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(54) A METHOD TO CONTROL A LAUNDRY APPARATUS

(57) The present invention relates to a method for operation of a laundry apparatus, said laundry apparatus including a drum which is rotatably mounted in a casing, the method including:

◦ selecting a washing or drying program among a plurality of washing or drying programs;

◦ rotating the drum for a given first time interval and given first speed before beginning of said washing or drying program;

◦ calculating a value associated with a torque and/or an unbalance of the drum during the rotation at the first speed;

◦ comparing the value with a first and/or second threshold;

◦ if said value associated with a torque and/or an unbalance is above the first and/or second threshold, then the method further includes:

• emitting a command to change a parameter of said selected washing or drying program; or

◦ if said value associated with a torque and/or an unbalance is below or equal to the first and/or second threshold, then the method further includes:

• calculating a first weight of said laundry before beginning of said selected washing or drying program.

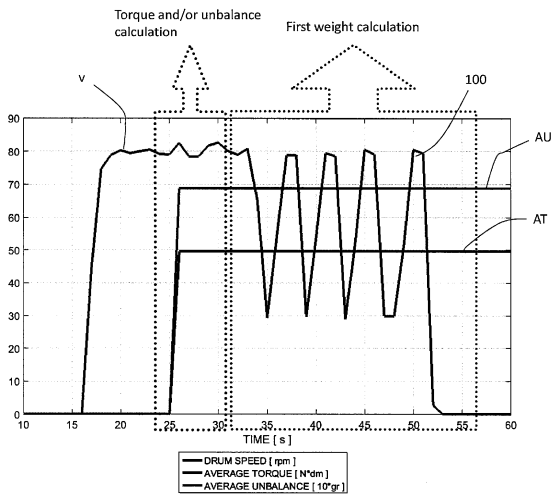

FIG. 5

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Description

[0001] The present invention relates to a method to control a laundry apparatus.

[0002] Commonly, a washing machine includes a tub where water is introduced, a drum which is rotatably mounted inside the tub to receive laundry, such as clothes, shoes, accessories etc., and a motor which generates a drive force to rotate the drum, thereby allowing washing to be performed via tumbling of laundry in the drum. For example, the laundry is tumbled along an inner wall of the drum during rotation of the drum.

[0003] Further, in such washing machines, a plurality of washing programs or drying programs are generally available. Commonly, washing programs or cycles include a washing step to eliminate stains on laundry using water and preferably also a detergent, and a rinsing step to rinse the laundry.

[0004] The weight of the load which is introduced in a washing machine, that is, the weight of the laundry introduced in a drum of a washing machine, is a relevant parameter for the correct operations of the washing machine in a washing program. The weight of the laundry indeed may determine the correct amount of water and/or detergent which needs to be introduced inside the tub or drum during a washing step or the speed at which the drum should be rotated in order to wash the laundry properly or not to create imbalances and noises. Further, it may influence the overall duration time of the washing program.

[0005] On the other side, weighting the laundry with a weighting scale or the like is not a feasible step to be achieved in a washing machine, due to its construction and the presence of water. Further, the weighting of the laundry should not increase the costs of production of the washing machine in such a way that it may change the overall apparatus cost noticeably.

[0006] There is a need of a method to control a washing machine, and a washing machine in which the weight determination is rather easy, realized in a relatively quick way and performed only when needed.

[0007] For this purpose, some methods have been developed by the same Applicant, where, in order to determine the load at the beginning of the washing program, some initial tumbling or spinning of the drum is required for a limited amount of time. In some particular conditions, such as when the washing machine has been fully loaded, and/or the laundry has not been optimally loaded, etc., during the execution of the tumbling/spinning sporadic cases of motor alarms or hits between the drum or tub or components attached to any of those and the cabinet might happen.

[0008] It is therefore desired to avoid such situations, in particular to avoid or minimize motor alarms (due to too high torque requested to the motor), hits between the washing group and the cabinet (due for example by a laundry ball "trapped" between the bellows and the glass porthole) or excessive rubbing of the laundry.

[0009] According to an aspect, the invention relates to a method for operation of a laundry apparatus, said laundry apparatus including a drum which is rotatably mounted in a casing, the method including:

- ◦ selecting a washing or drying program among a plurality of washing or drying programs;
- ◦ rotating the drum for a given first time interval and given first speed before beginning of said selected washing or drying program;
- ◦ calculating a value associated with a torque and/or an unbalance of the drum during the rotation at the first speed;
- ◦ comparing the value with a first and/or second threshold;
- ◦ if said value associated with a torque and/or an unbalance is above the first and/or second threshold, then the method further includes:
  - emitting a command to change a parameter of said selected washing or drying program; or
- ◦ if said value associated with a torque and/or an unbalance is below or equal to the first and/or second threshold, then the method further includes:
  - calculating a first weight of laundry present in the drum before beginning of said selected washing or drying program.

[0010] In the present context, a laundry apparatus includes both washing machine and laundry dryers. A washing machine may indicate a "simple" washing machine where the washing of laundry is performed, or a combined washer dryer, where, in addition to the washing, drying of the laundry is performed.

[0011] The laundry apparatus includes a drum where laundry is located, which can rotate around an axis by means of a motor. The axis of rotation of the drum can be horizontal, that is, substantially parallel to a surface where the appliance is located or slightly tilted to it, or vertical. Therefore, the laundry apparatus might be a front loading laundry apparatus or a top loading laundry apparatus as well.

[0012] The laundry apparatus further preferably comprises a casing, preferably but not necessarily parallelepiped-shaped, on which a door is advantageously hinged to access and close the drum in order to load or unload the laundry to be washed and/or dried. The door is preferably hinged on a front wall of the casing in case of a front loading laundry apparatus, while it is hinged on a top wall of the casing in case of a top loading laundry apparatus.

[0013] Further, in case the laundry apparatus is a

washing machine, the latter is connected to a water supply, for example to the water mains, by means of suitable pipes which can be opened or closed, for example by a valve, in order to introduce water to the drum. One or more discharge pipes can be present as well in order to discharge water from the drum.

[0014] A drawer or other container is also preferably present and fluidly connected to the drum in order to introduce detergent into the drum itself, if needed during the laundry washing.

[0015] A condensate canister may be present as well to collect the water condensed during drying.

[0016] The laundry apparatus may further include a control panel, for example located in an upper portion of the casing, where inputs or commands can be selected by an user, and/or information about the status of the laundry apparatus can be displayed, for example by means of a display or one or more light indicators.

[0017] In operation, a laundry apparatus include a plurality of washing or drying programs. In case of a washing program, each washing program preferably includes a washing step where the laundry is washed, such as tumbled, and a rinsing step, where the laundry is rinsed. The washing program may also include a spinning step where the drum is rotated at relatively high velocity. Further steps may be present as well, for example a pre-washing or others. In case of washing and drying program, a drying step is added at the end of the spinning. In case of purely drying programs, different steps at different drying temperatures might be present, dividing the laundry program in different time intervals, where the speed of the drum might also be varied.

[0018] The various washing or drying programs may differ one from the others for the duration of the same, for the number or rinsing steps, for the temperature of the washing water, for the amount of detergent, the drying temperature, the rotational speed of the drum and so on.

[0019] The washing or drying programs are preferably designed to treat laundry made of a specific textile type or composition or type of dirt or stain. For example, in a washing machine, a cotton program at high temperature is generally present, as well as a delicate program for delicate textiles (e.g. silk) at lower temperatures. The same applies to a drying machine, where the drying temperature for cotton is different from the drying temperature for synthetic textiles.

[0020] According to the invention, a washing or drying program is set. The washing program or drying program is generally set either by a user operating on the control panel, for example by means of a switch, button, knobs and the like, or automatically, that is, a predefined washing program is stored on a memory of the laundry apparatus and automatically selected when the appliance is switched on. Alternatively, the laundry apparatus may "auto-select" the washing program among the available ones, for example all stored in a memory, depending on one or more characteristics of the laundry inserted in the drum, which are automatically detected.

[0021] The setting of a washing or drying program predefines one or more of a plurality of parameters, that is, given the washing or drying program, for example the duration of the same may be defined, as well as the type and quantity of detergent to be used, the temperature of the water, the amount of water to be used in washing, the amount of water to be used in rinsing, the revolution per minute of the drum, the maximum allowed weight of the laundry, and others.

[0022] In addition, for some or all washing or drying programs, some constraints on the program may be present. For example, in case a synthetic program has been selected, it is not allowed to select a high washing temperature (for example a temperature above 60°C). If a delicate program has been selected, a load above a certain threshold cannot be selected at the same time. Those constraints are imposed to avoid a poor performance of the selected washing or drying program. However, the user may be allowed to override some of those constraints, for example inputting specific commands on the control panel.

[0023] According to the invention, before the beginning of the washing or drying program which has been set, a check is performed on the loading of the drum. In other words, the drum is rotated for a given first time interval and at a given first speed. This rotation is performed before the beginning of any washing or drying program, for example, in case of a washing program, before water is introduced in said drum. This rotation for a limited time interval can be performed at a rather "high" speed, such as 80 rpm.

[0024] During this rotation at the first speed, a value associated with a torque and/or an unbalance of the drum is calculated. For example, this value can be the mean torque or the mean unbalance of the drum during a certain time interval. For example, the mean torque or the mean unbalance during the whole first time interval can be calculated.

[0025] Preferably, the apparatus includes a motor control unit, which senses signals from or characteristics of the functioning of motor. The torque can be for example calculated by the motor control unit which senses characteristics of the electric current absorbed by the motor. The torque calculated by the motor control unit can be for example an average torque calculated over two complete rotations of the drum around its axis.

[0026] The unbalance is also calculated preferably by the motor control unit. The clauclation can be performed sensing characteristics of the electrical current absorbed by the motor over two complete rotations of the drum around its axis.

[0027] Further, preferably, the value of torque and/or unbalance calculated or obtained by the motor control unit, is sent to a main control unit of the apparatus to be possibly further elaborated.

[0028] Rotating unbalance is the uneven distribution of mass around an axis of rotation. A rotating mass, such as the rotating drum of the apparatus, is said to be out

of balance when its center of mass (inertia axis) is out of alignment with the center of rotation (geometric axis). Unbalance causes a moment which gives the drum a wobbling movement characteristic of vibration of rotating structures.

[0029] This calculation is performed to detect whether the load is correctly placed within the drum, whether there are unbalances present, whether there is an overload of the drum, etc. This step is preferably performed before starting any other process in the apparatus, because detecting an excessive torque or an excessive unbalance at the beginning of the apparatus functioning avoids or minimizes triggering any alarm response.

[0030] In order to determine whether the value representing the torque and/or the unbalance is indicating a potentially problematic condition, this value is compared with a first and/or a second threshold. For example a torque threshold T1 and an unbalance threshold T1' are set. According to the invention, two values might be calculated, i.e. a value representing the torque and a value representing the unbalance, or only one of these. Further, both or only one of these values can be compared with a threshold, T1 and/or T1'.

[0031] The result of the above mentioned comparison triggers a different response. If said value associated with a torque and/or an unbalance is above the first and/or second threshold, that is if the first value relative to the torque is > T1 and/or if the value relative to the unbalance is > T1', then the method further includes a step of emitting a command to change a parameter of said washing program.

[0032] If the torque and/or unbalance is "high", it means that there is either excessive load in the drum or the laundry is not correctly positioned within the drum. Therefore, in order to perform a correct washing or drying program, a command is sent - for example by the main control circuit of the apparatus - which forces the selected washing or drying program to consider this situation. The situation is considered forcing the change of a parameter of the selected washing or drying program.

[0033] Depending on the apparatus, it might be enough that only one value is above T1 or T1' or it is needed that both values (related to torque and unbalance) are above their respective threshold. Further, there is no need that both values are compared with their respective threshold. A single comparison may be enough.

[0034] For example, the command might include "set the load equal to the maximum load accepted by the apparatus". In this case, the apparatus during the washing or drying program considers that the drum has been loaded with the maximum possible weight of laundry.

[0035] The maximum load may depend on the type of laundry apparatus, because not all laundry apparatuses have the same maximum load. Commonly, laundry apparatuses having a maximum load of 5 kg, 8 kg or 4 kg are known for household uses.

[0036] It has to be understood that not all washing or drying programs allow this change: there are programs where, for the correct execution of the program itself, it is not possible to select as the load the maximum load accepted by the laundry apparatus.

[0037] Further, it is possible that the maximum load has been already selected by the user. In this case, the command does not change any parameter in the washing or drying program, because this parameter is already set as required by the circumstances.

[0038] Therefore, in these examples, the command to change the parameter is sent, but it does not have any "visible" consequence.

[0039] Preferably, if the torque and/or unbalance is "high" (as defined above), then there is no calculation of the weight of the laundry before the beginning of the selected washing or drying program.

[0040] If said value associated with a torque and/or an unbalance is "low", that is, if this value is below or equal to the first and/or second threshold T1, T1', then a "standard" situation is present and the method further includes the step of calculating a first weight of said laundry before beginning said selected washing or drying program.

[0041] Therefore, when the situation is not "problematic", because the value related to the torque and/or the value related to the unbalance are below their respective threshold T1 and T1', then a weight of the laundry is calculated before the selected washing or drying program starts.

[0042] Depending on the apparatus, it might be enough that only one value is below T1 or T1' or it is needed that both values (related to torque and unbalance) are below their respective threshold. Further, there is no need that both values are compared with their respective threshold. A single comparison may be enough.

[0043] Thus, in case of "low" torque or unbalance, the calculation of a first weight of the laundry introduced into the drum is performed. Such calculation takes place in any known manner, by means of a first weight sensor.

[0044] For example, the first weight sensor may be a mechanical sensor of the weight of the laundry, but it may also be a predictive algorithm calculating the first weight by statistical methods. This first weight calculation determines a certain value of the weight of the laundry introduced in the drum. This first weight may be compared with a first weight threshold.

[0045] Preferably, the calculation of the first weight is relatively "rough", that is, with a relatively low precision, and performed in a rather fast manner.

[0046] According to the invention, therefore, a first weight calculation is performed only when the risk of triggering an alarm due to a too high torque or unbalance is relatively low. In case a high unbalance or torque, the selected washing or drying program is "adjusted" to take the situation into consideration, altering a parameter of the same, such as the load.

[0047] According to the aforementioned aspect, the invention may include one or more of the following characteristics.

[0048] Preferably, calculating a first weight of said

laundry before the beginning of said selected washing program includes calculating a weight of said laundry before water is introduced in said drum.

[0049] In case of a washing machine, the measurement of the first weight of the laundry, in case of a low torque or unbalance, is performed before the beginning of the selected washing program, which means before the introduction of water into the drum or the tub. The first calculation is preferably a fast calculation.

[0050] Preferably, emitting a command to change a parameter of said selected washing or drying program includes changing a load setting of the washing program equal to a maximum load accepted by the laundry apparatus.

[0051] In order to take into account the fact that there is a high torque or unbalance in the drum, the load is set to the maximum possible one. The selected washing or drying program is therefore performed as if in the drum there is the maximum acceptable load for the apparatus (regardless of the real load present). The maximum load value depends on the type of apparatus, e.g. it can be for example 5 or 8 kilos in case of household apparatuses.

[0052] Preferably, emitting a command to change a parameter of said selected washing or drying program includes emitting a warning signal. More preferably, emitting said warning signal includes emitting said warning signal if said parameter change is not allowed by the selected washing or drying program. Even more preferably, emitting said warning signal includes emitting said warning signal if said selected washing or drying program does not allow a load setting equal to the maximum load accepted by the laundry apparatus.

[0053] As mentioned, washing or drying programs may have constraints in the range of parameters which can be set. These constraints are present in order to perform the washing or drying programs correctly and obtain a proper result, without damaging the laundry introduced in the drum. For this reason, it is not always possible to fulfil the command request, that is, although a command signal has been sent to change a parameter of the selected washing or drying program, the selected program does not allow such a change. For example, if the requested change via the command is to put load = "maximum load of the apparatus" in a delicate program, the program itself via a control unit will refuse to perform such a change because a delicate program does not allow to have a heavy load. In this case, therefore, a warning signal is emitted, to warn the user of this problem. As an example an "overload" indication can be emitted.

[0054] Preferably, in this case where a warning signal is emitted, the program is forced to set the load equal to the maximum load possible for that specific program (which - as said - can be different from the maximum load accepted by the apparatus).

[0055] Preferably, the method includes calculating a second weight of said laundry after beginning of said selected washing or drying program. More preferably, calculating a second weight of said laundry after beginning of said selected washing program includes calculating a second weight of said laundry during/after water has been introduced in said drum.

[0056] This second weight is calculated after the selected washing or drying program has started, for example after water has been introduced into the tub and/or drum, or during the introduction of the water itself. This second weigh calculation is "the second one" only if the first weight calculation has been performed, that is, preferably only if the torque and/or balance have been found "low".

[0057] In this second calculation, the weight of the laundry is calculated again, for example preferably in a longer and/or more precise manner. This second weight calculation can be used to vary other parameters of the selected washing or drying program, for example its time to end.

[0058] Preferably, the method includes calculating a time to end of said selected washing or drying program before the step of calculating the value associated with a torque and/or an unbalance.

[0059] It is known that a user prefers to receive information about the status of the washing program. One of these desired information is the duration of the washing program. So, a first estimate of the time to end is visualized to the user, for example by means of a display, on the basis of the selected washing or drying program only.

[0060] Preferably, the method includes updating said time to end after emitting a command to change a parameter of said selected washing or drying program or after calculating said first weight before the beginning of said selected washing or drying program.

[0061] The time to end depends on the parameters of the selected washing or drying program. Due to the fact that the command modifies a parameter of the washing program, the time to end may be affected as well and therefore an update is preferred.

[0062] Further, the time to end may be affected by the weight of the laundry in the drum. Therefore, after the first weight calculation, the time to end may need to be updated as well.

[0063] Preferably, the step of calculating the weight of said laundry before the beginning of said selected washing or drying program includes rotating and stopping the rotation of said drum a plurality of times.

[0064] The first weight calculation may include a plurality, e.g. in the number of four, of "bursts" of rotation of the drum. Preferably, in these rotation, the drum is rotated for a short time at a given speed (e.g. between 30 rpm and 80 rpm) and then stopped. The given speed may be preferably equal to the first speed.

[0065] In these bursts, parameters of the motor and/or the drum are calculated in order to obtain a weight calculation.

[0066] Preferably, said apparatus includes a motor driving the drum in rotation and calculating a first weight of the laundry in the drum before the beginning of the

selected washing or drying program includes:

o calculating the first weight by detecting one or more parameters of the motor while the drum is rotating.

[0067] The drum is rotated by means of a motor, which may also control the drum velocity and the reversal of rotations, if needed. In order to calculate the first weight, which is calculated without the introduction of water into the drum, preferably parameters of the motor while it rotates the drum are calculated, for example sensed or detected by suitable sensor(s) which are commonly present in a washing machine for other purposes. One of these parameters can be for example the torque of the motor. However, one or more of the following can be used as well:

- Parameters indicative of the operating conditions of the motor driving the drum in rotation, such as a motor torque value and/or a power absorbed by the motor and/or a current absorbed by the motor;
- Speed or acceleration of the drum or number of times in which the drum reverses its rotation direction;
- Speed or acceleration of an agitator located in the drum to move the laundry located therein;
- Humidity of the laundry and variations thereof;
- Time from the beginning of the selected program and/or phase of the program which is taking place;
- Parameters indicative of operating conditions of mechanical elements of the appliance, like the opening or closing of valves, the activations of alarms and so on;
- Etc.

[0068] Preferably, said apparatus includes a motor driving the drum in rotation and calculating a first weight of the laundry in the drum before beginning of the selected washing or drying program includes:

- Sensing a plurality of parameters concerning operating conditions of the washing machine; and
- Predicting a weight of the laundry present within the washing machine based on said plurality of parameters by means of a data-driven soft sensor.

[0069] The weight of the laundry in a laundry treatment appliance is a quantity that is either unmeasurable or costly/time-consuming to obtain. Therefore, in the present invention a statistical model-based technology addressed to industrial environments that provide an estimate of such quantity is used. The primary purpose of sensors is to deliver data for process monitoring and control. In the context of process industry, predictive models are called Soft Sensors: term is a combination of the words "software", because the models are usually - but not necessarily - computer programs, and "sensors", because the models are delivering similar information as their hardware counterparts. Other common terms for predictive sensors in the process industry are inferential sensors, virtual sensor or on- line analyser and observer-based sensors.

[0070] Two different classes of Soft Sensors, namely model-driven and data-driven, can be distinguished.

[0071] Model-driven models are also called white-box models because they have full phenomenological knowledge about the process background. In contrast to this purely, data-driven models are called black-box techniques because the model itself has no knowledge about the process and is based on empirical observations of the process. In between the two extremes there are many combinations of these two major types of models possible. A typical example of such a combination is a model-driven Soft Sensor making use of data- driven method for the modelling of fractions which can not be modelled easily in terms of phenomenological models.

[0072] The present invention preferably uses a data driven model, being based on empirical data. Therefore a data-driven soft sensor is an inferential statistical model developed from process observations.

[0073] The soft sensor, which normally operates using a software, might be embedded in the control unit of the appliance. The same control unit - as already stated - preferably controls also the appliance during its functioning, that is, during the execution of the selected laundry program, for example sending command signals to the motor of the drum and to the other components participating in the correct functioning of the appliance. For example, in a heat pump dryer, the control unit sends command signals to the heat pump.

[0074] In this way, making use of values from sensors which are already available in the appliance for other purposes, and the same processor already used to control the proper functioning of the appliance, the weight of the laundry introduced inside the washing machine is predicted. This prediction is obtained by means of a statistical method by means of a soft sensor which is data driven. The operation of "training" the soft sensor is preferably performed in the production site. Without adding further elements (such as a new sensor) to the appliance, a prediction of the weight of the laundry is obtained.

[0075] Preferably, said step of predicting a first weight of the laundry by means of a data driven soft sensor includes a step of predicting a first weight of the laundry by means of a supervised learning prediction.

[0076] In supervised learning, from input data (in this case the values of the operating conditions of the appliance) are used to predict an output value (in this case the weight of the laundry).

[0077] In supervised learning, input data is called training data. A model is prepared through a training process where it is required to make predictions and is corrected when those predictions are wrong. The training process continues until the model achieves a desired level of accuracy on the training data. Preferably, the soft sensor of the invention uses a supervised learning method, that is a learning task of inferring a function from labelled train-

ing data. The training data consist of a set of training examples. In supervised learning, each example is a pair consisting of an input object (typically a vector) and a desired output value (also called the supervisory signal). A supervised learning algorithm analyses the training data and produces an inferred function, which can be used for mapping new examples.

[0078] In the present invention therefore, preferably the soft sensor uses the operating conditions of the appliance during the selected program and the output value includes the weight of the laundry present in the drum of the laundry treatment appliance. This is done after the algorithm had been properly trained by the training examples which are data collected in field tests of the appliance.

[0079] Preferably, the method includes performing said selected washing or drying program after said first weight calculation and/or after emission of said command.

[0080] The washing or drying program then can start, either modified by the command or as selected by the user.

[0081] Preferably, said laundry apparatus includes a display and/or a light indicator and said step of emitting a warning signal includes displaying a warning message on the display or switching on the light indicator.

[0082] It is known that a user prefers to receive information about the status of the washing or drying program. In addition, if a possible problematic situation may arise during the washing or drying program, it is preferred to inform the user, so that he/she can take action. Thus, such information as the warning signal is visualized to the user, for example by means of a display or any light indicator (e.g. LED on the control panel).

[0083] Preferably, the method includes waiting for or requesting an external input after emitting a command or calculating said first weight before beginning of said selected washing or drying program.

[0084] As seen, after emitting said command, a warning signal might be present. Alternatively, an indication that the load has been changed into the maximum load allowed by the apparatus may be emitted as well. It is preferred that the user is informed of the status of the apparatus (e.g. torque and/or unbalance above a threshold), and that he/she is allowed to modify the status of the apparatus itself, for example by removing some laundry from the drum, by reshuffling of the laundry in the drum or even by changing the selected washing or drying program. For this purpose, preferably a waiting time is allotted. During this waiting time, the user may open the door of the apparatus and operate in the drum.

[0085] Alternatively, there is no information given by the apparatus of the request for input. That is to say, the method of the invention might provide for a time interval during which the apparatus allows the user to modify some of its settings, such as the amount of load in the drum or its distribution, without warning or requesting it visibly.

[0086] Further, also at the end of the calculation of the first weight, information for the user can be displayed, for example in case of a too high or too low weight of the laundry present in the drum. Therefore, there should be preferably the possibility for the user to alter the status and change for example the amount of load present in the drum, adding or removing laundry or redistributing the content of the drum.

[0087] Preferably, the method includes:

- comparing said first weight with a third threshold; and
- requesting an external input if said first weight is above or below said third threshold.

[0088] When the first weight is calculated, which happens when the torque or the unbalance is "low", then the first weight can be compared to a third threshold, such as value T2, so that it is checked whether a different problematic condition may arise. For example, in case the weight of the laundry is too high or too low for the selected washing or drying program, the selected washing or drying program may not give the expected results. To avoid this, the user may change the condition of the drum, adding or removing laundry for example, in the same waiting time interval which is available after the calculation of the first weight.

[0089] Preferably, the method includes, in case said external input is received, rotating said drum for a given second speed.

[0090] In case the external input is received, that is, the user has opened the door of the apparatus and made some adjustments to the laundry contained in the drum (removing laundry, adding laundry, reshuffling the same, etc.), some movements to disentangle the laundry are performed, Preferably the rotational speed of the drum in these movements is lower than the first speed, that is, second speed < first speed.

[0091] Preferably, the method includes, after receiving said external input, rotating the drum for a given first time interval and given first speed before beginning of said selected washing or drying program; and calculating a value associated with a torque and/or an unbalance of the drum during the rotation at the first speed.

[0092] The method may include a step in which some untangling movements of the drum are provided for. During this untangling movements, preferably at a second speed lower than the first speed (e.g. at a second speed of about 40 rpm for 2 seconds), the laundry is shuffled around in the drum. After the untangling movements, the calculation of the torque and/or the unbalance is performed again and its evaluation (i.e. the comparison with the corresponding threshold) is made. The method is repeated from the beginning. These untangling movements are performed preferably only if an external input is received, e.g. if the user opens the door of the apparatus.

[0093] Alternatively, there are no untangling movements and, after the input of the user, the method of the invention starts again, calculating the value associated with the torque and/or the unbalance and repeating the comparison with the thresholds.

[0094] Preferably, the method comprises, in case said external input is not received, starting said selected washing or drying program.

[0095] In case nothing happens, that is, in case no input is received from the user, the program which has been selected can start.

[0096] Preferably, the step to calculate a value associated with an unbalance includes calculating a value associated with a static unbalance of the drum.

[0097] A static unbalance is defined as a single mass placed in the center of the drum (center of gravity). Rotating the drum, the static unbalance generates a centrifugal force that causes an undesired translational movement (cylindrical) of the washing group and high level of vibrations. An excessive static unbalance can cause mechanical damages.

[0098] A static unbalance occurs when the inertial axis of a rotating mass is displaced from and parallel to the axis of rotation. It is calculated as:

$$U = m * r$$

where U = Unbalance, m = mass, r = distance between unbalance and the centre of the object.

[0099] Preferably, said first weight calculation lasts less than 1 minute.

[0100] The first weigh calculation is preferably "rough" but very fast in order to start the washing or drying program without delay.

[0101] Preferably, calculating the second weight includes:

- checking a level of water inside the drum; and
- calculating a second weight of the laundry present into the drum on the basis of the amount of water needed to maintain a pre-set level of water in the drum.

[0102] The second weight calculation is preferably an accurate calculation, that is, preferably more accurate than the first calculation, and also it may last longer than the first calculation in order to obtain the second weight value. The second calculation is performed after the water has been allowed into the drum, for example via an inlet pipe, and it uses the amount of water introduced as an indicator of the weight of the laundry. The level of the water in the drum is thus checked as a measure of the amount of water in it and of the amount of water absorbed by the laundry. The variations of the water level due to the absorbance of the water introduced in the drum by the laundry are monitored and when these variations remain below a certain value, that is, when these variations are "small", then the second weight is calculated.

[0103] Preferably, calculating the second weight includes:

- introducing in the drum a pre-determined amount of water;
- waiting a predetermined time interval;
- stopping water introduction if after said predetermined time interval a water level variation within said predetermined time interval is below or equal to a third threshold;
- calculating a second weight of the laundry present into the drum on the basis of the amount of water added in the drum up to the stopping of water introduction.

[0104] In order to calculate the second weight, preferably a predefined amount of water is introduced in the drum. This amount is predefined and preferably depends on the set washing program. After the water introduction, the water level in the drum is checked, it is waited for a given time interval and after this time interval has elapsed, the level of water in the drum is checked again. A variation of the water level can be thus calculated, subtracting from the initial water level the end water level. If the laundry has absorbed so much water that the variation of the water level is above a third threshold, more water is introduced, again in a pre-defined amount, and the steps above are repeated, to check whether the water level variations are still "big", i.e. above the third threshold limit. As above, the water level may be monitored with or without drum rotations.

[0105] The time interval is set so that generally the laundry has absorbed all the water it can absorb within it, so that the level of water into the drum cannot get lower than a given value even if more time than the pre-set one elapses. In this way, the second weight can be determined on the basis of the amount of water absorbed by the laundry.

[0106] Preferably, calculating a first weight of laundry present in the drum before beginning of said selected washing or drying program includes:

- determining a first duration of said selected washing program on the basis of said first weight;
- displaying said first duration on a display.

[0107] Preferably, the first duration is updated on the basis of the second weight. Updating said parameter on the basis of said second weight includes:

- determining a second duration of said set washing program on the basis of said second weight;
- updating said display displaying said second dura-

tion.

[0108] Due to the fact that the first weight calculation is performed rather fast, while the second weight calculation is relatively slow, in order to give immediately some feedback to the user, some parameters of the washing program are already calculated just after the first weight calculation and for example displayed. One of such parameters could be for example the duration of the washing program. When the more accurate weight calculation is obtained so that the value of the second weight is available, then the parameter is updated so that the user can see the correct parameter and rely on it.

[0109] The update could also result in keeping the parameter equal to what it had been determined using the first weight. For example, the duration calculated using the first weight could be identical to the duration calculated using the second weight.

[0110] The present invention will now be described with reference to the accompanying drawings that illustrate non-limiting embodiments thereof, wherein:

- Fig. 1 is a isometric view of the washing machine of the invention;
- Fig. 2 is a further isometric view of the washing machine of figure 1 with the casing made transparent in order to show its inner components;
- Fig. 3 is an isometric view of the washing machine of figure 2;
- Fig. 4 is a flow chart of the various steps of the method of the invention; and
- Fig. 5 is a graph of several values relevant in the method of the invention.

[0111] The following description refers to an advantageous embodiment of the invention in which the washing machine 1 is a "standard washing machine" with no drying functionality (i.e. a washing machine which can only wash and rinse the laundry).

[0112] However it is clear that the invention can be applied as well to washer - dryers (i.e. a washing machine which can also dry the laundry), not illustrated. Further, although this preferred embodiment is limited to washing machine, the invention applies to laundry dryers as well.

[0113] The washing machine 1 according to the invention which is schematically illustrated in the enclosed Figures is advantageously of the front-loading type; it is however clear that the invention is applicable, substantially without any crucial modification, to a top-loading washing machine.

[0114] With reference to Figures 1 to 3, the washing machine 1 comprises an external casing 2 in which frontal wall 2a an access opening 3 is obtained, provided with a loading/unloading door 4, which allows the access to a washing tub 5 contained in the external casing 2; the washing tub 5 contains a rotatable perforated drum 6 in which the laundry to be washed, not depicted in the drawings, can be loaded and unloaded. In this advantageous embodiment the drum 6 embodies, therefore, a treating chamber in which one or more items (pieces of laundry in this advantageous embodiment) can be loaded and treated with water and one or more additives (washing/rinsing products in this advantageous embodiment). The rotational axis of the drum 6 is substantially horizontal.

[0115] The washing tub 5 is connected to the external casing 2 preferably via a flexible bellows, not represented, connected between the frontal, opened, surface of the washing tub 5 facing the access opening 3, and the border of the latter.

[0116] In the example illustrated, the washing tub 5 is advantageously elastically supported by the external casing 2 via a suitable resilient support system, comprising, for example, springs 8; preferably the oscillations of the washing tub 5 are damped by suitable shock-absorbing devices or dampers 9, interposed between the washing tub 5 and the bottom of the casing 2.

[0117] Clearly, the washing tub 5 may be associated to the casing 2 in any other suitable way.

[0118] Advantageously, the washing machine 1 comprises a water inlet circuit, not visible in the figures, adapted for feeding water and washing/rinsing products, into the washing tub 5; the water inlet circuit comprises, for example, a removable drawer 19, adapted to be filled with washing and/or rinsing products, e.g. liquid or concentrate or gel detergent, or powder detergent, or softener, an inlet duct, also not represented, connectable to water delivery means present outside the washing machine 1 and adapted to deliver fresh water to the drawer 19 and/or to the tub, and an outlet duct, fluidly connecting the drawer 19 and the washing tub 5 and adapted to deliver water and washing/rinsing products into the washing tub 5.

[0119] The washing machine 1 also advantageously comprise a draining circuit, fluidly connected to the bottom of the washing tub 5 and adapted to drain the washing/rinsing liquid from the washing tub 5; in a further embodiment, not illustrated, the draining circuit may be also provided with a recirculation circuit, adapted to drain the washing/rinsing liquid from the bottom of the washing tub 5, and to re-admit such liquid into an upper region of the washing tub 5, for improving the wetting of the laundry.

[0120] Water inlet circuit and draining circuit are considered standard and known in the art and therefore not further discussed.

[0121] The washing machine 1 also comprises some electric and/or electronic components, adapted for performing some specific functions; for example the washing machine comprises an electric motor 11 for rotating the rotatable drum 6, a valve (not shown) adapted to deliver the washing/rinsing liquid into the washing tub 5, an electric pump (not shown) adapted to drain and/or to recircu-

late the washing/rinsing liquid from the washing tub 5, an electric heater (also not shown) adapted to heat the washing/rinsing liquid, etc.

[0122] The drum 6 is advantageously rotated by the electric motor 11 which preferably transmits the rotating motion from a motor shaft 24 to the drum 6, advantageously by means of a belt/pulley system 29. In a different embodiment of the invention, the motor 11 can be directly associated with the shaft 24 of the drum 6.

[0123] The washing machine 1 advantageously comprises a logic unit (for example an electronic board, a microcontroller, a microprocessor, or any other similar electronic control unit/device), schematically indicated in Figure 1 with the block numbered 12, configured to control the electric and/or electronic components of the washing machine 1, so as to make the washing machine 1 to perform a washing program, advantageously comprising one or more phases; for example the washing program may comprise a prewash phase, a soaking phase, a main washing phase (comprising, for example, the adduction into the washing tub 5 of water mixed with detergent and the rotation of the drum 6, so as to apply a mechanical action on the laundry), a steam supplying phase, a rinsing phase, a spinning phase, etc. The washing program may comprise one or more of the above mentioned phases (or also other phases well known in the art) adapted to apply to the laundry to be washed a specific chemical and/or physical action. A phase of the washing program may be performed, during a single washing program, only once or also two or more times. Clearly the duration of the overall washing program depends on the kind, on the number, and on the duration of its phases.

[0124] Each washing program is defined by a plurality of parameters, which are for example stored in a memory of the control unit 12. These parameters may include the duration of the program, the water temperature during the main washing phase, the number of rinsing phases, the maximum load for that specific program, and so on. Thus, when a program among the plurality is set, a plurality of parameters is set as well.

[0125] Further, the washing machine 1 has a pre-defined maximum allowed load which can be inserted in the drum. The maximum load depends on the model of washing machine. Some programs may have as acceptable maximum load the maximum load of the washing machine, other programs may have as maximum acceptable load a load lower than the maximum load of the machine.

[0126] The washing machine 1 is also provided with a first weight sensor, schematically represented in Figure 1 with the block numbered 13, which is configured to detect/measure the weight of the laundry loaded in the rotatable drum 6. For example, the weight sensor 13 may comprise one or more transducers, operatively connected to the logic unit 12; the transducers may comprise, for example, a load cell or a strain gauge and can be associated with the resilient support system 8, 9 supporting the washing tub 5, as for example depicted in figure 2. More preferably, the first weight sensor 13 is a soft sensor measuring the weight of the laundry by means of an algorithm. Most preferably, it is part of the control unit 12.

[0127] However, it is underlined that the use of a particular first weight sensor 13 is not critical for the invention, and therefore substantially any device adapted to measure the weight of the laundry loaded into the rotatable drum 6 may be used. In all cases, the first weight sensor 13 is apt to measure a weight of the laundry when the laundry is in a dry state, that is, before water is introduced inside the drum 6.

[0128] The washing machine 1 comprises a control panel or user interface 14, which is operatively connected to the logic unit 12 and is configured to allow the user to manually set a washing program to be performed. Alternatively, the washing program can be set automatically.

[0129] User interface 14 may comprise, for example, a touch screen display, adapted to display information and to receive inputs from the user, and or it may comprise a one or more buttons, and/or switches, and/or knobs, and/or displays, etc. allowing the user to receive information and to input instructions/commands directed to the logic unit 12.

[0130] The user, by means of the user interface 14, may program the washing machine 1 with one or more parameters indicating his/her "wish values" for them. That is, when the washing program or program is set, the user may change some of the pre-memorized values of these parameters by inputting its wished value from the user interface 14. These user's inputs overrule the standard memorized values for the parameters.

[0131] User interface 14 may be further configured to display user information; this information may comprise the name of a particular washing program, an indication of the weight of the loaded laundry, the duration of the washing program, the temperature of the washing/rinsing liquid, the rotating speed of the spinning, etc. More in general the user interface 14 is designed to present information related to the washing program and/or the status of the washing machine 1 and even more preferably it is designed to display the duration of the washing program.

[0132] In the embodiment illustrated in the enclosed Figures, the user interface 14 advantageously comprises a display device, preferably a LCD or a LED display, designed to present user information, and a separated input device, not illustrated, comprising for example a keyboard, and/or a set of keys or knobs, and/or one or more touch-sensitive input devices, etc., adapted for setting a washing program and washing-product information.

[0133] In another embodiment, not illustrated, the logic unit 12 may be advantageously integrated in the user interface 14.

[0134] Further, the washing machine includes a second weight sensor 16 apt to measure a weight of the laundry in the wet state. As for the first weight sensor,

this second weight sensor 16 can be any as long as is apt to measure the weight of the laundry when it is wet. This second weight sensor 16 can also be a soft sensor, that is, an algorithm, and can be part of the logic unit 12, as depicted in figure 2.

[0135] A method of controlling the washing machine 1 will be described in more detail as follows, with reference to figure 4. First, a washing program or program among the stored plurality is set in the washing machine in step 1F. Such program or program may be inputted by the user. Given the set washing program, a plurality of parameters of the same is set, the values of which may be changed according to the method of the invention. The user may also indicate a value of one or more of these parameters of the washing program. For example, the user may push a button indicating that the load of the laundry is the maximum load of the machine 1. Parameters relative to the set washing program may be displayed on the display of the control panel 14, such as for example the duration of the set washing program. The value displayed is either the "standard" value, that is, the value as stored in the memory and considered to be the default value for the set washing program, or the value of the parameter as modified by the user. In case the parameter displayed is the duration of the program, from this moment for example the countdown of the visualized value begins so at any point in time the user is aware of the remaining duration of the washing program watching the display of the user interface 14.

[0136] In step 2F, the drum 6 is rotated to a first speed for a first time interval. The rotation of the drum at a first speed is depicted in the graph of Figure 5 (in this graph, the units of the coordinate axes are arbitrary) as a curve indicated with v representing the velocity of the drum (angular velocity or rpm).

[0137] Further, in step 3F, the unbalance and the torque as an average value of the torque and unbalance during the first time interval are calculated. The resulting average torque AT and average unbalance AU are also depicted in the graph of figure 5.

[0138] In step 4F, the average torque and/or the average unbalance are compared with their respective thresholds, T1 and T1'. If any or both of the values of average torque/unbalance is below the given threshold T1, T1', then the situation is "normal" and a "standard" process starts.

[0139] Further, the weight of laundry is detected, before the water is introduced into the drum, by means of the first weight sensor 13 in step 5F. For example, the first weight value can be calculated driving the motor 11 to accelerate the drum 6 accommodating laundry to a certain speed and then measuring the torque and using a predictive algorithm. Therefore, from the measurement of the torque and/or imbalance at a first speed, the speed of the drum is changed, for example lowered (see figure 5) and then accelerated in order to perform the "burst". The drum is accelerated in bursts 100 as depicted in figure 5. Parameters of these bursts are used to obtain a value of the first weight of the laundry inside the drum.

[0140] The value of the first weight is used to calculate a parameter of the washing program, for example the parameter visualized in the display of the user interface 14, for example the duration of the washing program. In case the first weight calculation gives a result which is already indicating that the parameter which has been visualized after the selection of the washing program in phase 1F needs to be modified by the new value calculated on the basis of the first weight, the value on the display can be updated in phase 6F. The visualized parameter(s) therefore may have a "sudden jump" from one value to the other, that is, from the pre-set memorized value that the set program refers to in a memory of the washing machine, to a new value which is based on the first weight value.

[0141] The first weight calculated in this step 5F may trigger also the display of alarms. For example, the first weight could be above a given threshold and therefore a "overload" indication may be displayed, or it might be too low.

[0142] Then, a waiting time interval is reached in step 7F. In this waiting time interval, user intervention may take place, for example as a response of the warning message.

[0143] If in step 4F, any or both of the values of average torque/unbalance is above the given threshold T1, T1', then the situation is "potentially nonstandard" and different steps of the method of the invention take place. In this case, at the end of the calculation of the torque and/or of the unbalance, the drum is stopped.

[0144] There is no measurement of the weight of the laundry in the drum before the beginning of the selected washing program. The logic unit 12 sends a command to change the setting of parameters of the selected washing program, for example changing the load therein indicated with "maximum load allowed by the washing machine" in step 8F. If the washing machine is for example an 8 kg washing machine, then the load to be considered in the execution of the selected washing program is 8 kg. However, not all selected programs allow having the load set equal to the maximum available load for the washing machine. In the latter case, the logic unit 12 triggers the visualization or the production of an alarm or warning signal, for example acoustic or displayed in control panel 14.

[0145] After the command (either to change the program's setting or - additionally - to emit a warning signal), waiting time step 7F is reached.

[0146] If during the waiting time 7F, which may for example lasts 30 seconds, there is no user input, that is, if the user does not react (step 9F), then the selected washing program starts in step 11F.

[0147] The washing process begins, main water supply is executed to supply water into the drum 6 (wash water) until a target water amount for washing set according to the set washing program. The amount of water is preferably big enough that the laundry is in contact to

the water. A first level of water inside the drum is reached and it is measured. However, this first water level is lowered as laundry absorbs water in the drum 6. If after a pre-determined time interval, the laundry has absorbed so much water that the difference between the new - second - water level at the end of the predetermined time interval and the first water level is above a given value considered as a threshold, water supply to additionally supply water is executed accordingly. The water is not supplied any more if after the pre-determined time interval the difference between the first level and the second level water is below the selected threshold. The water amount which is introduced in the laundry at the beginning preferably depends on the set washing program or program.

[0148] After the introduction of the water loading, the washing and/or rinsing process can proceed. The parameter displayed may slowly change as the washing process proceed, for example in case of a display of the duration of the program, the remaining time till the end of the program is continuously updated in a countdown manner.

[0149] In certain conditions, a more accurate evaluation of the weight of the laundry is performed by means of the second weight sensor 16 is step 12F. To perform this calculation, a pre-defined amount of water is preferably introduced into the drum 6. The water level is lowered as laundry absorbs water. If after a pre-determined time interval, the laundry has absorbed so much water that the difference between a first water level at the beginning of the predetermined time interval and a second water level at the end of the predetermined time interval is above a given value considered as a threshold, water supply to additionally supply water is executed accordingly. The water is not supplied any more if after the predetermined time interval the difference between the first and second level is below the threshold.

[0150] Since weight of laundry is proportional to an amount of absorbing water from laundry, the second weight of laundry may be determined according to the number of water resupplies, in each of which a known amount of water is introduced in the drum. That is, since the number of water resupplies varies according to weight of laundry, the second weight of the laundry can be calculated in a more precise manner. Alternatively, not only the number of water resupplies is used to calculate the load of the laundry, but also the time the water takes to maintain the desired water level.

[0151] The same parameter which has been determined using the first weight is then recalculated, for example the duration of the washing program. The display is updated with the new value of the parameter, which is optimized for washing programs in which there is a heavy load. For example, the display may show a new time duration of the program, and the visualized value may perform a noncontinuous "jump" from the previously displayed value obtained on the basis of the first weight to a new value obtained on the basis of the second weight.

[0152] At the end of the washing program, the machine stops.

[0153] Alternatively, in case there is a user input in step 9F, untangling movements are performed (step 10F). Drum 6 is rotated at a second speed, preferably lower than the first speed, to re-distribute the laundry inside the drum. The amount of laundry has possibly been modified by the user. After the untangling movements, the method of the invention re-starts from step 2F, where rotation of the drum at the first speed is performed (see figure 5) and a calculation of the torque and/or unbalance is made.

Claims

1. Method for operation of a laundry apparatus (1), said laundry apparatus including a drum (6) which is rotatably mounted in a casing (2), the method including:

    o selecting a washing or drying program among a plurality of washing or drying programs;
    ◦ rotating the drum (6) for a given first time interval and given first speed before beginning of said washing or drying program;
    ◦ calculating a value associated with a torque and/or an unbalance of the drum during the rotation at the first speed;
    ◦ comparing the value with a first and/or second threshold (T1, T1');
    ◦ if said value associated with a torque and/or an unbalance is above the first and/or second threshold, then the method further includes:

        • emitting a command to change a parameter of said selected washing or drying program; or

    ◦ if said value associated with a torque and/or an unbalance is below or equal to the first and/or second threshold, then the method further includes:

        • calculating a first weight of laundry present in the drum (6) before beginning of said selected washing or drying program.

2. The method according to claim 1, wherein calculating a first weight of said laundry before the beginning of said selected washing program includes:

    ◦ calculating a first weight of said laundry before water is introduced in said drum (6).

3. The method according to claim 1 or 2, wherein emitting a command to change a parameter of said selected washing program includes:

o changing a load setting of the washing program equal to a maximum load accepted by the laundry apparatus.

4. The method according to any of the preceding claims, wherein emitting a command to change a parameter of said selected washing or drying program includes:

◦ emitting a warning signal.

5. The method according to claim 4, wherein emitting said warning signal includes:

◦ emitting said warning signal if said parameter change is not allowed by the selected washing or drying program.

6. The method according to claim 5, including the step of:

◦ emitting said warning signal if said selected washing or drying program does not allow a load setting equal to the maximum load accepted by the laundry apparatus.

7. The method according to any of the preceding claims, including:

◦ calculating a second weight of said laundry after beginning of said selected washing or drying program.

8. The method according to claim 7, wherein calculating a second weight of said laundry after beginning of said selected washing program includes:

◦ calculating a second weight of said laundry during/after water has been introduced in said drum.

9. The method according to one or more of the preceding claims, including:

◦ calculating a time to end of said washing program before the step of calculating the value associated with a torque and/or an unbalance.

10. The method according to claim 9, including:

◦ updating said time to end after emitting a command to change a parameter of said selected washing or drying program or after calculating the first weight performed before the beginning of said selected washing or drying program.

11. The method according to any of the preceding claims, including:

◦ performing said selected washing or drying program after said first weight calculation and/or after emission of said command.

12. The method according to any of the preceding claims, including:

◦ waiting for or requesting an external input after emitting a command or calculating said first weight before beginning of said selected washing or drying program.

13. The method according to claim 12, including:

◦ in case said external input is received, rotating said drum for a given second speed.

14. The method according to claim 12 or 13, including, after receiving said external input :

◦ calculating a value associated with a torque and/or an unbalance during the rotation at the first speed.

15. The method according to claim 12, including:

◦ in case said external input is not received, starting said washing cycle.

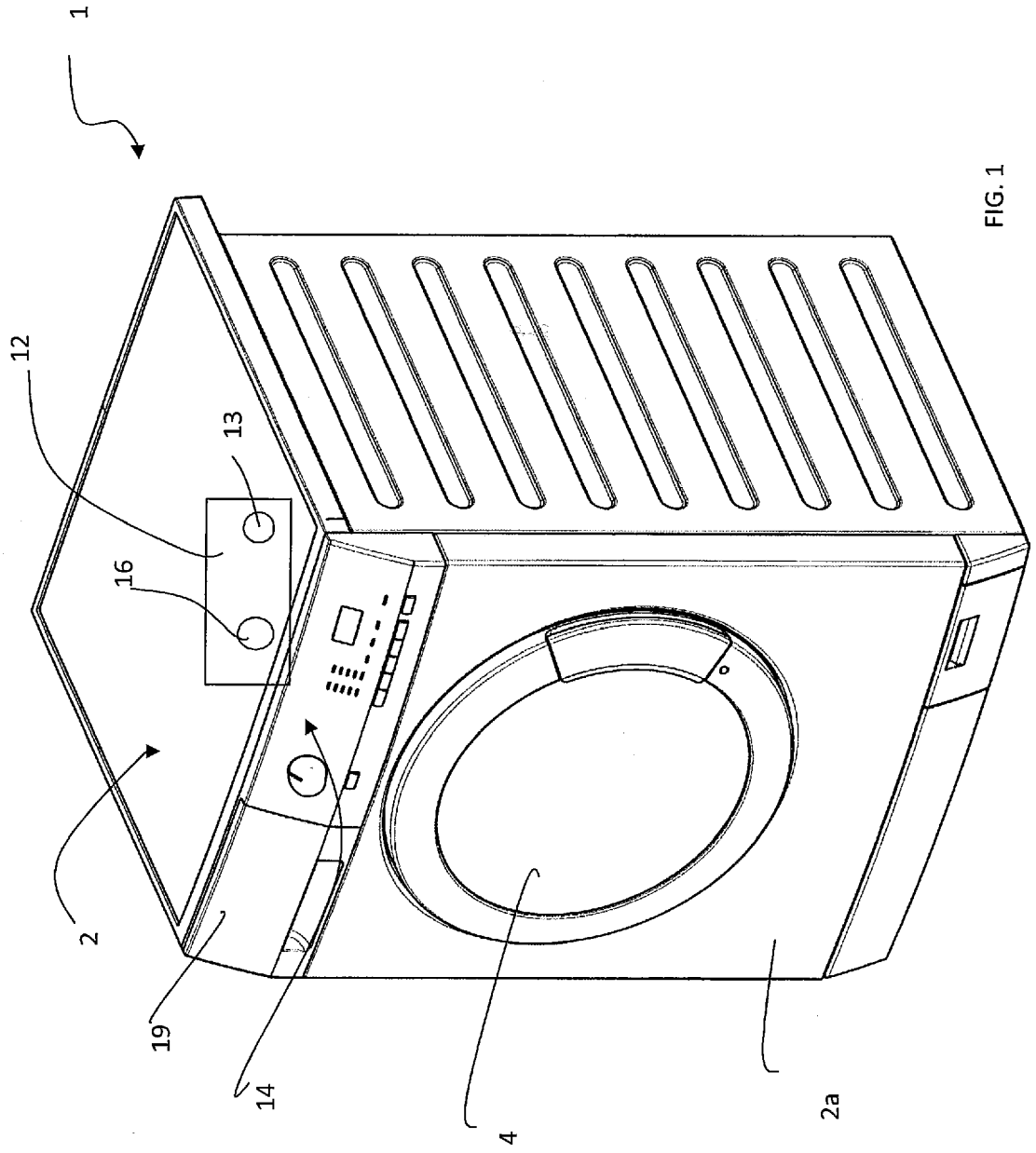

FIG. 1

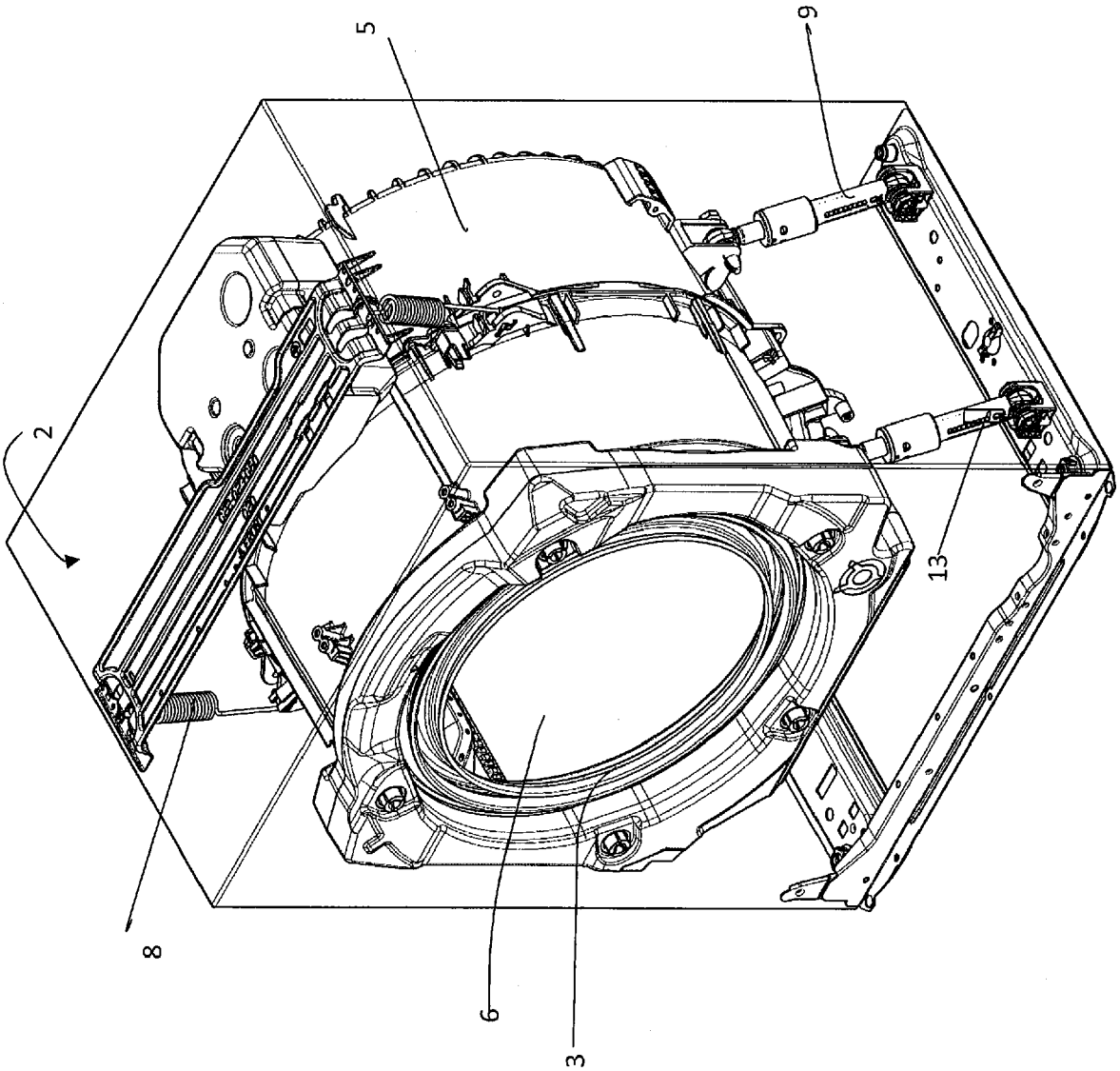

FIG. 2

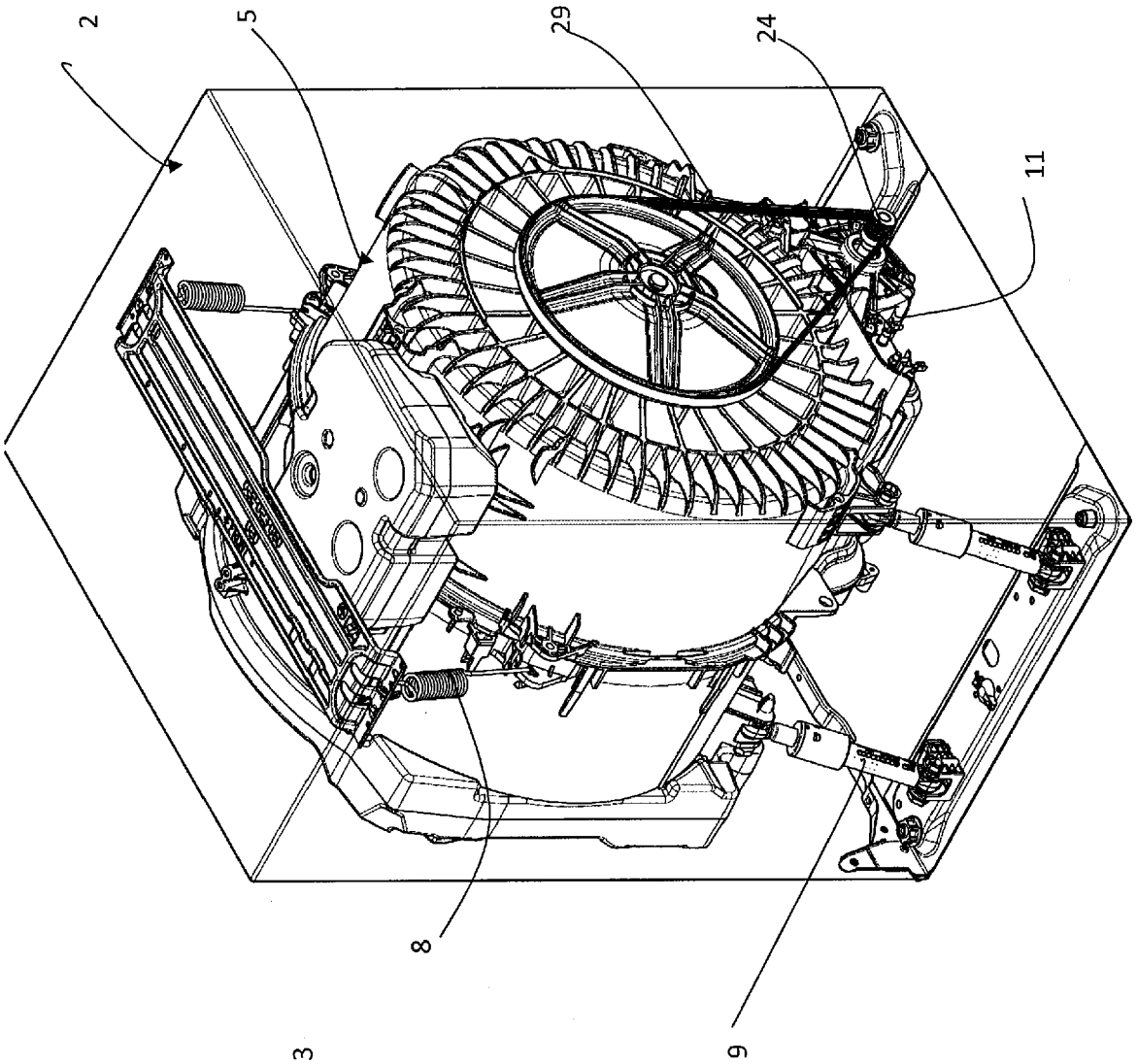

FIG. 3

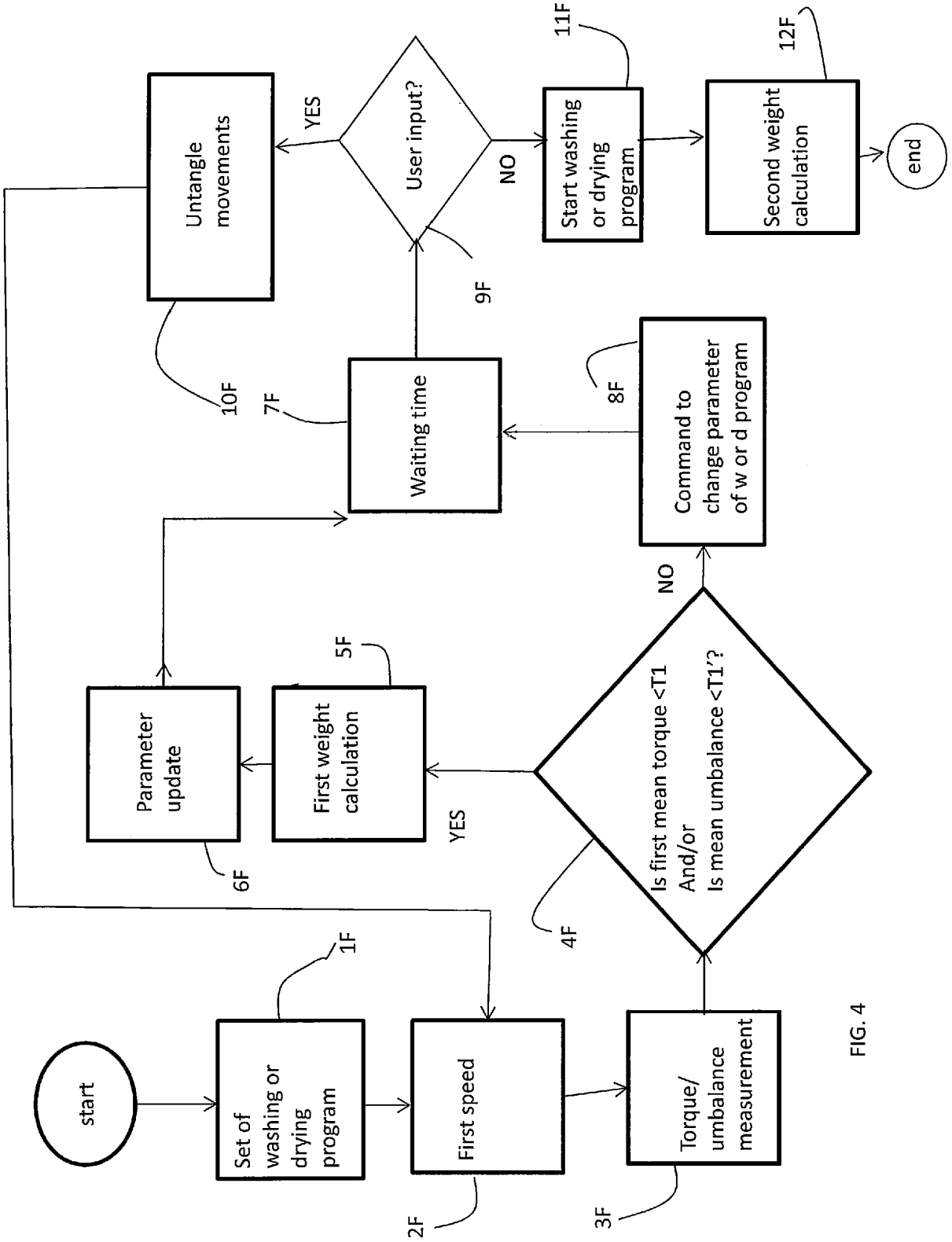
start
Set of washing or drying program
1F
First speed
2F
Torque/ umbalance measurement
3F
Is first mean torque <T1
And/or
Is mean umbalance <T1'?
4F
NO
YES
Parameter update
6F
First weight calculation
5F
Waiting time
7F
Command to change parameter of w or d program
8F
User input?
9F
YES
NO
Untangle movements
10F
Start washing or drying program
11F
Second weight calculation
12F
end

FIG. 4

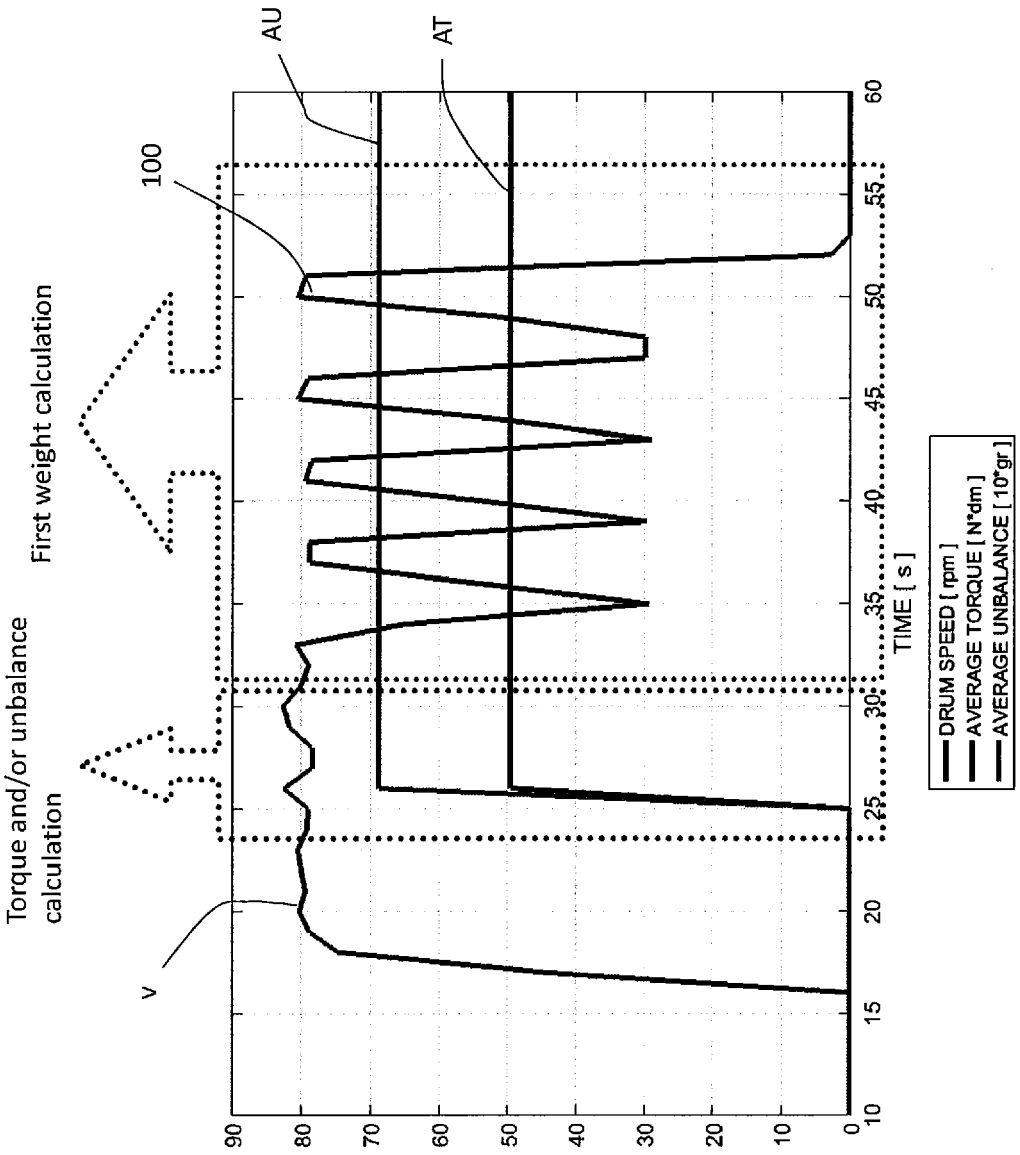
AU
AT
100
First weight calculation
Torque and/or unbalance calculation
V
TIME [s]
DRUM SPEED [rpm]
AVERAGE TORQUE [N*dm]
AVERAGE UNBALANCE [10*gr]

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 17 15 1746

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 684 990 A2 (WHIRLPOOL CO [US]) 15 January 2014 (2014-01-15) * paragraphs [0002], [0003], [0033], [0045], [0056]; claims; figures *	1-15	INV. D06F33/02 D06F37/20 D06F39/00
A	WO 2011/025312 A2 (LG ELECTRONICS INC [KR]; JANG JAE HYUK [KR]; KOO BON KWON [KR]) 3 March 2011 (2011-03-03) * the whole document *	1-15	
A	EP 2 604 751 A1 (ELECTROLUX HOME PROD CORP [BE]) 19 June 2013 (2013-06-19) * the whole document *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	21 June 2017	Stroppa, Giovanni

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 15 1746

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21-06-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2684990 A2	15-01-2014	EP 2684990 A2	15-01-2014
		US 2014013518 A1	16-01-2014
WO 2011025312 A2	03-03-2011	CN 102549208 A	04-07-2012
		EP 2470712 A2	04-07-2012
		US 2012151688 A1	21-06-2012
		WO 2011025312 A2	03-03-2011
EP 2604751 A1	19-06-2013	NONE	

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