valve (2) in each opening in the first series flows along at least one delimitation wall (30) of the compartment (3) without wetting said rotating drum (4) for housing laundry contained in the compartment (3) or the laundry contained in the drum (4).
7. A laundry drying method comprising the step of implementing the activation method of a solenoid valve (2) according to any of claims 1 to 6, the liquid introduced in the step of determining a first series of openings in succession of the solenoid valve (2) determining the cooling of said at least one delimitation wall (30) and the condensation of at least a part of the moisture contained in the compartment (3) and determined by the presence in the drum (4) of damp laundry.
8. The drying method according to claim 7, **characterised in that** the openings in said first series are staggered by closing intervals of the solenoid valves (2) lasting between 45 and 75 seconds.
9. A cooling method of the compartment (3) comprising the step of implementing the activation method of a solenoid valve (2) according to any of claims 1 to 6.
10. A method of treating garments comprising the steps of:
 - implementing the activation method of a solenoid valve (2) according to any of claims 1 to 6; the step of implementing said activation method envisaging introducing into the compartment (3) a quantity of liquid so that the level covers an electrical heating resistance of the liquid placed in the compartment (3) but without reaching the rotating drum (4);
 - vaporising at least a part of the liquid loaded into the compartment (3) during said first series of openings; the step of vaporising the liquid comprising the step of heating the liquid contained in the compartment (3) using said heating resistance.
11. The treatment method according to claim 10, **characterised in that** said predetermined opening pulses of the solenoid valve are staggered by intervals lasting less than 2 seconds.

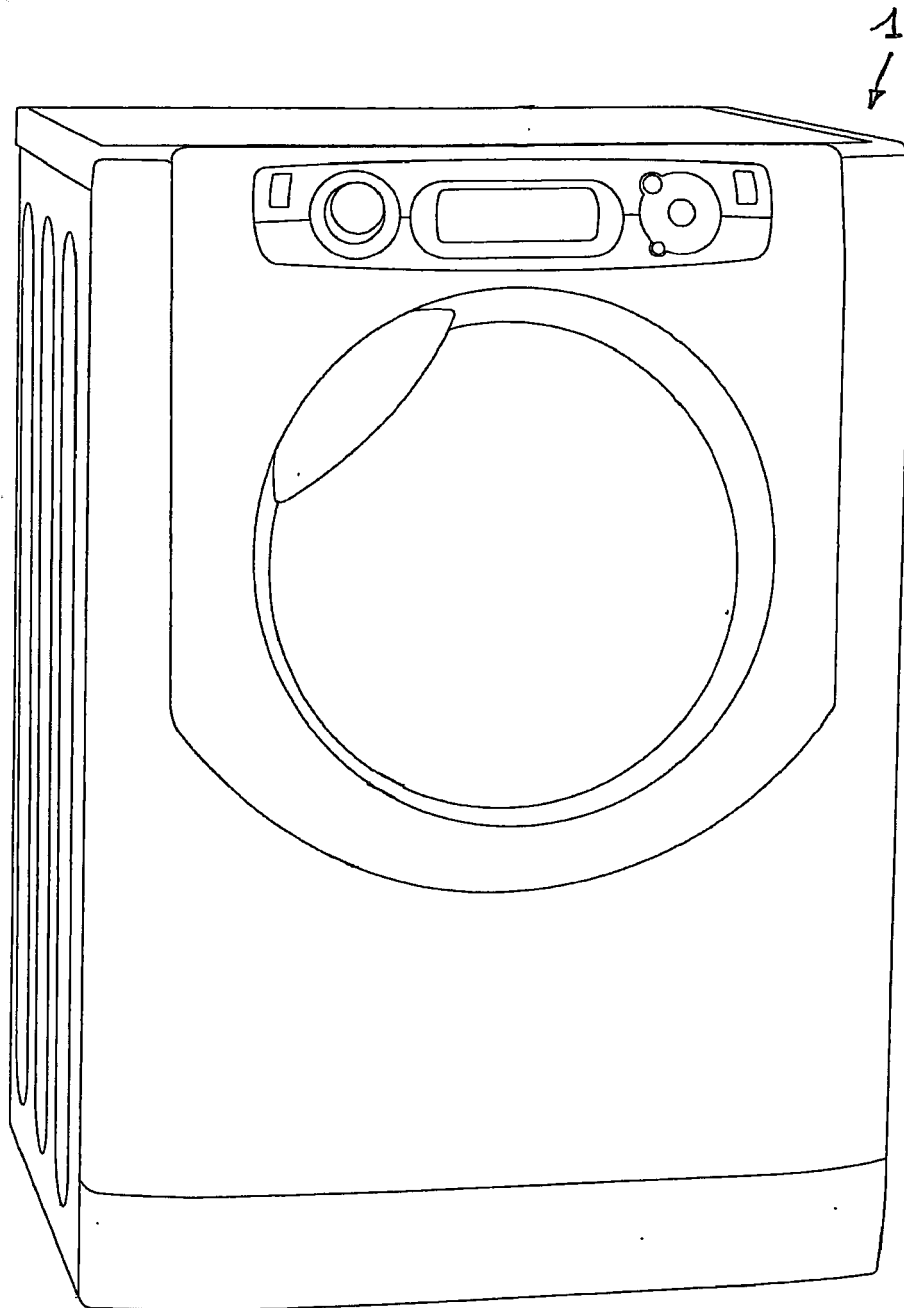


Fig. 1

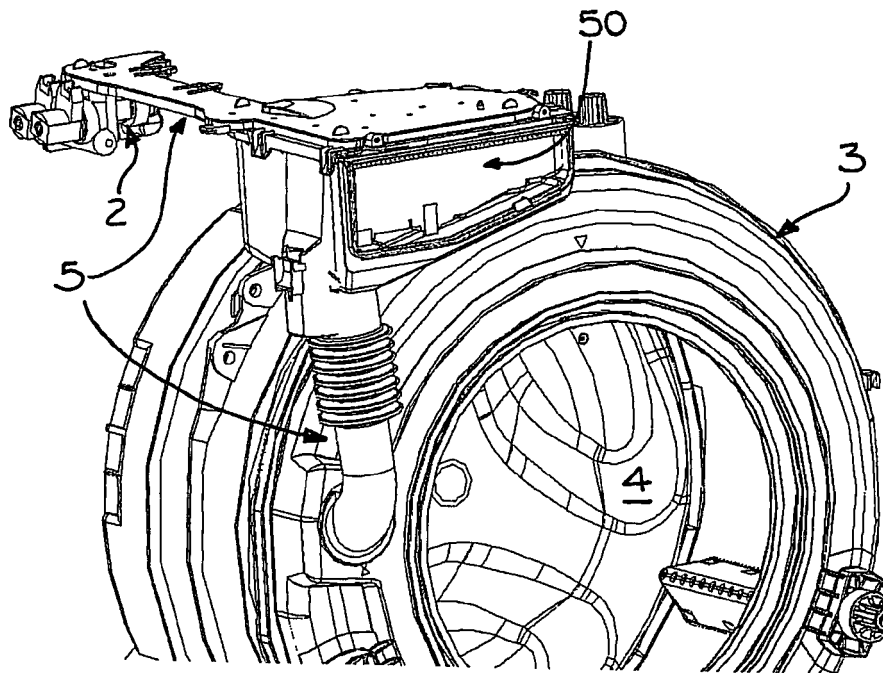


Fig. 2

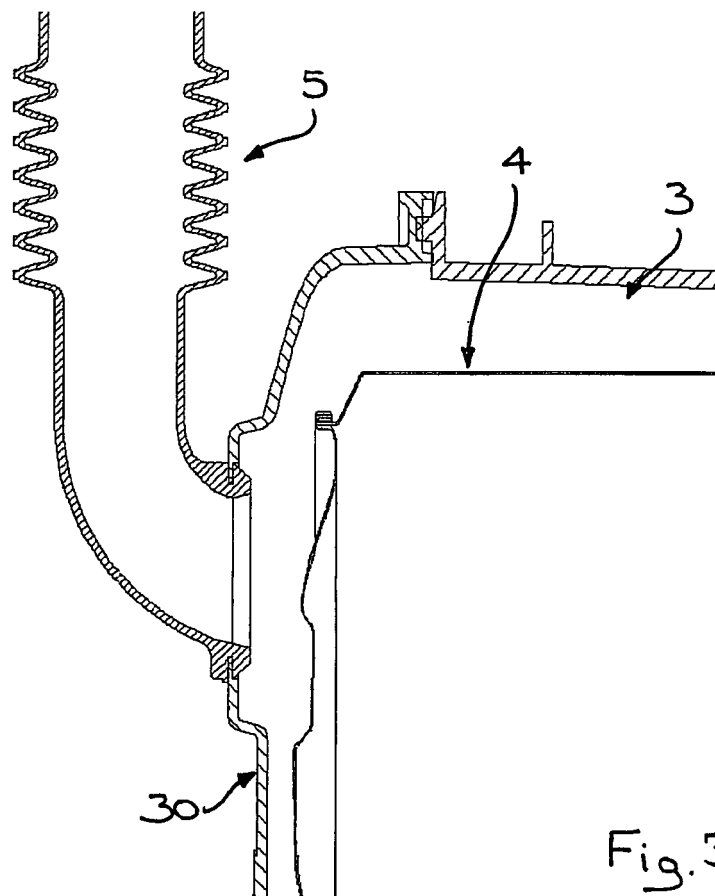


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 13 19 3074

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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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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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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