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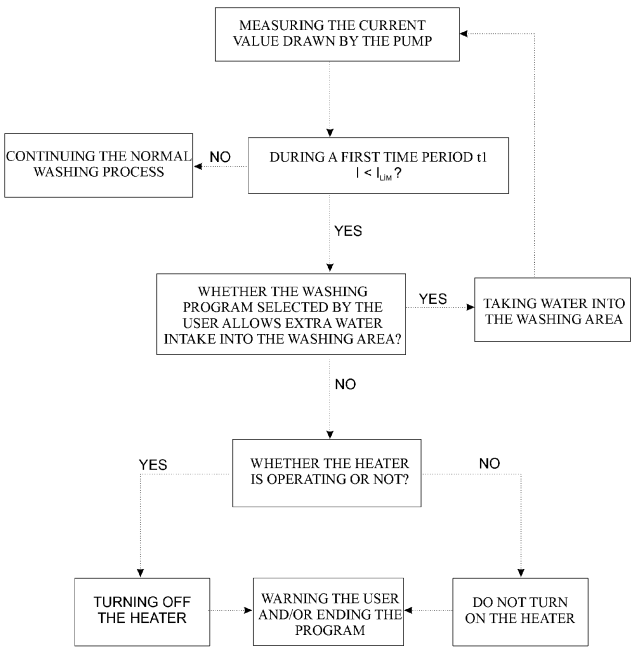
(54) **A DISHWASHER WITH INCREASED SECURITY AND THE CONTROL METHOD THEREOF**

(57) The present invention relates to a dishwasher (1) comprising a body (2); a washing area (3) that is arranged in the body (2) and wherein the dishes are placed and washed; a heater (4) that is disposed at the floor/base of the washing area (3) and that enables the wash water to be heated; a pump (5) that realizes the cycle of the wash water in the washing area (3); and a control unit (6) that controls the heater (4) and monitors the current (I) drawn by the pump (5) and that decides that the pump (5) is out of water if the drawn amount of the current (I) is less than a predetermined limit current value (I_{lim}) during a predetermined first limit time period (t1).

Figure 3



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Description

[0001] The present invention relates to a dishwasher that comprises a heater that is used in the washing of the dishes and a pump that provides the cycle of the washing water.

[0002] Since the energy and water resources are being depleted, energy and water saving is aimed in dishwashers like in every household appliance. With the increasing competition, dishwashers that consume less and less water are launched in the market. By spraying the water in the dishwashers onto the dishes in a pressurized manner, containers and pots that are being washed can turn upside down. In this situation, wash water may fill in the container. When a similar situation occurs in the dishwashers that wash dishes with less water, the water level in the dishwasher can significantly get low. In such a situation, the pump that realizes the cycle of the washing water can be out of water. Moreover, the heater that provides the heating of the washing water may cause fire by overheating since sufficient water is not available. In order that the washing process is realized in a proper and secure manner, the situations wherein the water level in the dishwasher gets low should efficiently be detected.

[0003] In the state of the art European Patent Application No. EP1737332, a dishwasher is disclosed, comprising a control unit that monitors the current value drawn by the circulation pump, thus that detects whether the pump is out of water and the filter is clogged according to this value.

[0004] In the state of the art Korean Patent Application No. KR20080087600, a micro switching element is disclosed that is used in the detection of the water level; and a dishwasher is disclosed wherein the heater is controlled according to the data received from the said micro switching element.

[0005] In the state of the art Korean Patent Application No. KR20140014744, a dishwasher is disclosed, wherein the heater is prevented from overheating when idle due to low water level.

[0006] In the state of the art Korean Patent Application No. KR20100048467, a dishwasher is disclosed, comprising a heater disposed at the base of the washing area, wherein the heater is prevented from overheating due to low water level.

[0007] The aim of the present invention is the realization of a dishwasher of which the security is improved while operating in low water level.

[0008] The dishwasher realized in order to attain the aim of the present invention, explicated in the claims, comprises a control unit that decides whether the pump is out of water by monitoring the current value drawn by the circulation pump and that delays the operation of the heater for the security of the heater when the pump is out of water. By means of the present invention, the decision whether the water level gets below the level that the pump can operate normally can be made only by monitoring the amount of the current the pump draws without the need for the use of any level sensor to determine the water level in the dishwasher. Since the water level in this situation is also below the level that the heater can operate normally, when the pump is detected to be out of water, it is also detected that the heater cannot operate under normal circumstances. The control unit prevents the heater from overheating by delaying the operation of the heater when the water level stays below the heater level for a certain amount of time.

[0009] In an embodiment of the present invention, the control unit does not operate the heater if the pump is out of water for a predetermined time period. In this embodiment, if the water level stays below the required level preferably for a long period of time in any way, it is aimed to prevent possible problems by not operating the heater.

[0010] In another embodiment of the present invention, the control unit enables the heater to be turned off if the pump is out of water for a predetermined time period when the heater is operating. In addition to the above-explained embodiment, if the water level is detected to get low when the heater is being operated, a secure washing is realized by turning off the heater.

[0011] In another embodiment of the present invention, the control unit enables the user to be warned if the pump is out of water for a predetermined time period. By means of this embodiment, the user is warned when the pump is out of water due to the low water level and the heater cannot be operated, and thus the user is informed about the washing cycle not being completed.

[0012] In another embodiment of the present invention, the control unit enables extra water intake into the dishwasher if the pump is out of water for a predetermined time period. If the program selected by the user for the washing process does not have a predetermined limit value for water consumption, the control unit provides extra water intake into the dishwasher for the solution after the problem is detected.

[0013] In another embodiment of the present invention, the control unit provides extra water intake into the dishwasher until the pump draws more current than the predetermined limit current value.

[0014] The control method of the present invention comprises the steps of measuring the current value drawn by the pump; controlling whether the current value of the pump stays below the limit current value during the first limit time period; continuing the normal washing process if the pump draws more current than the limit current value; controlling whether extra water should be taken if the pump draws less current than the limit current value; taking extra water if extra water can be taken; controlling whether the heater operates if extra water cannot be taken; shutting off the heater if the heater operates; not operating the heater if the heater does not operate, and ending the program by warning the user.

[0015] In the dishwasher of the present invention, the decrease in the wash water in any way is detected by taking into consideration the amount of the current drawn

by the pump without using any extra level sensors, etc for the measuring of the water level used in the washing. The control unit prevents the heater from overheating by interfering the operation of the heater when the pump is out of water, and a possible fire is prevented.

[0016] The dishwasher realized in order to attain the aim of the present invention is illustrated in the attached figures, where:

Figure 1 - is the perspective view of a dishwasher.
Figure 2 - is the schematic view of the dishwasher related to an embodiment of the present invention.
Figure 3 - is the flow chart of the control method of the present invention.

[0017] The elements illustrated in the figures and the steps are numbered as follows:

1. Dishwasher
2. Body
3. Washing area
4. Heater
5. Pump
6. Control unit

[0018] The following symbols are used so that the present invention is understood better:

I. Current value drawn by the pump
I_{lim}. Limit current value
t1. First limit time period
t2. Second limit time period
t3. Third limit time period
t4. Fourth limit time period
t5. Fifth limit time period
t6. Sixth limit time period

[0019] The dishwasher (1) comprises a body (2); a washing area (3) that is arranged in the body (2) and wherein the dishes are placed and washed; a heater (4) that is disposed at the floor/base of the washing area (3) and that enables the wash water to be heated; a pump (5) that realizes the cycle of the wash water in the washing area (3); and a control unit (6) that controls the heater (4) and monitors the current (I) drawn by the pump (5) and that decides that the pump (5) is out of water if the drawn amount of the current (I) is less than a predetermined limit current value (I_{lim}) during a predetermined first limit time period (t1).

[0020] In the dishwasher (1), the user places the dishes to be washed into the rack (not shown in the figures) disposed in the washing area (3). Then, the control unit (6) provides water intake into the washing area (3) and the cycle of the taken water inside the washing area (3) by controlling the pump (5), in other words, enables the dishes to be washed by sending the water taken to the spray arms (not shown in the figures). The heating of the water used in the washing is realized by the heater (4) disposed in the floor of the washing area (3) being energized by the control unit (6). The water occupies a certain volume in the washing area (3) so as to cover the heater (4) at the base of the washing area (3), and the heater (4) heats the water located at the base of the washing area (3).

[0021] The control unit (6) decides whether the pump (5) is out of water/pumps enough amount of water by monitoring the current drawn by the pump (5). When the volume of the water at the base of the washing area (3) decreases, the amount of the water passing through the pump (5) for the realization of the cycle decreases. The amount of the water that the pump (5) circulates and the power consumed by the motor (not shown in the figures) that enables the pump (5) to realize its function are in direct proportion with each other. When the amount of the water passing through the pump (5) gets low, the resistance on the pump (5) motor (not shown in the figures) gets lower and the pump (5) draws less current. Thus, the control unit (6) continually monitors the current value drawn by the pump (5), and decides whether the pump (5) realizes the cycle of enough amount of water according to the decrease in the current value. Since the pump (5) is disposed preferably in the lower portion of the washing area (3), in case the pump (5) cannot pump enough water, it is understood that the water in the washing area (3) has decreased, and the water level stays below the heater (4) level.

[0022] The control unit (6) decides that the pump (5) is out of water if the amount of the current (I) drawn by the pump (5) is less than a predetermined limit current value (I_{lim}) during a predetermined first limit time period (t1). As a result of the experiments performed by the producer, the producer determines the current value (I) drawn by the pump (5) as the limit current value (I_{lim}) wherein the pump (5) is out of water within a certain interval in case the pump (5) is out of water, in other words in case not enough water passes through the pump (5). The control unit (6) monitors the current value (I) drawn by the pump (5) during the washing process and decides that the pump (5) is out of water when the said current value (I) stays below the predetermined limit current value (I_{lim}) during the first limit time period (t1).

[0023] The control unit (6) of the dishwasher (1) of the present invention delays the operation of the heater (4) when the pump (5) operates without water during a predetermined second limit period (t2). Since the water level in the washing area (3) also stays below the heater (4) level when the pump (5) is out of water, the control unit (6) delays the operation of the heater (4) preferably until the problem is solved.

[0024] In an embodiment of the present invention, the control unit (6) does not operate the heater (4) when the pump (5) operates without water during a predetermined third limit time period (t3). If the pump (5) is out of water during the third limit time period (t3) that is preferably longer than the first and the second time periods, the control unit (6) does not operate the heater (4), thus pre-

venting possible security problems.

[0025] In another embodiment of the present invention, the control unit (6) enables the heater to be turned off (4) when the pump (5) operates without water during a predetermined fourth limit time period (t4) while the heater (4) operates. If the pump (5) is out of water during the fourth limit period (t4) that is predetermined by the producer and that is preferably the maximum time period in which the heater (4) can safely operate when the washing process properly starts and while the control unit (6) enables the wash water to be heated by operating the heater (4), the control unit (6) enables the heater (4) to be turned off.

[0026] In another embodiment of the present invention, the control unit (6) enables the user to be warned if the pump (5) operates without water for a predetermined fifth limit time period (t5). In this embodiment1, if the pump (5) cannot realize the cycle of enough water during the fifth limit time period (t5) that is preferably longer than the time periods mentioned in the above-mentioned embodiments, the control unit (6) enables the user to be warned.

[0027] In another embodiment of the present invention, the control unit (6) provides water intake into the washing area (3) if the pump (5) operates without water for a predetermined sixth limit time period (t6). In this embodiment, if the washing program selected by user does not have a consumption amount of water that is guaranteed by the producer, the control unit (6) provides water intake into the washing area (3) in order that the water level inside the washing area (3) increases and therefore both the pump (5) and the heater (4) operate in a proper way.

[0028] The time periods stated in the above-mentioned embodiments can be equal, different, or some of them equal and some of them different in different embodiments of the invention. For example, the first limit time period (t1) required to elapse in order that the pump (5) is decided to be out of water and the fourth limit time period (t4) during which the pump (5) is required to be out of water in order that the operating heater (4) is turned off may be equal in an embodiment of the present invention.

[0029] In another embodiment of the present invention, the control unit (6) provides water intake into the washing area (3) until the pump (5) draws current that is equal to or more than the predetermined limit current value (I_{lim}). In this embodiment, the control unit (6) provides extra water intake into the washing area (3) until the water level in the washing area (3) reaches the level at which the pump (5) can normally operate, in other words until the pump (5) draws current that is equal to or more than the predetermined limit current value (I_{lim}).

[0030] The control method of the present invention used in the above-disclosed dishwasher (1) and executed by the control unit (6), comprises the following steps for determining the water level in the washing area (3),

- measuring the current value (I) drawn by the pump (5) when the pump (5) performs the water cycle,
- comparing the current value (I) drawn by the pump (5) with the limit current value (I_{lim}) during a first limit time period (t1),
- continuing the normal washing process if the pump (5) draws more current than the amount of the limit current (I_{lim}) during the first limit time period (t1),
- controlling whether the washing program selected by the user allows extra water intake into the washing area (3) by deciding that the pump (5) is out of water if the pump (5) draws less current than the amount of the limit current (I_{lim}) during the first limit time period (t1),
- controlling whether the heater (4) is operating if the selected washing program does not allow extra water intake,
- turning off the heater (4) if the heater (4) operates,
- not turning on the heater (4) if the heater (4) does not operate,
- warning the user and ending the program,
- taking water into the washing area (3) if the selected washing program allows extra water intake,
- going back to the first step.

[0031] In the dishwasher (1) of the present invention, the current value (I) drawn by the pump (5) is monitored by the control unit (6) in order to measure the amount of the water in the washing area (3), in other words in order to detect the water level, and thus the need for using an extra level sensor is eliminated. The water level is decided to decrease with the pump (5) drawing less current. The pump (5) being out of water also means that the heater (4) is above the water level, in other words the heater (4) is without water. Therefore, the control unit (6) can also decide on the heater (4) by monitoring the current value (I) drawn by the pump (5) and operates the heater (4) so as to create no danger.

Claims

1. A dishwasher (1) comprising a body (2); a washing area (3) that is arranged in the body (2) and wherein the dishes are placed and washed; a heater (4) that is disposed at the floor/base of the washing area (3) and that enables the wash water to be heated; a pump (5) that realizes the cycle of the wash water in the washing area (3); and a control unit (6) that controls the heater (4) and monitors the current (I) drawn by the pump (5) and that decides that the pump (5) is out of water if the drawn amount of the current (I) is less than a predetermined limit current value (I_{lim}) during a predetermined first limit time period (t1), **characterized by** the control unit (6) that delays the operation of the heater (4) if the pump (5) operates without water during a predetermined second limit period (t2).

2. A dishwasher as in Claim 1, **characterized by** the control unit (6) that does not operate the heater (4) if the pump (5) operates without water during a predetermined third limit time period (t3).

3. A dishwasher as in Claim 1 or 2, **characterized by** the control unit (6) that enables the heater to be turned off (4) when the pump (5) operates without water during a predetermined fourth limit time period (t4) while the heater (4) operates.

4. A dishwasher as in Claim 1, 2 or 3, **characterized by** the control unit (6) that enables the user to be warned if the pump (5) operates without water for a predetermined fifth limit time period (t5).

5. A dishwasher as in Claim 1 or 2, **characterized by** the control unit (6) that provides water intake into the washing area (3) if the pump (5) operates without water for a predetermined sixth limit time period (t6).

6. A dishwasher as in Claim 5, **characterized by** the control unit (6) that provides water intake into the washing area (3) until the pump (5) draws current that is equal to or more than the predetermined limit current value (I_{lim}).

7. A control method used in a dishwasher (1) as in the above claims and executed by the control unit (6), comprising the steps of:

- measuring the current value (I) drawn by the pump (5) when the pump (5) performs the water cycle,
- comparing the current value (I) drawn by the pump (5) with the limit current value (I_{lim}) during a first limit time period (t1),
- continuing the normal washing process if the pump (5) draws more current than the amount of the limit current (I_{lim}) during the first limit time period (t1),
- controlling whether the washing program selected by the user allows extra water intake into the washing area (3) by deciding that the pump (5) is out of water if the pump (5) draws less current than the amount of the limit current (I_{lim}) during the first limit time period (t1),
- controlling whether the heater (4) is operating if the selected washing program does not allow extra water intake,
- turning off the heater (4) if the heater (4) operates,
- not turning on the heater (4) if the heater (4) does not operate,
- warning the user and/or ending the program,
- taking water into the washing area (3) if the washing program allows extra water intake,
- going back to the first step.

Figure 1

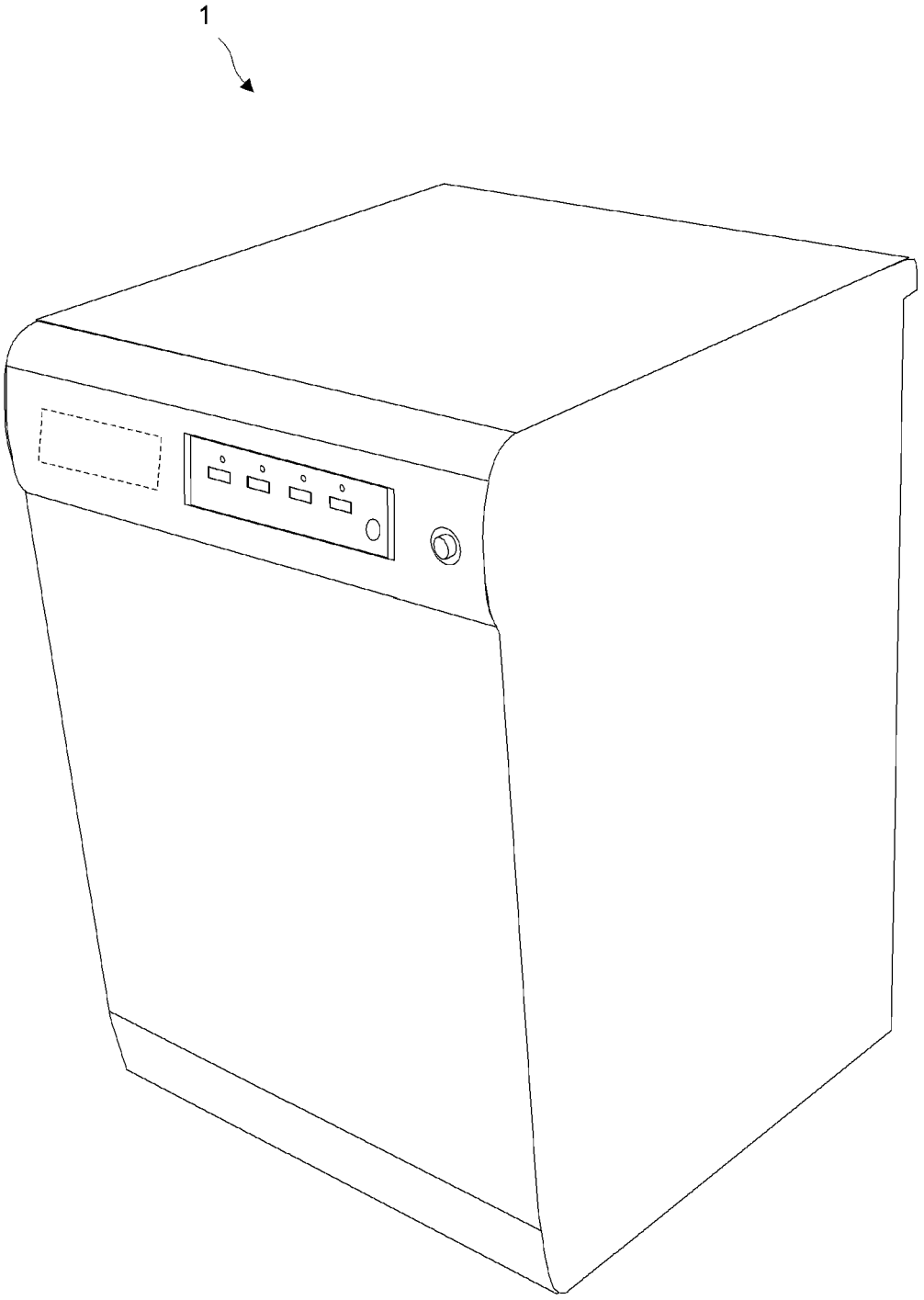


Figure 2

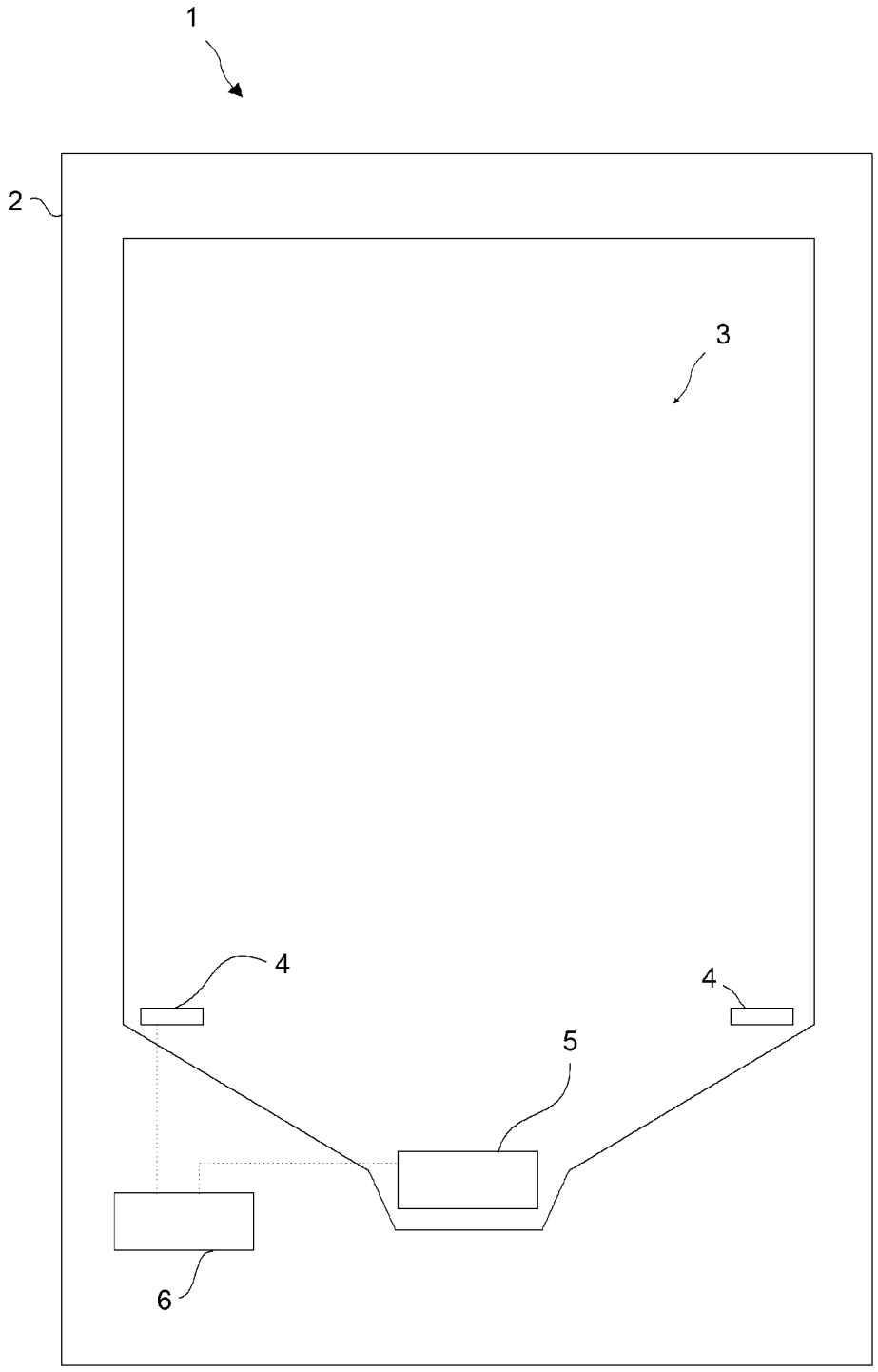
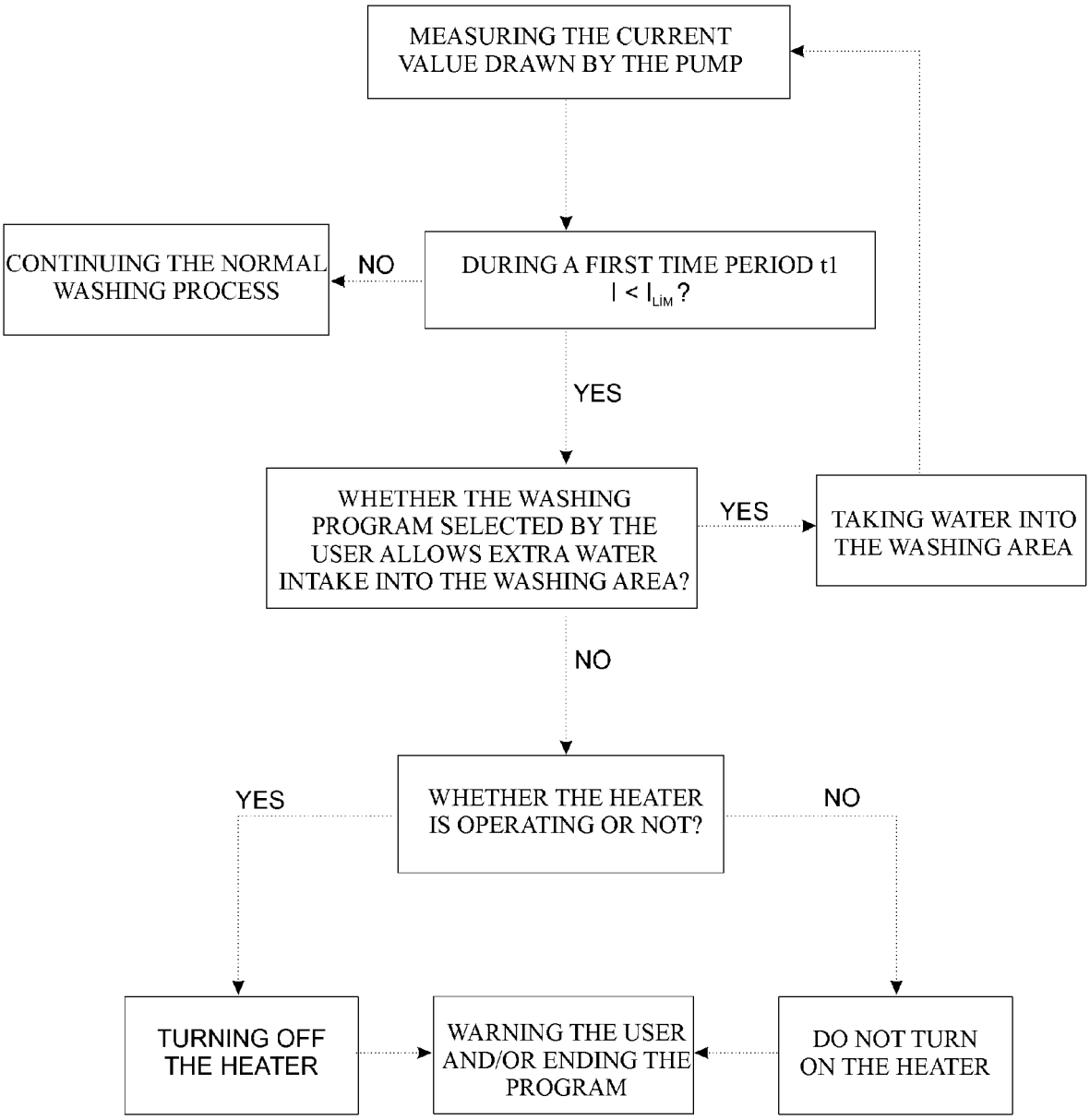


Figure 3


MEASURING THE CURRENT VALUE DRAWN BY THE PUMP
DURING A FIRST TIME PERIOD t1 I < I_LIM ?
NO
CONTINUING THE NORMAL WASHING PROCESS
YES
WHETHER THE WASHING PROGRAM SELECTED BY THE USER ALLOWS EXTRA WATER INTAKE INTO THE WASHING AREA?
YES
TAKING WATER INTO THE WASHING AREA
NO
WHETHER THE HEATER IS OPERATING OR NOT?
YES
NO
TURNING OFF THE HEATER
WARNING THE USER AND/OR ENDING THE PROGRAM
DO NOT TURN ON THE HEATER

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EUROPEAN SEARCH REPORT

Application Number
EP 16 18 4767

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 Y	US 2015/019026 A1 (FRYMAN MARK THOMAS [US] ET AL) 15 January 2015 (2015-01-15) * paragraph [0007] * * paragraph [0034] * * paragraph [0044] - paragraph [0075] * * paragraph [0082] - paragraph [0091]; claims 1,3,4,6; figures 2-4,8 *	1-3,5,6 4,7	INV. A47L15/00 A47L15/42
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TECHNICAL FIELDS SEARCHED (IPC)

A47L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	5 January 2017	Beckman, Anja

CATEGORY OF CITED DOCUMENTS

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REFERENCES CITED IN THE DESCRIPTION

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- KR 20140014744 **[0005]**
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