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(54) **Dishwasher and method for detecting malfunctions thereof**

(57) The invention relates to a method for detecting a malfunction situation of a dishwashing machine (1), which comprises a recirculation pump (31) and a drain pump (36) for a liquid contained in the tub (2).

The machine is also equipped with a control unit

(5,5') capable of acquiring and processing, at predetermined time intervals, at least one electromechanical quantity related to the operation of the motors of the pumps, so as to detect a malfunction situation, such as foam presence in the tub (2), water leakage from the drain and the like.

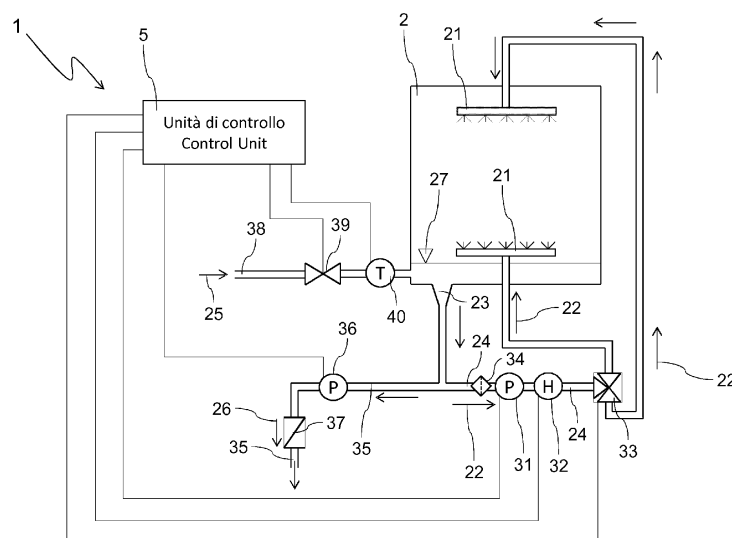


Fig. 1

Description

[0001] The present invention relates to a dishwashing machine and to a method for controlling the general operation thereof.

[0002] It is known that the components of a dishwasher (such as, for example, pressure switch, heating resistor, hoses and the like) are subject to wear due to ageing and/or corrosion. If a failure of one or more of these components is not immediately detected, e.g. through the use of automatic means, there is a high probability that the dishwasher will cause a flooding of the place where it is installed, with easily imaginable consequences.

[0003] In this regard, international patent application WO 2011/128176 A1 in the name of BSH et al. describes a solution for checking that the quantity of water contained in a tub of a dishwasher is correct. This solution is based on measuring the electric power absorbed by the motor of the recirculation pump, because the absorbed power value is a function of the quantity of water supplied into the tub.

[0004] The drawback of this solution is that it is only suitable for detecting an abnormal operating state of the machine during the water supply step, not during the entire wash cycle, when other abnormal states may arise which should be identified, such as, for example, a sudden water leakage, an improperly positioned pot, foam formation, clogged filters or the like.

[0005] An improvement over this state of the art is represented by the dishwasher with pulse width modulation (PWM) described in international patent application PCT/IB2005/052291.

[0006] In this case, the dishwasher allows detecting some malfunction situations, such as presence of excessive foam in the tub, clogged filter or presence of upturned pots or bowls, based on variations over time of electric parameters (voltage and current) related to the motor that drives the recirculation pump.

[0007] This dishwasher represents an improvement with respect to the previous ones but, as is often the case, improved performance gives rise to new drawbacks; indeed, the autonomous capability of diagnosing malfunctions offered by the dishwasher of patent application PCT/IB2005/052291 is accompanied by new problematic situations.

[0008] For example, the machine described in this prior art appears to be not able to discern situations wherein water circulation is prevented due to the presence of upturned pots or bowls or wherein there are leaks from the tub.

[0009] The present invention aims at solving these and other problems by providing a dishwasher having such structural and functional features as to allow for quickly and effectively checking its operating conditions.

[0010] This object is achieved through a dishwasher having the features set out in the claims appended to the present description; the invention also relates to a method for controlling a dishwasher, the steps of which are

also set out in the appended claims. The idea underling the present invention is to determine and/or estimate a set of known operating variables of a dishwasher upon activation of one or more motors comprised in said dishwasher, including the motor associated with the drain pump, thereby creating *de facto* a virtual sensor and detecting in the shortest possible time, by means of said virtual sensor, any malfunction and/or incorrect use of the household appliance during the entire wash cycle.

[0011] The features of the present invention are set forth in the appended claims.

[0012] These features as well as further advantages of the present invention will become more apparent from the following description of an embodiment thereof as shown in the annexed drawings which are provided by way of non-limiting example, wherein:

Fig. 1 shows a hydraulic diagram of a dishwasher according to the invention;

Fig. 2 shows a flow chart of a treatment program carried out by the dishwasher of Fig. 1;

Fig. 3 shows a state diagram relating to a finite-state machine comprised in the dishwasher of Fig. 1;

Fig. 4 shows a flow chart of a method for controlling the dishwasher of Fig. 1, used for determining a type of malfunction;

Fig. 5 is a graph showing the trend of operating variables of the dishwasher of Fig. 1 during a normal loading step of a washing cycle;

Figs. 6-8 are graphs showing the trends of the operating variables of the dishwasher of Fig. 1 in various malfunction conditions;

Fig. 9 shows a state diagram relating to a second finite-state machine comprised in a variant of the dishwasher of Fig. 1;

Fig. 10 is a graph showing the trend of the operating variables of the dishwasher of Fig. 1 during a liquid drain step.

[0013] With reference to Fig. 1, a dishwasher 1 according to the invention comprises a tub 2 wherein dishes are placed, which comprises one or more rotary sprayers 21 fed with a flow 22 running along a recirculation duct 24; said flow consists of a wash or rinse liquid pumped by a recirculation pump 31 and heated by a heater 32, both of which are comprised in the recirculation duct 24. In order to ensure a proper supply to the recirculation pump 31, said pump 31 comprises an intake duct in fluidic communication with a sump 23 located on the bottom of the tub 2 and capable of collecting the liquid. In addition, a filter 34 located in the sump 23 prevents any dirt from reaching the pump 31 and the heater 32. The delivery duct of the recirculation pump 31 is connected to a selection valve 33, which allows selecting the desired hydraulic circuit (in the case shown in Fig. 1, the selection valve 33 allows to feed a lower sprayer only, an upper sprayer only, or both sprayers simultaneously).

[0014] The drain duct 35, which extends from the sump

23, is in fluidic communication with a sewage system (not shown in the drawings), and comprises a drain pump 36 to pump the water away from the tub 2 and a non-return valve 37, the latter advantageously preventing any liquid or gaseous sewage backflow from getting into the dishwasher 1, which might jeopardize the hygiene thereof.

[0015] In order to allow water to be supplied, the dishwasher 1 comprises a supply duct 38 in fluidic communication with the inside of the tub 2 and with a water mains (not shown in the drawings); said supply duct 38 comprises a valve 39 for allowing or preventing the water from entering the tub 2, and a turbine flow meter 40 capable of measuring the quantity of water flowing into the tub 2, preferably arranged between the valve 39 and the tub 2.

[0016] The dishwasher 1 further comprises a control unit 5, which controls the execution of wash cycles of the dish treatment program.

[0017] With reference also to Fig. 2, a typical treatment cycle of the dishwasher 1 comprises a sequence of steps (usually pre-wash, wash, cold rinse, hot rinse), each comprising in succession a water loading substep P1, a holding substep P2 and a drain substep P3. During the water loading substep P1, the valve 39 is kept in the open position most of the time, thus causing a water flow 25 to enter the tub 2.

[0018] During the holding substep P2, the valve 39 is kept closed and the recirculation pump 31 stays on most of the time, thereby causing the flow 22 to run along the duct 24 and feed with a liquid (according to wash and rinse requirements) the lower sprayer and/or the upper sprayer, depending on the position of the selection valve 33.

[0019] During this step, detergent and/or rinse aid may be added to the liquid, which mainly consists of water. The liquid may be heated by turning on the heater 32, so as to improve the cleaning action, in the case of a wash liquid, or the drying action, in the case of a rinse liquid.

[0020] During the drain substep P3, the valve 39 is kept closed and the recirculation pump 31 is turned off, whereas the drain pump 36 is turned on to generate a liquid drain flow 26 towards the sewage system, thereby emptying the tub 2.

[0021] After the drain substep P3, the dish treatment program will carry out the next step of the cycle or it will end, if said program has been completed.

[0022] Both pumps 31 and 36 are preferably driven by variable-speed electric motors supplied by an electronic power circuit (not shown in the drawings) comprised in the dishwasher 1, more preferably by three-phase permanent-magnet brushless motors, the electronic power circuit thereof comprises at least one inverter (not shown in the drawings).

[0023] In the case of three-phase permanent-magnet brushless motors supplied by an inverter, a significant advantage is attained in that the motor can be controlled through the control system in accordance with different control laws: torque control, speed control, etc.

[0024] In order to control the motor, a number of electromechanical quantities that characterize the operation of the motor associated with the respective pump 31, 36 are periodically monitored/measured; such electromechanical quantities may comprise currents absorbed by each phase, voltage on the DC-Bus of the inverter, mechanical revolution speed, direction of rotation of the motor, torque delivered by the motor, and other electromechanical quantities. These electromechanical quantities may be detected by means of suitable measuring circuits or determined/estimated by processing measured physical quantities, e.g. absorbed current; based on such electromechanical quantities, it is possible to determine the state of a virtual sensor comprised in the dishwashing machine 1, thereby estimating a set of operating variables of said dishwashing machine 1.

[0025] These operating variables comprise a head of the wash or rinse liquid relative to the bottom of the sump 23.

[0026] Indeed the head of the liquid can be discriminated, preferably by associating it with a discrete set of levels, based on the state of said virtual sensor.

[0027] In particular, the state of the virtual sensor allows, among other things, to discriminate the presence of a hydraulic head on the intake ducts of the pumps 31 and 36. In fact, the level of the liquid (hydraulic head) affects the resistant torque and therefore the current absorbed by the motors of the pumps 31 and 36, which is a function of the torque delivered by said motors.

[0028] The state of said virtual sensor also allows to discriminate the quality of the wash liquid, e.g. the presence of dirt and/or foam.

[0029] In this embodiment, the control unit 5 advantageously acquires and processes these electromechanical quantities of the motors of the pumps 31 and 36, so that said unit 5 can determine a set of states of the virtual sensor associated with the dishwashing machine 1, deriving therefrom information about the operating state of the dishwashing machine 1 to monitor the proper operation thereof, so as to detect in the shortest possible time any anomalous situations, such as problems caused by one or more failures or by incorrect use of the dishwasher 1, and/or to detect in the shortest possible time the presence of any dirt or foam.

[0030] In this respect, as shown in Fig. 3, the control unit 5 comprises a state machine, the state transitions of which are generated by the values of the electromechanical quantities of the motor of the pump 31.

[0031] Therefore, determination of the presence of the hydraulic head advantageously takes place without using a dedicated physical sensor, such as, for example, a pressure switch, but indirectly by monitoring the electromechanical quantities of the motor of the pumps 31 or 36.

[0032] A method for controlling the dishwasher comprises the following steps:

- a. calculating operating variables starting from measured electromechanical quantities related to

the operation of the motor;

b. determining a state of a virtual sensor associated with the operation of the dishwashing machine;

c. identifying the occurrence of a set of anomalous situations on the basis of the state of said sensor and of the treatment substep/step being carried out by the dishwashing machine;

d. taking appropriate measures on the dishwashing machine, which may comprise signalling the anomalous situation(s) detected and/or taking corrective measures to allow the dish treatment program to proceed normally.

[0033] The operating variables also include a mean torque ME_Mean and a torque standard deviation ME_DevStd, both of which are calculated starting from measurements of the phase currents of the motor based on well-known relations, of course by using the nominal data of the controlled motor. As an alternative or in addition to such operating variables, it is possible to use a combination of other electromechanical quantities (currents, voltages, back-emf, speed, power, etc.), manipulated through one or more statistic operators (mean, standard deviation, variance, rms, etc.), and/or the instantaneous values of said electromechanical quantities.

[0034] It must be pointed out that these operating variables can only be calculated when the motors of the pumps 31 and 36 are in an operating condition, so that the state of the state machine FSM1 is only valid when said motors are on.

[0035] The state machine FSM1 preferably comprises three states: a state S0 (initial state) representing a substantially empty tub 2, a state S1 representing the tub 2 as containing a quantity of wash or rinse liquid corresponding to the full level, i.e. sufficient for executing the holding step P2, and, finally, a state S2 representing a situation in which there are problems due to dirt deposited in the filter 34 or foam formed inside the tub 2. The following will briefly describe the conditions that cause transitions from one state to another.

[0036] The transition to the initial state S0 can occur from the states S1 and S2 when the mean torque ME_Mean is lower than a threshold value Me_Threshold, preferably lower than 50Nmm, for a time interval t0, preferably shorter than 10 seconds.

[0037] The transition to the state S1 can occur from the states S0 and S2 when the mean torque ME_Mean is preferably greater than the threshold value Me_Threshold and the torque standard deviation ME_DevStd is smaller than a lower threshold value Me_DevStd_Low, preferably lower than 5Nmm, for at least a time interval t1, preferably longer than 2 seconds.

[0038] The transition to the state S2 can occur from any other state (S0,S1) when the torque standard deviation ME_DevStd is greater than an upper threshold value Me_DevStd_High, preferably higher than 10 Nmm, for at least a time interval t2, preferably six seconds.

[0039] Said threshold values depend on the sizing of

the hydraulic circuit of said dishwasher and of the motor comprised in said recirculation pump 31.

[0040] The recognition of the states S0 and S1 occurs within a maximum time equal to the higher value between t0 and t1 ($\max(t_0, t_1)$), so as to ensure that the activation of the pump 31,36 for said maximum time will not pose a risk for its integrity, even in the worst operating conditions (vacuum or air inside). Likewise, said maximum time is such as to ensure safe operation of the heating resistor because, by immediately recognizing the switching to the state S0 the heating resistor can be turned off before it gets overheated; in said state S0, in fact, it is not certain that the heating resistor is immersed in wash or rinse liquid, and therefore it might be subject to overheating. Said maximum time is preferably shorter than ten seconds.

[0041] The recognition of the state S2 advantageously allows taking actions to improve the wash performance and reduce the noisiness of the machine, as shown in Fig. 4. When the dishwasher 1 is in the state S2 during the step P2, it means that there is foam or a clogged filter. In such a situation, corrective measures can be taken which comprise the following steps:

e. reducing the revolution speed of the motor of the pump 31 to a value preferably comprised between 90% and 70% of the initial value, for a time interval preferably lasting sixty seconds;

f. reading the state of the state machine FSM1; if the state is S1, it means that foam has formed inside the tub 2; it is therefore possible to continue the cycle step by turning on (again) the resistor 32 and keeping the pump 31 on at a reduced speed, since it is certain that there is a hydraulic head on the intake duct of the pump 31; if, on the contrary, the state machine FSM1 remains in the state S2, it means that the filter 34 is clogged and that an alternative procedure must be started, e.g. opening the valve 39 to supply water into the tub 2.

[0042] When it is detected that the filter 34 is clogged, the alternative procedure may comprise washing the filter 34 as described in Italian patent application ITTO2010A1044 by the present Applicant.

[0043] It will be apparent to those skilled in the art that the use of the state machine FSM1 can ensure a longer operating life of the pump 31, by preventing it from rotating too long with no load or while sucking in air.

[0044] With reference to Fig. 5, the operating variables of the dishwashing machine 1 sampled by the control unit 5 also comprise a quantity of supplied water WQ, which is measured by means of the turbine flow meter 40, and a number of revolutions per minute RPM of the motor of the pump 31.

[0045] The loading substep P1 comprises the following additional microsteps: empty condition verification/definition microstep SP1, static load microstep SP2, full condition verification microstep SP3, dynamic loading micro-

step SP4, and wash start microstep SP5.

[0046] These microsteps are carried out orderly (SP1, SP2, SP3, SP4, SP5), one after the other. During the empty condition verification microstep SP1, it is checked that the tub 2 contains no residual liquid left therein by previous treatment cycles or released into the tub 2 from a storage tank (not shown in Fig. 1) possibly present in the dishwashing machine 1, or due to a malfunctioning valve 37. For this purpose, the pump 31 is activated for a short period of time, while the control unit 5 verifies that the state machine FSM1 correctly stays in the state S0; in fact, should said state machine FSM1 switch to the state S1, it would mean that the tub 2 is not empty; should it switch to the state S2, instead, it would mean that the pump 31 is not operating correctly, i.e. it cannot stably rotate at a constant speed. In the former case it will be possible to take action, for example, by executing the drain step P3, whereas in the latter case it will be possible to warn the user that the recirculation pump 31 should be cleaned, since it has probably been clogged by a foreign body that escaped the filter 34, which will have to be checked as well. In both cases the drain pump 36 will be activated in an attempt to remove the liquid from the tub 2.

[0047] During the static load microstep SP2, the pump 31 is kept off, and therefore the state machine FSM1 will remain in the state S0 for the whole duration of this substep, whereas the valve 39 is opened to cause water to flow into the tub 2 and turn the turbine flow meter 40. If the control unit 5 receives no signal from the flow meter 40, it means that either the meter 40 has failed or the flow 25 is zero. In order to understand which one of these two cases is taking place, the control unit 5 continues the execution of the microstep SP2 for a predetermined period of time, and then it switches to the microstep SP3 as predetermined.

[0048] During the full condition verification microstep SP3, the pump 31 is activated and the control unit verifies that the finite-state machine FSM1 correctly settles into the state S1. If the finite-state machine FSM1 is in the state S1 and the central unit 5 detected no signal from the flow meter 40 in the previous microstep SP2, it means that said meter 40 has failed; if the finite-state machine FSM1 stays in the state S0 it means that, with high probability, the flow 22 was practically equal to zero throughout the static load microstep SP2.

[0049] Once the full condition verification microstep has been completed (whether successfully or unsuccessfully), the control unit 5 starts the dynamic loading microstep SP4, during which the pump 31 is operating throughout the whole microstep SP3 and the valve 39 is left open to increase the quantity of water in the tub 2. This substep ends when a predefined quantity of water has been supplied, i.e. a quantity of water sufficient to ensure a proper supply to the recirculation pump 31 as required by a given load configuration. In fact, the load configuration can affect the time required by the water to fall onto the bottom of the tub 2 after it has been sprayed

by the sprayers 21.

[0050] At the end of the dynamic loading microstep SP4, the control unit 5 checks that the state machine FSM1 has correctly entered into the state S1 and carries out the wash start microstep SP5, wherein the valve 39 is closed and the pump 31 is brought to a normal-state speed equal to the speed that will be held during the holding substep P2.

[0051] If during the microsteps SP4 and SP5 the dishwasher 1 is operating properly without any problem, then the state machine FSM1 will remain in the state S1.

[0052] By using the information coming from the state machine FSM1 together with the information about the step/substep/microstep of the wash cycle being executed by the machine 1, it is advantageously possible to identify a set of anomalous situations caused by malfunctions and/or improper use of the machine 1 by the operator; such situations require the intervention of the user of the machine 1, and therefore an accurate identification of the problem will advantageously help the user solve it.

[0053] The set of anomalous situations comprises a closed tap situation, a drain pipe leakage situation, an upturned concave container situation, and a clogged filter/foam presence situation, the latter having already been described above.

[0054] Fig. 6 shows the trend of the operating variables of the dishwashing machine 1 in the closed tap situation, i.e. when the flow 25 is always zero and no water is flowing into the tub 2. This situation can be identified by observing the state machine FSM1, which remains in the state S0 throughout the loading step P1; said step P1 must be fully completed for reasons that will be described more in detail below.

[0055] With reference to Fig. 7, in the drain pipe leakage situation, i.e. when there is continuous leakage from the bottom of the tub 2, the state machine FSM1 remains in the state S0 during the execution of the microsteps SP1-SP4, to enter then into the state S2 shortly after the beginning of the microstep SP5, following an increase in the revolution speed of the motor of the pump 31. It can also be seen that, in the course of the microstep SP5, the control unit 5 outputs a state S2 more often than in the same microstep during a normal cycle (see Fig. 5); such a state is due to the presence of air and water entering the pump 31, thereby not allowing the motor to run in normal conditions, which are only obtained when there is a hydraulic head on the intake duct of the pump.

[0056] Figure 8 shows the trend of the operating variables of the dishwashing machine 1 in a situation in which a container has been improperly positioned with its concavity turned upwards. In this situation, the container will tend to accumulate liquid, thereby causing the state machine FSM1 to enter into the state S2, as opposed to the state S1, during the wash start microstep SP5, thus making this type of problem easily identifiable.

[0057] This also allows taking specific corrective measures, such as, for example, supplying more water/liquid into the tub by opening the valve 39.

[0058] This behaviour of the state machine FSM1 is due to the high torque standard deviation value ME_DevStd of the motor of the pump 31.

[0059] Another variant of the invention is shown in Figures 9 and 10; for simplicity, the following description will only highlight those parts which make this and the next variants different from the above-described main embodiment; for the same reason, wherever possible the same reference numerals, with the addition of one or more apostrophes, will be used for indicating structurally or functionally equivalent elements. Compared to the main embodiment, a control unit 5', similar to the control unit 5 of the main example, comprises also a second finite-state machine FSM2, which comprises a state SO' (initial state) and a state S1', similar to the states S0 and S1, respectively, of the state machine FSM1.

[0060] The second state machine FSM2 can estimate a part of the state of the dishwasher 1 by using operating variables calculated by starting from the electromechanical quantities of the motor of the drain pump 36.

[0061] Such operating variables comprise the mean torque ME_Mean', calculated on the basis of the phase currents measured by the inverter according to well-known relations; this calculation is preferably made every 32 mechanical revolutions of the motor of the pump 36, so as to obtain a higher resolution, and hence a faster intervention, than required for the recirculation pump 31 (128 mechanical revolutions). This is necessary because the drain step has a much faster dynamics than the recirculation step.

[0062] The following will briefly describe the conditions that cause transitions of FSM2 from one state to another.

[0063] The transition to the initial state SO' can occur from the state S1' when the mean torque ME_Mean' is lower than a threshold value Me_Threshold', preferably lower than 80Nmm, for at least a time t0', preferably shorter than 10 seconds.

[0064] The transition to the state S1' can occur from the state SO' as soon as the mean torque ME_Mean' exceeds the threshold value Me_Threshold'.

[0065] The control unit 5' uses the state of the second state machine FSM2 during the drain step P3 (see Fig. 10).

[0066] The drain step P3 comprises a drain microstep SP6 and a pause microstep SP7; such microsteps may be repeated cyclically until the drain step is complete.

[0067] During the drain microstep SP6, the drain pump 36 is on and its motor preferably runs at a speed of 3,200 rpm, as long as the second state machine FSM2 remains in the state S1'. As soon as the second state machine FSM2 enters into the state SO', the control unit 5' will start the pause microstep SP7.

[0068] During the microstep SP7, the drain pump 36 is stopped, so that the wash and rinse liquid can flow down into the sump 23, and after a certain period of time the control unit 5' will start the drain microstep SP6 again.

[0069] If immediately after the start of the first drain microstep SP6 the second state machine FSM2 stays in

the state SO', it means that during the previous substep there some liquid was leaking and therefore a situation of drain pipe leakage occurred, which must then be appropriately signalled to the user of the dishwashing machine 1.

[0070] Instead, if immediately after the start the next drain microsteps SP6 the second state machine FSM2 stays in the state SO', the control unit 5' will end the drain step P3 and will continue the wash program, in that no liquid will have remained in the tub 2.

[0071] The detection of the electromechanical operating parameters associated with the electric motor of the drain pump 36, in addition to those of the pump 31, allows to discern cases of dishwasher malfunction which in the prior art could not be discerned as effectively or at all.

[0072] This is the case, for example, of drain leakage, which sometimes may be mistaken for the presence of upturned pots or bowls, since they both cause a lower water level in the sump.

[0073] Of course, the example described herein may be subject to further variations, which will nonetheless still fall within the scope of the following claims.

Claims

1. A dishwashing machine (1) comprising a tub (2), a recirculation pump (31) for recirculating a liquid contained in the tub (2) and a drain pump (36) for draining said liquid from the tub (2), electric motor means (31, 36) respectively associated with said pumps (31, 36), a control unit (5, 5') for acquiring and/or processing at least one electromechanical parameter associated with at least one of said motor means (31, 36) and controlling an operating cycle of the machine, **characterized in that** the control unit (5, 5') estimates, at predetermined time intervals, said at least one electromechanical parameter associated with at least one of said electric motor means in order to detect one or more of the following malfunction situations:
 - foam presence within the tub (2) exceeding a preset level;
 - presence in the tub (2) of a concave object turned upwards, which at least partly prevents circulation of the liquid in the tub;
 - closed tap, which stops the flow of water into the tub (2);
 - liquid leakage from the dishwasher (1).
2. A dishwashing machine (1) according to claim 1, wherein the set of operating variables comprises a head (27) of the liquid with respect to a bottom of the tub (2).
3. A dishwashing machine (1) according to any one of the preceding claims, wherein the control unit (5, 5')

continuously acquires said at least one electromechanical parameter of the motor.

4. A dishwashing machine (1) according to any one of the preceding claims, wherein said at least one electromechanical parameter comprises the current absorbed by each phase of an electric motor associated with a respective pump (31, 36). 5
5. A dishwashing machine (1) according to claim 4, wherein the motor of the pump (31) is of the three-phase permanent-magnet brushless type, and wherein the motor means comprise an electronic power circuit including an inverter. 10
6. A dishwashing machine (1) according to any one of the preceding claims, wherein the control unit (5,5') performs, at regular intervals, a calculation of a mean value (ME_Mean, ME_Mean') and/or of a standard deviation value (ME_DevStd, ME_DevStd') of the torque delivered by the motor means associated with the pumps (31,36). 15
7. A dishwashing machine (1) according to claim 6, wherein the calculation of the mean value (ME_Mean) of the torque delivered by the motor of the recirculation pump (31) is performed after a number of mechanical revolutions of said motor greater than 100, preferably every 128 revolutions. 20
8. A dishwashing machine (1) according to claim 6 or 7, wherein the calculation of the mean value (ME_Mean') of the torque delivered by the motor of the drain pump (36) is performed for a number of mechanical revolutions of said motor smaller than that of the motor associated with the recirculation pump (31), preferably every thirty-two mechanical revolutions of said motor of the drain pump. 25
9. A dishwashing machine (1) according to any one of claims 6 to 8, wherein the liquid leakage is detected when the mean value (ME_Mean) of the torque delivered by the motor of the recirculation pump (31) stays below a first threshold value (Me_Threshold) during most of a loading substep (P1) comprised in the wash cycle. 30
10. A dishwashing machine (1) according to any one of claims 6 to 9, wherein the situation of foam presence is detected when the torque standard deviation value (ME_DevStd) reaches and exceeds a threshold value (Me_DevStd_High). 35
11. A dishwashing machine (1) according to claim 10, wherein the threshold value (Me_DevStd_High) is higher than 10 Nmm. 40
12. A method for detecting a malfunction situation of a 45

dishwasher according to any one of claims 1 to 11, **characterized in that** it comprises the steps of:

- a. calculating a standard deviation value (ME_DevStd) of a torque delivered by a motor associated with a recirculation pump (31),
- b. taking corrective measures, if the torque standard deviation value (ME_DevStd) exceeds a threshold value (Me_DevStd_High).
13. A method according to claim 12, wherein the situation of foam presence is identified during a holding substep (P2) wherein the recirculation pump (31) is activated.
14. A method according to claim 12 or 13, wherein the detection of a liquid leakage from the dishwasher further comprises the steps of
 - c. calculating a mean value (ME_Mean, ME_Mean') of the torque delivered by motors respectively comprised in the recirculation pump (31) and in the drain pump (36),
 - d. taking corrective measures in the event that
 - the mean value (ME_Mean) of the torque delivered by the motor of the recirculation pump (31) stays below a first threshold value (Me_Threshold) during most of a loading substep (P1) comprised in the treatment program, or
 - the mean value (ME_Mean') of the torque delivered by the motor of the drain pump (36) stays below a second threshold value (Me_Threshold') just after the start of a first drain microstep (SP6) comprised in the treatment program.
15. A method according to any one of claims 10 and 11, wherein the corrective measures taken at step (b) comprise a reduction of a mechanical revolution speed (RPM) of the motor of the pump (31) for a certain time interval.

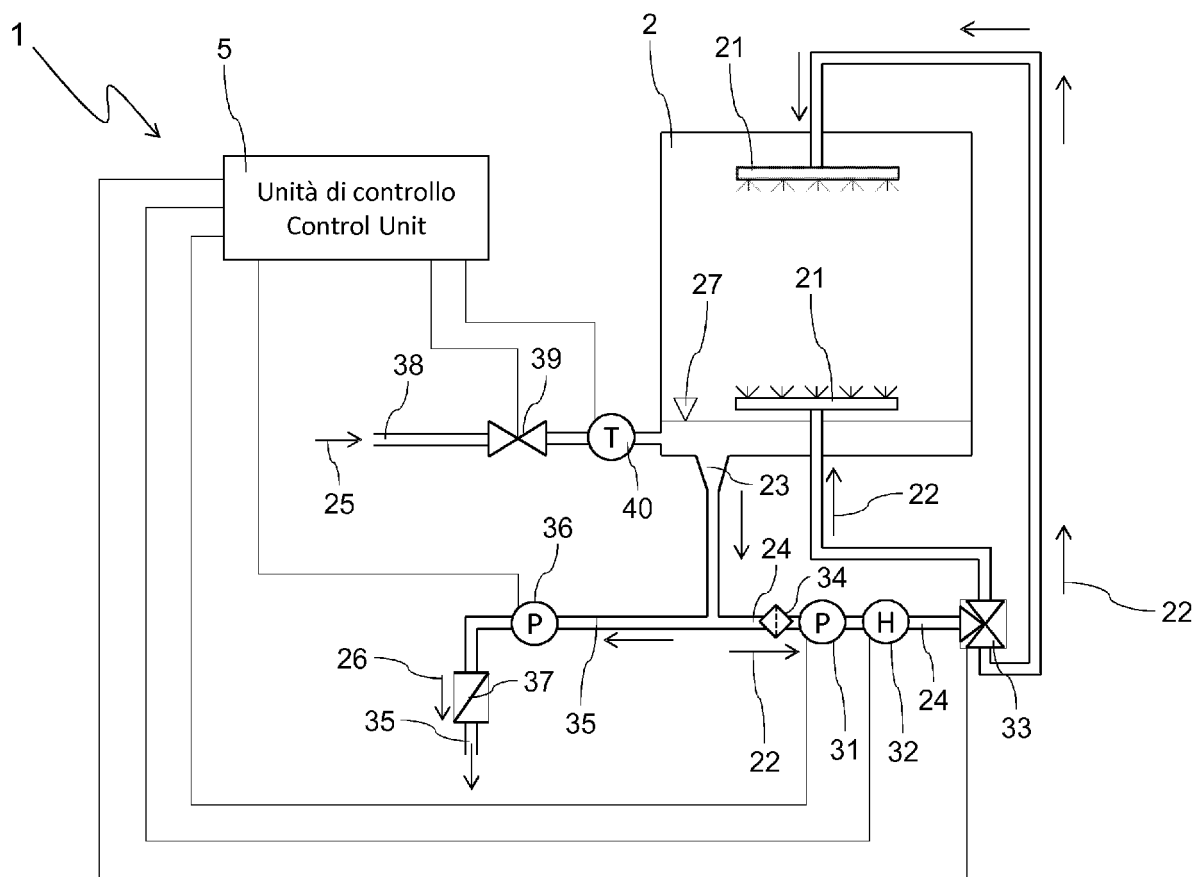


Fig. 1

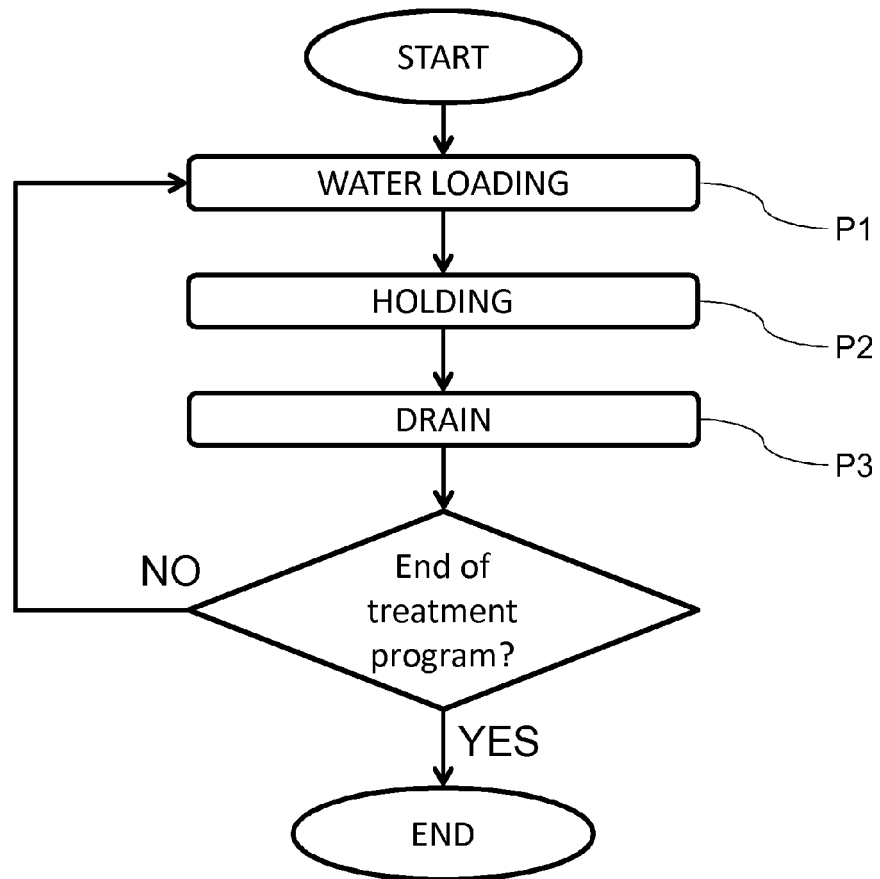


Fig. 2

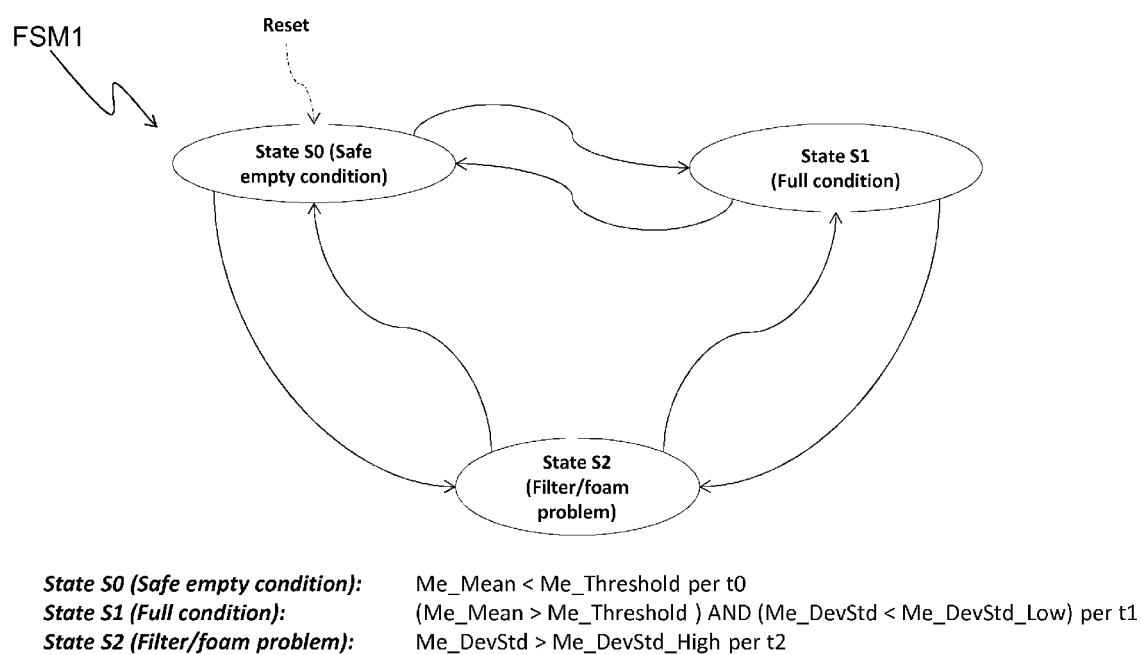


Fig. 3

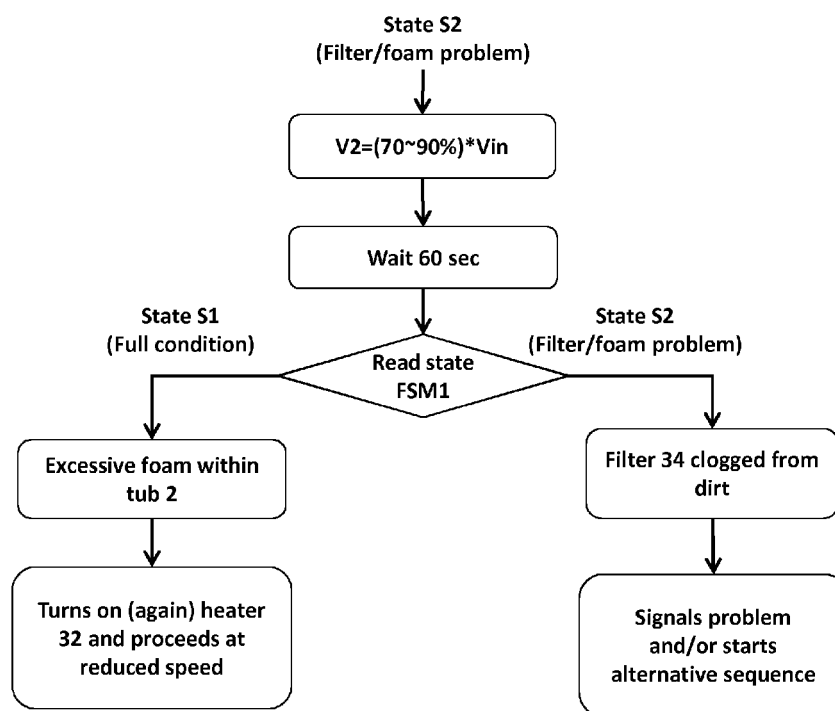


Fig. 4

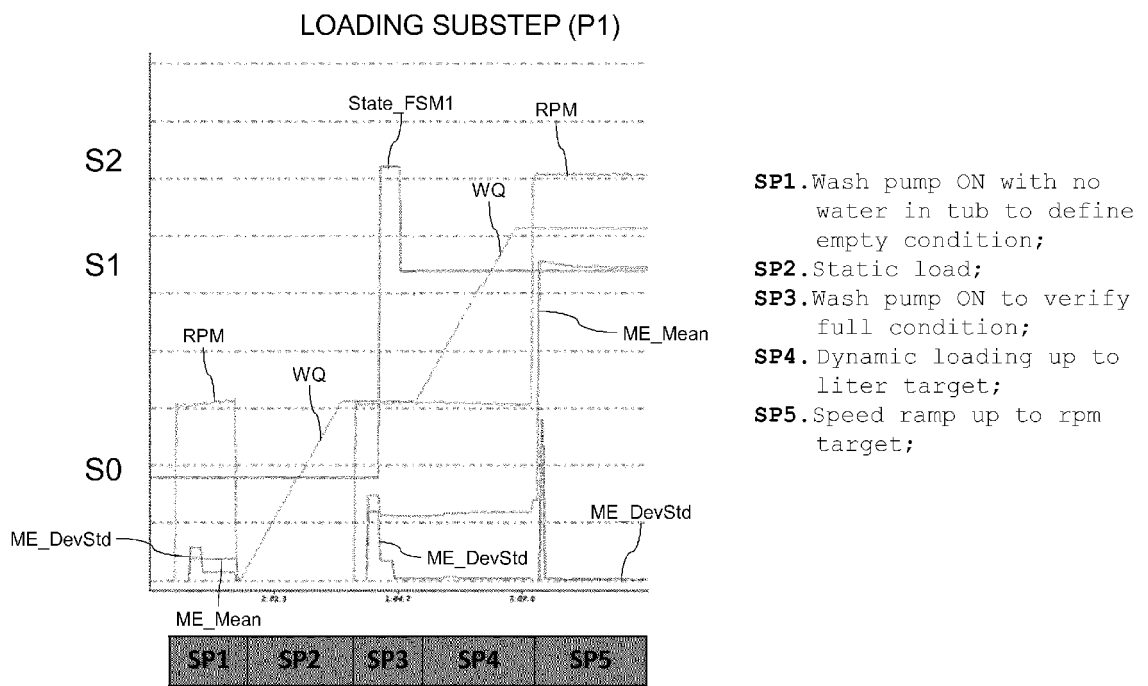


Fig. 5

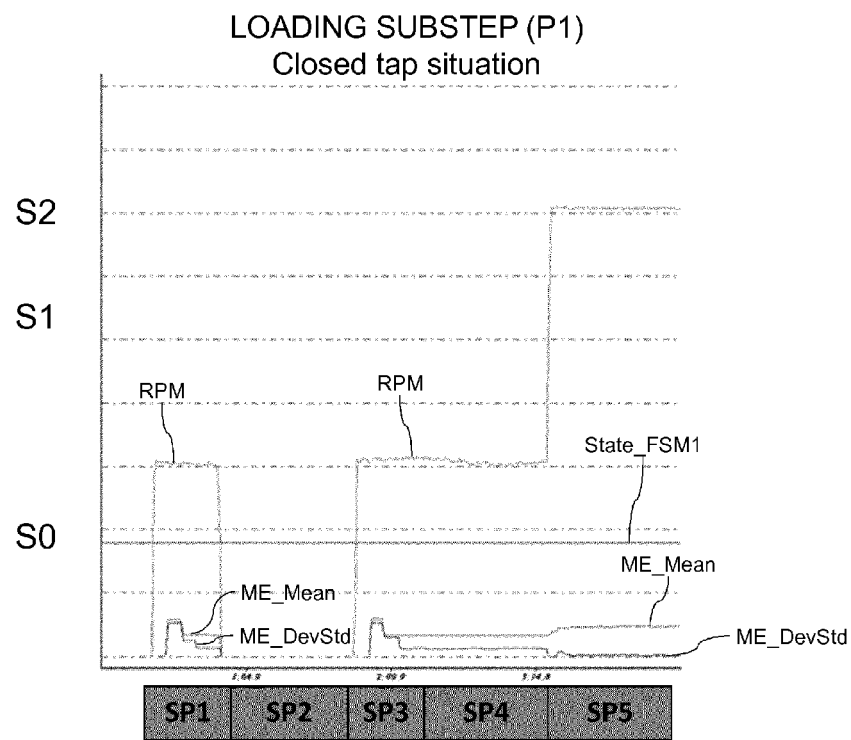


Fig. 6

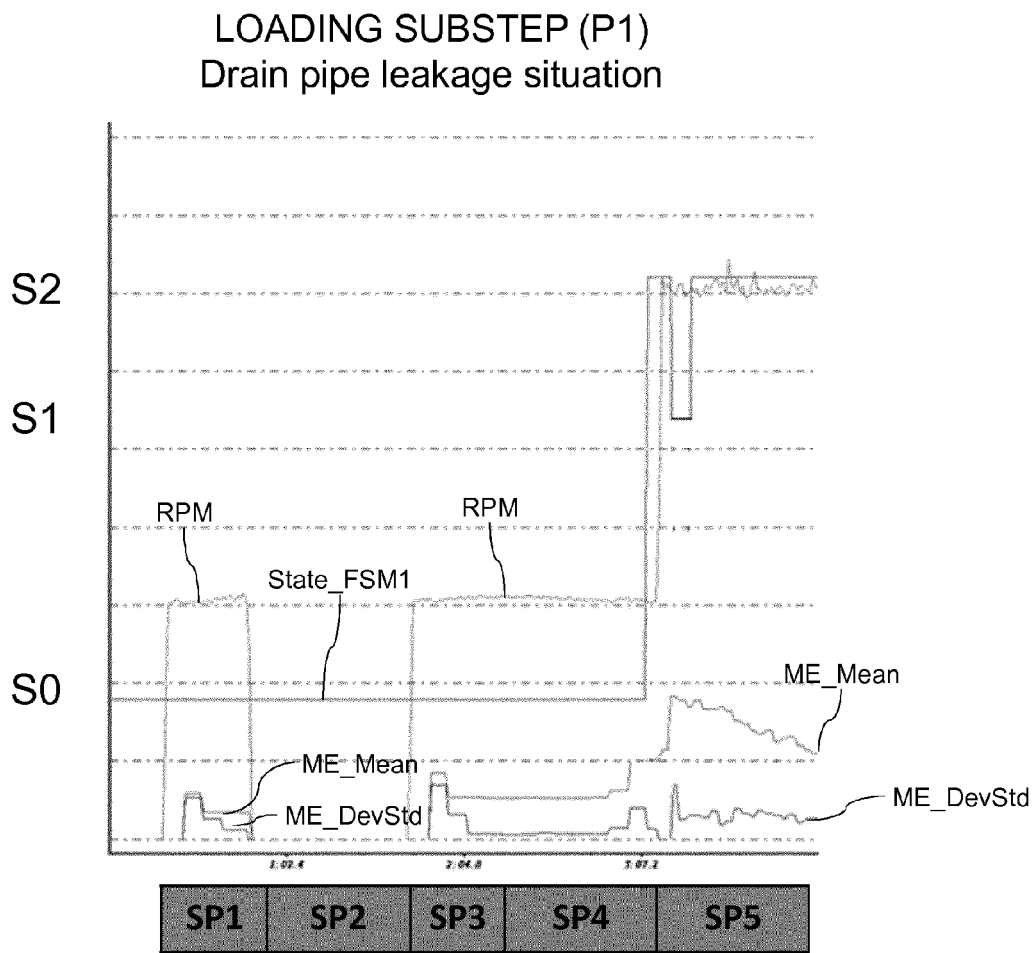


Fig. 7

LOADING SUBSTEP (P1)
(Incorrectly) upturned concave object situation

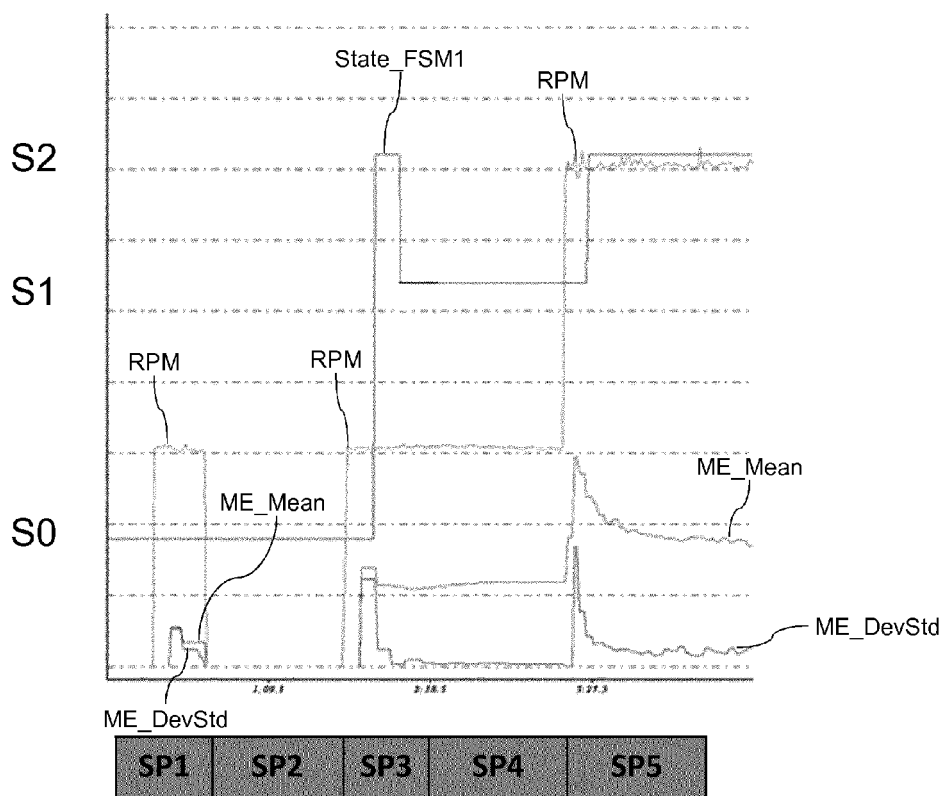


Fig. 8

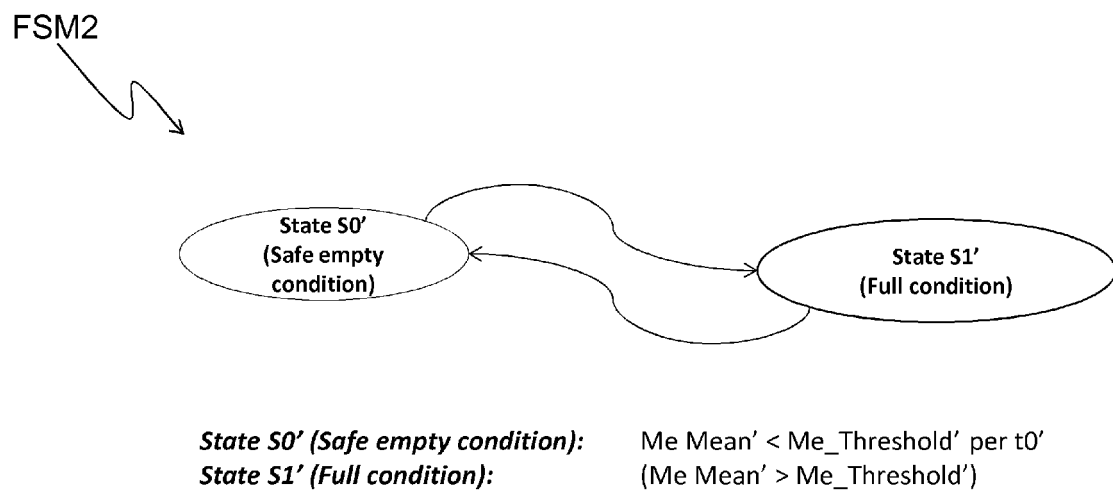


Fig. 9

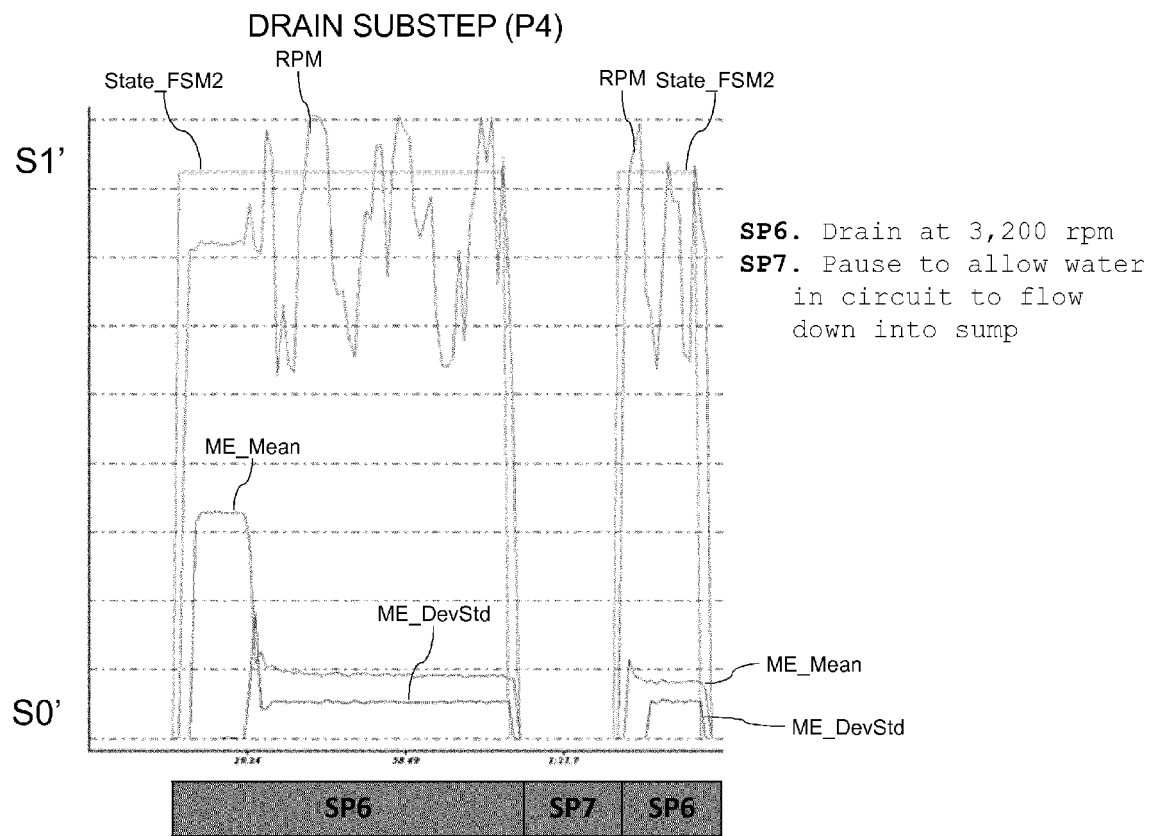


Fig. 10



EUROPEAN SEARCH REPORT

Application Number
EP 12 19 9559

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Place of search Munich		Date of completion of the search 17 April 2013	Examiner Redelsperger, C
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