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(54) **A LOAD DETECTION METHOD**

VERFAHREN ZUR BESTIMMUNG DER LADUNG

PROCEDE DE DETECTION DE CHARGE

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(73) Proprietor: **Arçelik Anonim Sirketi**
34950 Istanbul (TR)

(72) Inventors:
- **ERENAY, K.;**
c/o Arcelik Anonim Sirketi
34950 Istanbul (TR)
- **BAYKUT, A;**
c/o Arcelik Anonim Sirketi
34950 Istanbul (TR)
- **TEZDUYAR, L.;**
c/o Arcelik Anonim Sirketi
34950 Istanbul (TR)

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Description

[0001] This invention is related to a method of detecting the weight of the laundry placed into the drum in order to provide efficient performance of the washing machine.

[0002] In the washer/dryers and especially in washing machines, the water to be taken, amount of cleaning agent and softeners, time period and cycle of the washing are determined according to the type and weight of the laundry to be washed. Also, in case the laundries are not equally distributed on the sidewall of the drum during the spinning cycle, centrifugal forces formed thereof may create detrimental vibrations and can cause moving of the machine and excessive forcing of the machine.

[0003] In the prior art, in WO 03046271, a method for determining unbalanced load in front loading machines is described in which the sensed values are compared to prerecorded values at high speed, which comprises, inter alia, the steps of: bringing the unbalance to a balanced state by

providing the distribution of the load in the drum by rotating the drum in clockwise, counter-clockwise direction and stopping it; attaining a pre-spinning speed rate which is greater than the resonance speed rate in a short time by a high acceleration rate from a test spinning rate that is much lower than that of the resonance speed, which will cause the laundry to stick onto the inner peripheral walls of the drum, finding a firing angle value in AC motor drive systems at the pre-spinning speeds by calculating the rms voltage applied on the motor; after the pre-spinning speed, providing a fall to the test spinning speed rate by measuring the duration of the fall; measuring and calculating the value of deviation from the test speed; and calculation of the balanced loads and unbalanced loads by considering the measured and calculated data and experimental data recorded in a data storage unit.

[0004] In US 6029299, load is determined based on the speed fluctuation during the washing cycle. Load is determined by the rising and falling down of the laundry in the drum.

[0005] In DE 19832292, in a direct drive washing machine, load is estimated by the location and drawn voltage of the laundry placed into the drum rotating around its central axis.

[0006] In EP 1113102, total load and unbalanced load are determined according to the signals received from motor. Further documents disclosing a load detection method are EP 0536542 A and DE 19857903 A1.

[0007] The objective of this invention is to realize a method of detecting the load of the laundry placed into the washing machines in the most realistic way. This is achieved by the method according to independent claim 1. Preferred embodiments are the subject-matter of the dependent claims.

[0008] The load detection method realized to achieve the objective of this invention is shown in the attached drawings in which

[0009] Figure 1, is the schematic view of a dryer/washer.

[0010] Figure 2, is the flow chart of a load detection method.

[0011] Figure 3, is the graphical view of the change in the number of cycle in a load detection method applied before washing cycle.

[0012] Figure 4, is the graphical view of the change in the number of cycles in a method of detection load applied before the rinsing cycle.

[0013] Figure 5, is the graphical view of the change in the number of cycles in a method of detection load applied before the spinning cycle.

[0014] Each of the parts in the figures are numbered as follows:

1. Washing machine
2. Drum
3. Control card
4. Data storing unit
5. Microprocessor

[0015] The washing machines (1) preferably front loading washing machines comprises a drum (2) into which the laundry which is called load is placed and realizes washing and spinning by rotating around an axis, an electronic control card (3), a microprocessor (5) and a data storing unit (4).

[0016] Data storing unit (4) may be an external unit on the control card (3) or else an internal unit in a microprocessor such as RAM, ROM or EEPROM. In the preferrred embodiment, data is saved on a ROM in the microprocessor (5).

[0017] Washing machines perform the washing job in various program stages (PA) as washing cycle (PY) and/or rinsing cycle (PD) and/or spinning cycle (PS). In washing machines (1), before each washing cycle, weight of the laundry is determined by a load detection method.

[0018] The present load detection method comprises of the following steps

- A distribution step (200) during which the unbalance is decreased or eliminated that is caused by the distribution of the laundry in the washing machine at a speed (Vy) preset by the manufacturer;

- Speed deviation measuring step (300) in which first measurement is made at a test speed (Vt) preset by the manufacturer, absolute value deviations between measured speed values (V) and test speed (Vt) are calculated (IV_i - VtI) and added that gives the speed deviation (Sv) at the test speed (Vt), determining whether to proceed to the next step or to repeat the distribution step (200) according to the values obtained in the comparisons and in the next step:
- Ramp step (400) in which a pre-spinning speed (Vo) higher than the test speed (Vt) by a momentary acceleration is reached, the ramp period (t ramp) between the period from the test speed (Vt) and the pre-spinning speed (Vo) and total ramp motor voltage values (GTr) calculated at time intervals preset by the manufacturer are recorded;
- A pre-spinning step (500) in which, after spending some time at the reached pre-spinning speed (Vo), the total pre-spinning motor voltage values (Gts) at the pre spinning as calculated at the time intervals preset by the manufacturer at the pre-spinning speed (Vo) is recorded, and
- A fall step (600) wherein the fall interval (t_{decent}) required for to pass from the pre spinning speed (Vo) to a fall transition speed (Vg) that is lower than the pre spinning speed (Vo) and greater than the test spinning speed (Vt) is recorded, and by using ramp exit period (t ramp), fall period (t fall), total pre spinning voltage (GTs) and total ramp voltage (GTr) values and predetermined load constants (K1, K2, K3, K4, K5, ...) and unbalanced load constants (C1(Y), C2 (Y), C3 (Y), C4(Y),...) for possible load values (Y) predetermined by calculating from experimental data and which are stored in the data storing unit (4), the ramp temporary load value (Yr) is found by using the values obtained in the ramp stage (400), fall temporary load value (Yf) is found by using the values obtained in the fall stage (600), corrected load (Y) value is found by using the obtained ramp temporary load value (Yr) and fall temporary load value and the unbalanced load (DY) value is obtained by the obtained load (Y) and the way to start and to continue the program stages (PA) are determined according to the unbalanced load (DY) values.

[0019] Distribution step (200) comprises the steps of reaching a test speed (Vt) which is substantially lower than the resonance speed (Vr) that corresponds to the natural frequency of the entire washer and that harms itself at this frequency, which enables the laundry to cling on to the drum (2) due to the washing speed at a low speed and a long time interval and which results from the washers structure; and of waiting for a c ertain amount of time for the drum (2) speed within a specific time interval to settle into the constant test speed (Vt). During the distribution step (200) evacuation pump continuously pumps out the accumulated water.

[0020] Right after the distribution step, in the speed deviation calculation step (300), it is determined whether the absolute deviation is within the range set by the manufacturer. Thus when it is determined that the settling is provided at the test speed (Vt), speed measurement is made during "k" number of tours as set by the manufacturer in order to provide sufficient statistical data and required load distribution. Absolute deviation from the calculated speed values (V_i) from the test speed (Vt) (IV_i - VtI) are calculated and added. By means of this, at the speed deviation calculation step (300), the speed deviation (Sv) formed at the test speed (Vt) is calculated according to the equation:

[0021]

$$Sv = \sum_{i=1}^{k} I V_i - Vt I \qquad \text{(equation 1)}$$

[0022] Obtained deviation value (Sv) from the test speed (Vt) is compared with the reference values obtained during design and manufacturing stages and recorded into the microprocessor (5) and unbalanced load amount in an empty drum is calculated. These values are equal to the minimum unbalanced load amount according to the other balanced load position. If this value does not permit to move to the pre-spinning step, before doing this, drum (2) is stopped and distribution step is repeated (200). If minimum unbalanced load amount obtained at the result of this process cannot be lowered to a limit preset by the manufacturer, distribution step (200) is repeated equal to the number of maximum cycle number. In case it is not succeeded, unbalanced load amount is accepted as a value specified as a result of test data and the cycle is proceeded. Thus, as there is no pre-limiting, it is moved from the speed deviation calculation step (300) to ramp step (400).

[0023] At ramp step (400), at the ramp accelerating period (t ramp), from (t ramp start) moment to (t ramp end) moment, with a high acceleration in a short time a speed higher than the resonance spinning speed (Vr), for instance to a pre-spinning speed (Vo) about twice as much of the resonance spinning speed (Vr). This high acceleration is for distributing load and passing the resonance frequency with high speed in order to eliminate the moving of the washing machine and/or striking the parts to each other. Total ramp voltage (GTr) obtained as a result of specific time intervals at the ramp stage (G_{ramp}) and ramp acceleration time period (t_{ramp}) are calculated with the equations

[0024]

$$GTr = \sum_{j=1}^{m} (G_{ramp})_j \qquad \text{(equation 2)}$$

$$t_{ramp} = t_{ramp\ end} - t_{ramp\ start} \qquad \text{(equation 3)}$$

[0025] and gives a valuable information about the amount of laundry in the drum (2). Higher amount of the load increases the time period and current values.

[0026] As the pre-spinning step (500) is reached from ramp step (400), at pre-spinning speed (Vo) spinning is conducted for a specific time ($t_{settle\text{-}pre\ spinning}$). This period ($t_{settle\text{-}pre\ spinning}$) is a period of time wherein settling in is guaranteed at the pre spinning speed. At the end of this process an environment wherein clinging tightly on the wall of the drum (2) and minimum friction of laundry-glass lid is achieved.

[0027] At the pre spinning stage (500) after the part which corresponds to the settling ($t_{settle\text{-}pre\ spinning}$) of the duration period of the pre spinning speed (Vo), the voltage ($G_{pre\ spinning}$) applied to the motor in order to ensure spinning at the pre spinning speed (Vo) are added together and the total of the pre spinning voltage (GTs) is calculated with the equation;

[0028]

$$GTs = \sum_{i=1}^{n} (G_{pre\ spinning})_i \qquad \text{(equation 4)}$$

[0029] Passing from the pre spinning stage (500) to the fall stage (600), during a fall transition speed (Vg) which is smaller than pre spinning speed (Vo) and greater than the test spinning speed (Vt), the period of time ($t_{fall\ transition}$) which passes from the time where free fall begins from the pre spinning stage (Vo) and the time ($t_{fall\ ambition}$) where fall transition speed (Vg) is reached. The load value is calculated by using the period and voltage values obtained from this and from the previous stages and the fall stage (600) is continued according to the program used.

[0030]

$$t_{fall} = t_{fall\ transition} - t_{fall\ start} \qquad \text{(equation 5)}$$

[0031] If it is present before the washing stage (PY) a free fall is ensured at the fall stage (600) for a period of time wherein the drum (2) reaches a stop from the pre spinning speed (Vo).

[0032] If it is present at the rinsing stage (PD), free fall is ensured at the fall stage (600) from the pre spinning speed (Vo) to the test spinning speed (Vt). In the meantime, at which step to carry on with the rinsing stage (PD) is determined by calculating the determined load (Y) value and recorded manufacturer values and the unbalanced load (DY) value.

[0033] If it is present at the spinning stage (PS), free fall is ensured at the fall stage (600) from the pre spinning speed (Vo) to the test spinning speed (Vt). In the meantime, at which step to carry on with the spinning stage (PS) is determined by calculating the determined load (Y) value and recorded manufacturer values and the unbalanced load (DY) value.

[0034] The measured speed deviation (Sv) at the speed deviation calculation step (300), the ramp exit period (t_{ramp}) and the total ramp voltage (GTr) measured at the ramp stage (400), the total pre spinning voltage (GTs) and the fall period (t_{fall}) which is detected by the measurements made at the fall stage (600) and the constants, such as (K1, K2, K3, K4, K5, ...); which are recorded at the data storing unit (4) and which are obtained by solving the experimental data are used by a control card (3) and the temporary ramp load value (Yr) is found with the equation;

[0035]

$$Yr = K1 + K2 * Sv + K3 * (t_{ramp}) + K4 * GTr \qquad \text{(equation 6)}$$

[0036] In a similar way, the temporary fall load value (Yf) is found with the equation;

[0037]

$$Yf = K11 + K12 * Sv + K13 * (t_{fall}) + K14 * GTs \qquad \text{(equation 7)}$$

[0038] By using the obtained temporary ramp load value (Yr) and the temporary fall load value (Yf), the corrected load (Y) value is found with the equation;

[0039]

$$Y = K21 * Yr + K22 * Yf \qquad \text{(equation 8)}$$

[0040] The obtained load (Y) value, the unbalanced load constants ((C1(Y)), (C2(Y)) which are recorded in the data storing unit (4) and which are determined by experimental measurements for load values (Y) calculated from experimental data and speed deviation (Sv) and unbalanced load (DY) value measured at the speed deviation calculation step (300) is calculated with the equation

[0041]

$$DY = (C1\ (Y)) + (C2\ (Y)) * (Sv) \qquad \text{(equation 9)}$$

[0042] By taken into account the load (Y) quantity which is stored in the data storing unit (4) and which is found by solving the equations (equation 1 to eqution 8) with the parameters and the measurment values calculated from the results of the reference experiments carried out during design and production, the water quantity, the washing material such as detergant and softener quantity and the washing steps and the intervals to be used are selected according to the options predetermined by the manufacturer; and at the same time by comparing the experimental data defined for the spinning speeds that correspond to the obtained load (Y) quantity and the determined unbalanced load (DY) values, the spining profiles which comprise parameters such as the speed and the duration to be applied in the rinsing and the spinning stages are determined and applied.

[0043] In one of the embodiment of the invention, the load detection method, in a washer (1) which has a resonance frequency around 200 revolution/minute the test speed (Vt) used is 100 revolution/minute and the pre spinning speed (Vo) is 400 revolution/ minute.

[0044] With the invention, the load detection method, by properly determining the loads at the beginning of the washing process, appropriate washing algorithms can be applied by comsuming low energy and by using the required amount of washing material and water quantity. Consequently, it is possible to produce low volume washing machines that have high load capacities. Moreover, as efficient and reliable washing and spinning profiles are provided with the unbalanced load values (DY) which are calculated from the load (Y) values, problems resulting from spinning such as opening of the drum, breaking of the bearings, wearinng out of the damper and the burden of service is decreased and at the same time it is possible for the user to use the washer/ dryer by using minimum detergant, softener quantities and minimum time and minimum energy.

Claims

1. A load detection method, which is used in a washer (1) comprising an electronic control card (3) and a data storing unit (4) and which is applied before any of the program stages (PA) which are washing stage (PY), rinsing stage (PD) or spinning stage (PS) to detect the weight of the laundry placed inside the drum, and which is comprising the steps of;

- a distribution step (200) at a speed (Vy) preset by the manufacturer during which the unbalance is decreased or eliminated that is caused by the distribution of the laundry in the washing machine;
- a speed deviation measuring step (300) in which first measurement is made at a test speed (Vt) preset by the manufacturer, absolute value deviations between measured speed values (V_i) and test speed (Vt) are calculated ($|V_i - Vt|$) and added that gives the speed deviation Sv at the test speed (Vt), determining whether to proceed to the next step or to repeat the distribution step (200) according to the values obtained in the comparisons;
- a Ramp step (400) in which a pre-spinning speed (Vo) higher than the test speed (Vt) by a momentary acceleration is reached, the ramp period (t ramp) between the period from the test speed (Vt) and the pre-spinning speed (Vo) and total ramp motor voltage values GTr calculated at time intervals preset by the manufacturer are recorded ;
- a pre-spinning step (500) in which, after spending some time at the reached pre-spinning speed (Vo), the total pre-spinning motor voltage values GTs at the pre-spinning as calculated at the time intervals preset by the manufacturer at the pre-spinning speed is recorded, and

- a fall step (600) wherein the fall interval (t_{decent}) required for to pass from the pre-spinning speed (Vo) to a fall transition speed (Vg) that is lower than the pre-spinning speed (Vo) and greater than the test speed (Vt) is recorded,

and by using ramp exit period (t_{ramp}), fall (t_{fall}), total pre- spinning motor voltage values GTs and total ramp motor voltage values GTs values and predetermined load constants K1, K2, K3, K4, K11, K12, K13, K14, K21, K22 and unbalanced load constants C1(Y), C2 (Y); for possible load values (Y) predetermined by calculating from experimental data and which are stored in the data storing unit (4),

the ramp temporary load value Yr is found by using the values obtained in the ramp stage (400) with the equation :

$$Yr = K1 + K2 * Sv + K3 * t_{ramp} + K4 * GTr$$

the fall temporary load value Yf is found by using the values obtained in the fall stage (600) with the equation :

$$Yf = K11 + K12 * Sv + K13 * t_{fall} + K14 * GTs$$

the corrected load Y value is found by using the obtained ramp temporary load value Yr and the fall temporary load value Yf with the equation :

$$Y = K21 * Yr + K22 * Yf$$

and the unbalanced load value DY is obtained by the obtained corrected load Y and the way to start and to continue the program stages (PA) s determined according to the unbalanced load (DY) values,

2. A load detection method as defined in claim 1 comprising the fall stage (600) wherein its unbalanced load value DY is calculated with the equation;

$$DY = C1\ (Y) + C2\ (Y) * Sv$$

3. A load detection method as defined in claim 1 or 2 comprising a fall stage (600) wherein free fall is ensured from pre-spinning speed (Vo) until the drum reaches a stop before the washing stage (PY).

4. A load detection method as defined in any of the claims above comprising a fall stage (600) wherein a free fall is enabled from the pre-spinning speed (Vo) to the test speed (Vt) before the rinsing stage (PD).

5. A load detection method as defined in any of the claims above comprising a fall stage (600) wherein a free fall is enabled from the pre spinning speed (Vo) to the test speed (Vt) before the spinning stage (PS).

6. A method of operating a washer (1) according to a load detection method defined in any of the claims above.

Patentansprüche

1. Lasterkennungsverfahren, das in einer Waschvorrichtung (1) benutzt wird, die eine elektronische Steuerkarte (3) und eine Datenspeichereinheit (4) umfasst, und das vor einer der Programmstufen (PA), bei denen es sich um eine Waschstufe (PY), eine Spülstufe (PD) oder eine Schleuderstufe (PS) handelt, angewandt wird, um das Gewicht der in die Trommel gelegten Wäsche zu erkennen, und das folgende Schritte umfasst:

- einen Verteilungsschritt (200) bei einer vom Hersteller voreingestellten Geschwindigkeit (Vy), in dessen Verlauf

das Ungleichgewicht reduziert oder beseitigt wird, das durch die Verteilung der Wäsche in der Waschmaschine verursacht wird;
- einen Geschwindigkeitsabweichungsmessschritt (300), wobei bei einer vom Hersteller voreingestellten Testgeschwindigkeit (Vt) eine erste Messung durchgeführt wird, Absolutwertabweichungen zwischen gemessenen Geschwindigkeitswerten (V_i) und der Testgeschwindigkeit (V_t) berechnet werden ($| V_i - V_t |$) und addiert werden, um die Geschwindigkeitsabweichung Sv bei der Testgeschwindigkeit (Vt) zu ergeben, und anhand der in den Vergleichen erzielten Werte bestimmt wird, ob mit dem nächsten Schritt fortgefahren wird oder der Verteilungsschritt (200) wiederholt werden soll;
- einen Hochfahrschritt (400), wobei eine Vorschleudergeschwindigkeit (Vo), die höher ist als die Testgeschwindigkeit (Vt), durch vorübergehende Beschleunigung erreicht wird, wobei die Hochfahrperiode (t_{ramp}) zwischen der Periode von der Testgeschwindigkeit (Vt) zu der Vorschleudergeschwindigkeit (Vo) und die Gesamthochfahrmotorspannungswerte GTr, die in vom Hersteller voreingestellten Zeitintervallen berechnet werden, aufgezeichnet werden;
- einen Vorschleuderschritt (500), wobei dann, wenn einige Zeit bei der erreichten Vorschleudergeschwindigkeit (Vo) verbracht wurde, die Gesamtvorschleudermotorspannungswerte GTs beim Vorschleudern, die in vom Hersteller voreingestellten Zeitintervallen berechnet werden, aufgezeichnet werden;
- einen Abfallschritt (600), wobei das Abfallintervall (t_{decent}), das von der Vorschleudergeschwindigkeit (Vo) bis zu einer Abfallübergangsgeschwindigkeit (Vg), die unter der Vorschleudergeschwindigkeit (Vo) und über der Testgeschwindigkeit (Vt) liegt, verstreichen muss, aufgezeichnet wird, und durch Benutzen einer Hochfahrauslaufperiode t_{ramp}, einer Abfallperiode t_{fall}, der Gesamtvorschleudermotorspannungswerte GTs und der Gesamthochfahrmotorspannungswerte GTr und vorbestimmter Lastkonstanten K1, K2, K3, K4, K11, K12, K13, K14, K21, K22 und unsymmetrischer Lastkonstanten C1(Y), C2(Y) als mögliche Lastwerte (Y), die durch Berechnen aus Versuchsdaten vorbestimmt wurden, und die in der Datenspeichereinheit (4) gespeichert sind,
der vorübergehende Hochfahrlastwert Yr anhand der in der Hochfahrstufe (400) erlangten Werte mithilfe der folgenden Gleichung ermittelt wird:

$$Y_r = K1 + K2 * Sv + K3 * t_{ramp} + K4 * G_{Tr}$$

der vorübergehende Abfalllastwert Yf anhand der in der Abfallstufe (600) erlangten Werte mithilfe der folgenden Gleichung ermittelt wird:

$$Y_f = K11 + K12 * Sv + K13 * t_{fall} + K14 * G_{Ts}$$

der korrigierte Wert der Last Y anhand des erlangten vorübergehenden Hochfahrlastwerts Yr und des vorübergehenden Abfalllastwerts Yf mithilfe der folgenden Gleichung ermittelt wird:

$$Y = K21 * Y_r + K22 * Y_f$$

und der unsymmetrische Lastwert DY durch die erlangte korrigierte Last Y erlangt wird und das Verfahren zum Starten und Fortsetzen der Programmstufen (PA) gemäß den Werten der unsymmetrischen Last (DY) bestimmt wird.

2. Lasterkennungsverfahren nach Anspruch 1, umfassend die Abfallstufe (600), wobei deren Wert der unsymmetrischen Last (DY) mithilfe der folgenden Gleichung berechnet wird:

$$DY = C1 (Y) + C2 (Y) * Sv$$

3. Lasterkennungsverfahren nach Anspruch 1 oder 2, umfassend eine Abfallstufe (600), wobei vor der Waschstufe (PY) das freie Abfallen von der Vorschleudergeschwindigkeit (V_o) sichergestellt wird, bis die Trommel zum Halt kommt.

4. Lasterkennungsverfahren nach einem der vorangehenden Ansprüche, umfassend eine Abfallstufe (600), wobei vor der Spülstufe (PD) ein freies Abfallen von der Vorschleudergeschwindigkeit (Vo) auf die Testgeschwindigkeit (Vt) ermöglicht wird.

5. Lasterkennungsverfahren nach einem der vorangehenden Ansprüche, umfassend eine Abfallstufe (600), wobei vor der Schleuderstufe (PS) ein freies Abfallen von der Vorschleudergeschwindigkeit (Vo) auf die Testgeschwindigkeit (Vt) ermöglicht wird.

6. Verfahren zum Betreiben einer Waschvorrichtung (1) nach einem Lasterkennungsverfahren nach einem der oben stehenden Ansprüche.

Revendications

1. Une méthode de détection de charge, qui est utilisée dans une laveuse (1) comprenant une carte électronique de commande (3) et une unité de stockage des données (4), et qui est appliquée avant n'importe quelle étape de programme (PA) qui sont l'étape de lavage (PY), l'étape de rinçage (PD) ou l'étape d'essorage (PS) afin de détecter le poids du linge placé dans le tambour, et qui comprend les étapes de

- une étape de distribution (200) à une vitesse (Vy) prédéfinie par le fabricant au cours de laquelle le déséquilibre que la distribution du linge dans la machine à laver cause est diminué ou éliminé ;
- une étape de mesure d'écart de vitesse (300) où la première mesure est réalisée à une vitesse de test (Vt) prédéfinie par le fabricant, où des écarts de valeur absolus entre les valeurs de vitesse mesurées (V_i) et la vitesse de test (Vt) sont calculés (I V_i- Vt I) et ajoutés, qui donne l'écart de vitesse Sv à une vitesse de test (Vt), tout en décidant s'il convient de procéder à l'étape suivante ou de répéter l'étape de distribution (200) selon les valeurs obtenues dans les comparaisons ;
- Une étape d'augmentation (400) où une vitesse de pré-essorage (Vo) plus élevée que la vitesse de test (Vt) par une accélération momentanée est atteint, où la période d'augmentation (t_{ramp}) entre la période de la vitesse de test (Vt) à la vitesse de pré-essorage (Vo) et des valeurs totales de tension d'augmentation du moteur GTr calculées aux intervalles de temps prédéfinies par le fabricant sont enregistrées;
- une étape de pré-essorage (500) où, après avoir passé quelque temps à la vitesse de pré-essorage atteinte (Vo), les valeurs totales de tension de moteur de pré-essorage GTs au pré-essorage telles que calculées à des intervalles de temps prédéfinis à la vitesse de pré-essorage sont enregistrées, et
- une étape de baisse (600) où l'intervalle de baisse (t_{decent}) requis pour passer de la vitesse de pré-essorage (Vo) à une vitesse de transition de baisse (Vg) qui est inférieure à la vitesse de pré-essorage (Vo) et supérieure à la vitesse de test (Vt) est enregistrée et en utilisant la période de sortie d'augmentation t_{ramp}, la période de baisse t_{fall}, les valeurs totales de tension de moteur de pré-essorage GTs et les valeurs totales de tension d'augmentation du moteur GTr et les constantes de charge prédéterminées K1, K2, K3, K4, K11, K12, K13, K14, K21, K22 et les constantes de charge déséquilibré C1(Y), C2 (Y), pour les valeurs de charge possibles (Y) prédéterminées en calculant à partir des données expérimentales et qui sont enregistrées dans l'unité de stockage des données (4),

la valeur temporaire de change d'augmentation Yr est obtenue en utilisant les valeurs obtenues à l'étape d'augmentation (400) avec l'équation :

$$Yr = K1 + K2 * Sv + K3 * t_{ramp} + K4 * GTr$$

la valeur temporaire de change de baisse Yf est obtenue en utilisant les valeurs obtenues a l'étape de baisse (600) avec l'équation :

$$Yf = K11 + K12 * Sv + K13 * t_{fall} + K14 * GTs$$

la valeur de charge corrigé Y est obtenue en utilisant la valeur temporaire de charge d'augmentation Yr et la valeur temporaire de charge de baisse Yf avec l' équation :

$$Y = K21 * Yr + K22 * Yf$$

et la valeur de charge déséquilibré DY est obtenue par le charge corrigé obtenu Y et la façon de démarrer et de poursuivre les étapes du programme (PA) est déterminé selon les valeurs de charge déséquilibré (DY).

2. Une méthode de détection de charge selon la Revendication 1, comprenant l'étape de baisse (600) où sa valeur de charge déséquilibré (DY) est calculée avec l'équation :

$$DY = C1 (Y) + C2 (Y) * Sv$$

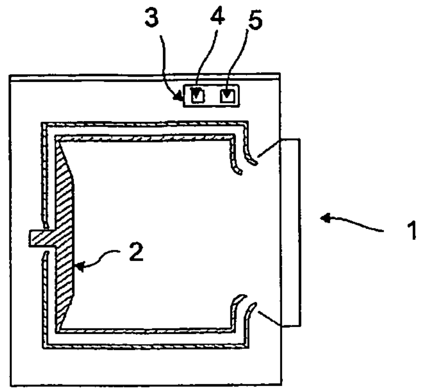
3. Une méthode de détection de charge selon la Revendication 1 ou 2, comprenant une étape de baisse (600) où la baisse libre est assurée par la vitesse de pré-essorage (Vo) jusqu'à ce que le tambour s'arrête après l'étape de lavage (PY).

4. Une méthode de détection de charge selon l'une quelconque des revendications précédentes, comprenant une étape de baisse (600) où une baisse libre est activée à partir de la vitesse de pré-essorage (Vo) à la vitesse de test (Vt) avant l'étape de rinçage (PD).

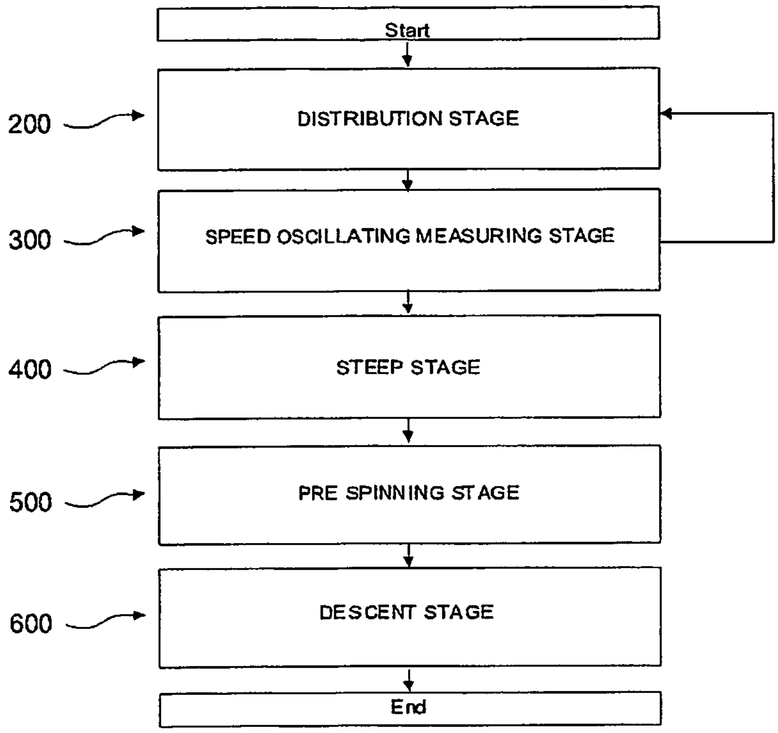
5. Une méthode de détection de charge selon l'une quelconque des revendications précédentes, comprenant une étape de baisse (600) où une baisse libre est activée à partir de la vitesse de pré-essorage (Vo) à la vitesse de test (Vt) avant l'étape d'essorage (PS).

6. Une méthode de fonctionner une laveuse (1) selon une méthode de détection de charge selon l'une quelconque des revendications précédentes.

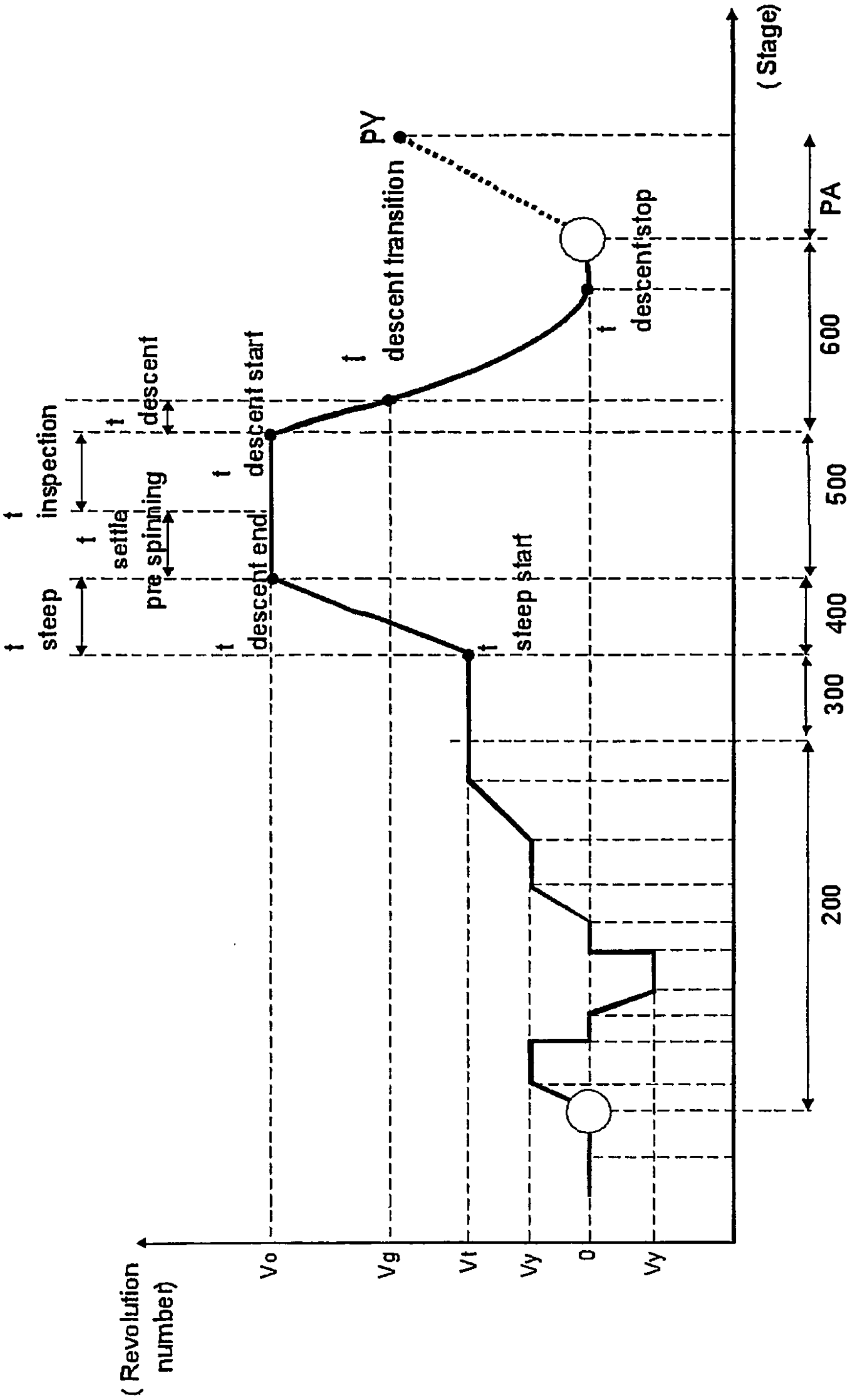
[Fig. 001]



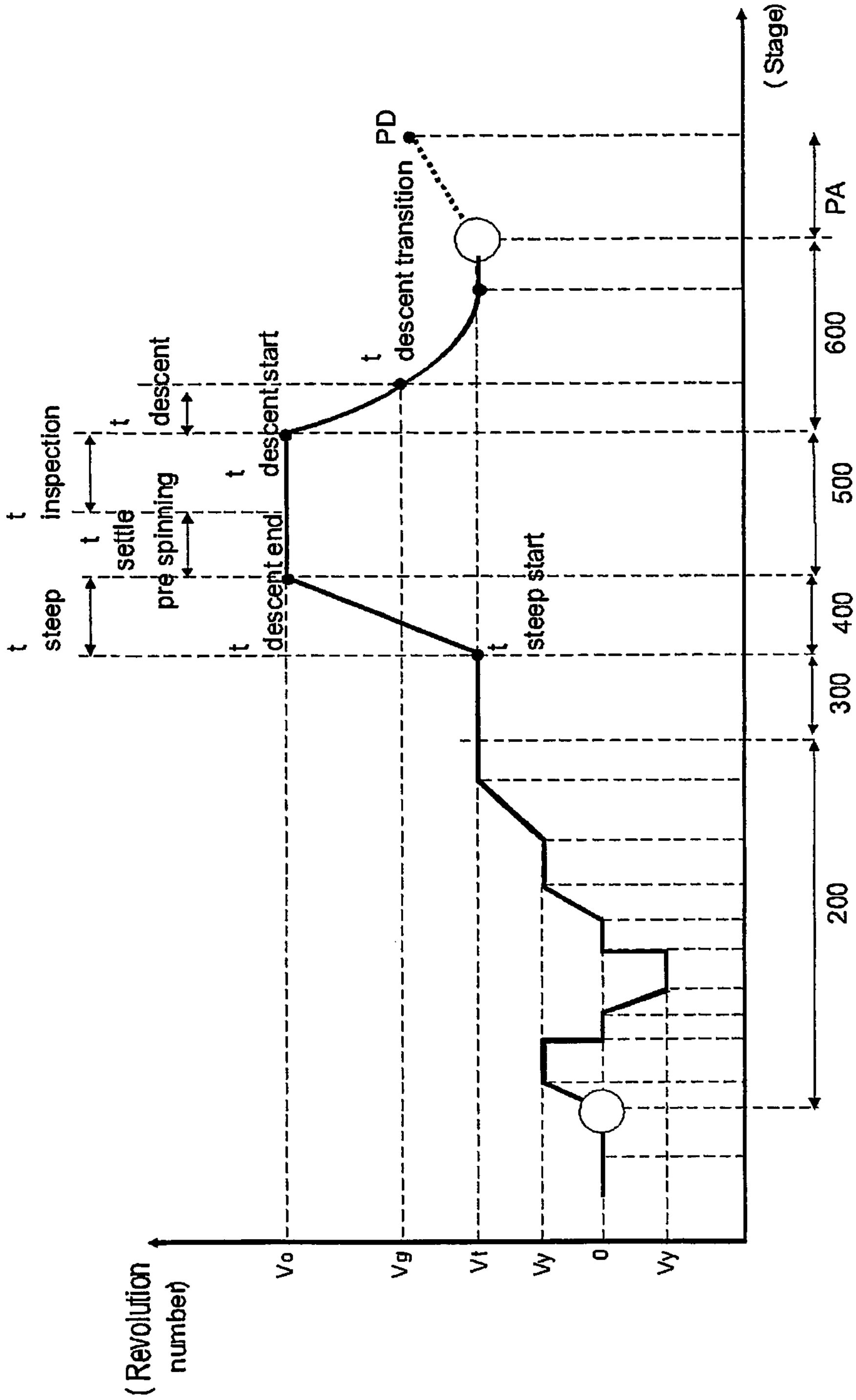
[Fig. 002]



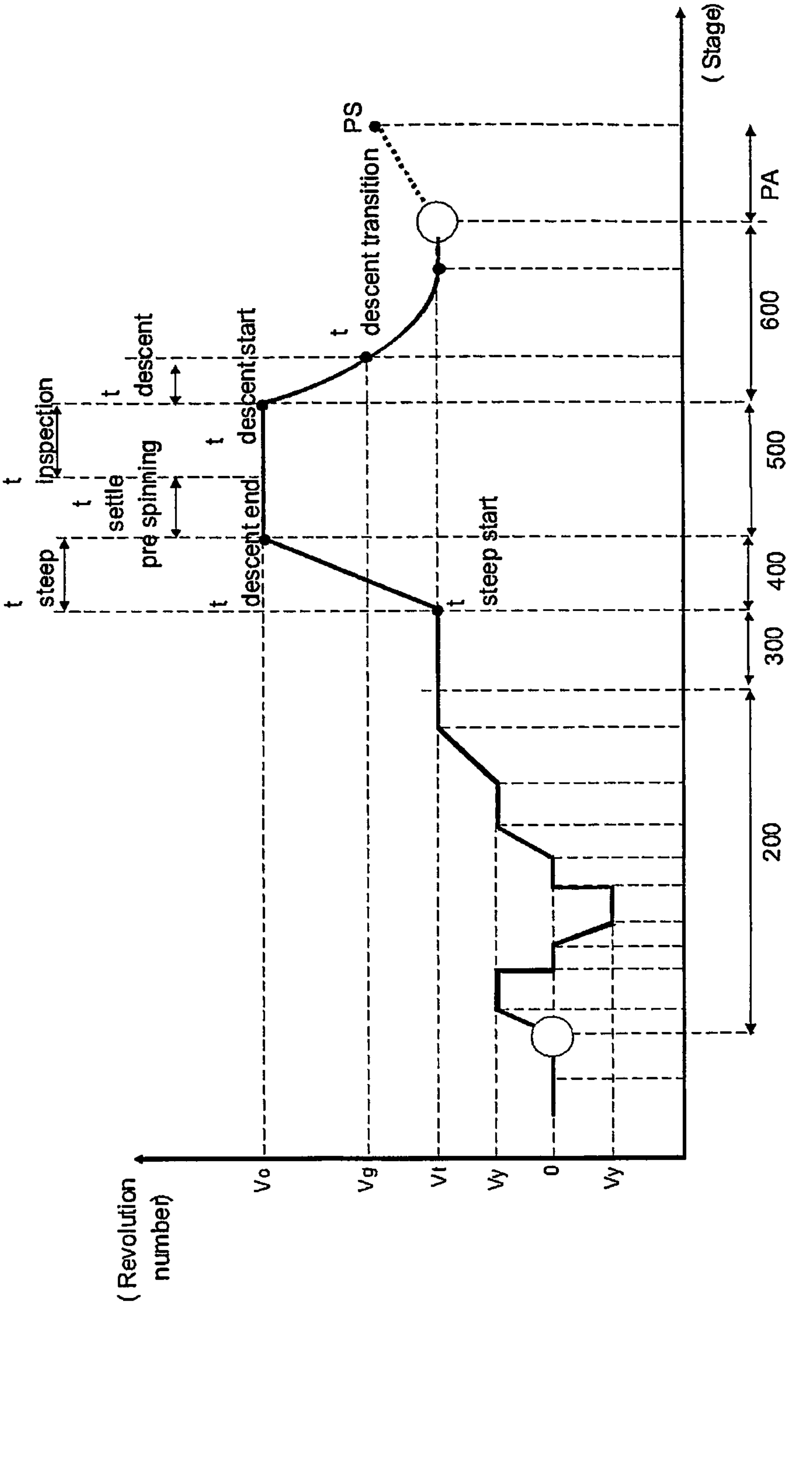
[Fig. 003]


(Stage)
PY
PA
descent transition
descent stop
descent start
descent end
descent
inspection
settle
pre spinning
steep
steep start
t
600
500
400
300
200
Vo
Vg
Vt
Vy
0
Vy
(Revolution number)

[Fig. 004]


(Stage)
(Revolution number)
PD
PA
600
500
400
300
200
Vo
Vg
Vt
Vy
0
Vy
t steep
t inspection
t settle
t descent
pre spinning
t descent end
t descent start
t descent transition
t steep start

[Fig. 005]


(Stage)
(Revolution number)
PS
PA
descent transition
descent start
descent end
steep start
t
steep
settle
pre spinning
inspection
descent
Vo
Vg
Vt
Vy
0
Vy
200
300
400
500
600

REFERENCES CITED IN THE DESCRIPTION

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