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(54) CONTROL METHOD OF LAUNDRY MACHINE

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Description

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

[0002] In general, a laundry machine may include washing, rinsing and spinning cycles. Here, the spinning cycle includes a rotating step of rotating a drum provided in such a laundry machine at the highest RPM. Because of the step, the spinning cycle would generate noise and vibration quite a lot, which is required to be solved in the art the present invention pertains to.

[0003] KR 100 730 930 B1 relates to a dehydration method of a drum washer being provided to remove bubbles by operating a blowing fan for a predetermined period of time and supplying condensate, thereby reducing excessive consumption of water and maintaining the dehydration performance.

[0004] JP 9 108489 A relates to a washing method capable of removing bubbles inside a washing machine, wherein when the rotation number of the washing tank is less than normal, it is determined that bubbles remain between the tank and the outer side washing bucket and the washing machine is stopped for a prescribed time.

[0005] JP 2008 295531 A relates to a washing machine including a spin-drying tub having spin-drying holes in its upper part, calculating the rotating speed of the spin-drying tub based on pulses generated from a rotation sensor of a motor, comparing two different prescribed rotating speeds, determining the degree of the bubble interruption and executing optimal corrective rinsing.

[0006] JP 9 066188 relates to a washing machine with a control device for judging whether or not rotational failure of a washing tank is caused on the basis of detection of rotating speed of a rotating speed sensor in early stages at dehydrating time after a washing stroke. When it is determined that rotational failure is caused by bubbles generated by residual detergent quantity between a water receiving tank and the washing tank, power to a motor is cut off and water is injected from a water injection passage.

[0007] Accordingly, the present invention is directed to a control method of a laundry machine.

[0008] An object of the present invention is to provide a control method of a laundry machine which can solve the above problem.

[0009] To solve the problems, an object of the present invention is to provide a control method of a laundry machine comprising a spinning cycle, the control method comprising a sensing step configured to sense a rotation speed (rpm) of a motor while increasing a pulse duty of the motor during the spinning cycle and a determining step configured to determine bubble generation inside a tub based on the sensed pulse duty and rotation speed.

[0010] The present invention has following advantageous effects.

[0011] According to the spinning cycle control method of the laundry machine, bubbles generated in the spinning cycle of the laundry machine may be detected ef-

fectively and the operation of the laundry machine may be controlled efficiently based on the generated bubbles.

[0012] The accompanying drawings, which are included to provide further understanding of the disclosure and are incorporated in and constitute a part of this application, illustrate embodiments of the disclosure and together with the description serve to explain the principle of the disclosure.

[0013] In the drawings:

FIG. 1 is an exploded perspective view illustrating a laundry machine a control method according to the present invention is applied to;

FIG. 2 is a sectional view illustrating a connecting state of FIG. 1;

FIG. 3 is a graph illustrating changes of a rotation speed of a drum according to a spinning cycle control method of the present invention;

FIG. 4 is a graph illustrating changes of an unbalance wave;

FIG. 5 is a flow chart illustrating a control method configured for the rotation speed of the drum to pass a transient region shown in FIG. 3;

FIG. 6 is a graph illustrating RPM change of the drum according to a second method shown in FIG. 5;

FIG. 7 is a flow chart illustrating a bubble preventing method of the laundry machine according to an embodiment of the present invention;

Fig. 8 is a graph showing a relation of mass vs. a natural frequency. ; and

Fig. 9 is a graph illustrating vibration characteristics of the laundry machine of FIG. 2.

Best Mode for Carrying out the Invention

[0014] Reference will now be made in detail to the specific embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0015] According to a laundry machine according to an embodiment, the tub may be fixedly supported to the cabinet or it may be supplied to the cabinet by a flexible supporting structure such as a suspension unit which will be described later. Also, the supporting of the tub may be between the supporting of the suspension unit and the completely fixed supporting.

[0016] That is, the tub may be flexibly supported by the suspension unit which will be described later or it may be complete-fixedly supported to be movable more rigidly. Although not shown in the drawings, the cabinet may not be provided unlike embodiments which will be described later. For example, in case of a built-in type laundry machine, a predetermined space in which the built-in type laundry machine will be installed may be formed by a wall structure and the like, instead of the cabinet. In other words, the built-in type laundry machine may not

include a cabinet configured to define an exterior appearance thereof independently.

[0017] In reference to FIGS. 1 and 2, a tub 12 provided in the laundry machine is fixedly supported to a cabinet. The tub 12 includes a tub front 100 configured to define a front part of the tub and a tub rear 120 configured to define a rear part of the tub. The tub front 100 and the tub rear 120 are assembled to each other by screws, to form a predetermined space big enough to accommodate the drum. The tub rear 120 has an opening formed in a rear portion thereof and an inner circumference of the rear portion composing the tub rear 120 is connected with an outer circumference of a rear gasket 250. The tub back 130 has a through-hole formed in a center thereof to pass a shaft to pass there through. The rear gasket 250 is made of a flexible material not to transmit the vibration of the tub back 130 to the tub rear 120. The tub rear 120 has a rear surface 128 and the rear surface 128, the tub back 130 and the rear gasket 250 may define a rear wall of the tub. The rear gasket 250 is connectedly sealed with the tub back 130 and the tub rear 120, such that the wash water held in the tub may not leak. The tub back 130 is vibrated together with the drum during the rotation of the drum. At this time, the tub back 130 is distant from the tub rear 120 enough not to interfere with the tub rear. Since the rear gasket 250 is made of the flexible material, the tub back 130 is allowed to relative-move, without interference of the tub rear 120. The rear gasket 250 may include a corrugated portion 252 extendible to a predetermined length to allow the relative-motion of the tub back 130.

[0018] A foreign substance preventing member 200 configured to prevent foreign substances from drawn between the tub and the drum may be connected to a front portion of the tub front 100. The foreign substance preventing member 200 is made of a flexible material and it is fixed to the tub front 100. Here, the foreign substance preventing member 200 may be made of the flexible material identical to the material composing the rear gasket 250. Hereinafter, the foreign substance preventing member 200 will be referenced to as 'front gasket'.

[0019] The drum 32 includes a drum front 300, a drum center and a drum back 340. Balancers 310 and 330 may be installed in front and rear parts of the drum, respectively. The drum back 340 is connected with a spider 350 and the spider 350 is connected with the shaft 351. The drum 32 is rotated in the tub 12 by a torque transmitted via the shaft 351.

[0020] The shaft 351 is directly connected with a motor 170, passing through the tub back 130. Specifically, a rotor 174 composing the motor 170 is directly connected with the shaft 351. a bearing housing 400 is secured to a rear portion of the tub back 130 and the bearing housing 400 rotatably supports the shaft, located between the motor 170 and the tub back 130.

[0021] A stator 172 composing the motor 170 is secured to the bearing housing 400 and the rotor 174 is located surrounding the stator 172. As mentioned above,

the rotor 174 is directly connected with the shaft 351. Here, the motor 170 is an outer rotor type motor and it is directly connected with the shaft 351.

[0022] The bearing housing 400 is supported via a suspension unit with respect to a cabinet base 600. The suspension unit 180 includes three perpendicular supporters and two oblique supporters configured to support the bearing housing 400 obliquely with respect to a forward and rearward direction.

[0023] The suspension unit 180 may includes a first cylinder spring 520, a second cylinder spring 510, a third cylinder spring 500, a first cylinder damper 540 and a second cylinder damper 530.

[0024] The first cylinder spring 520 is connected between a first suspension bracket 450 and the cabinet base 600. The second cylinder spring 510 is connected between a suspension bracket 440 and the cabinet base 600.

[0025] The third cylinder spring 500 is directly connected between the bearing housing 400 and the cabinet base 600.

[0026] The first cylinder damper 540 is inclinedly installed between the first suspension bracket 450 and a rear portion of the cabinet base. The second cylinder damper 530 is inclinedly installed between the second suspension bracket 440 and a rear portion of the cabinet base 600.

[0027] The cylinder springs 520, 510 and 500 of the suspension unit 180 may be elastically connected to the cabinet base 600 enough to allow a forward/rearward and rightward/ leftward movement of the drum, not connected to the cabinet base 600 fixedly. That is, they are elastically supported by the base 600 to allow the drum to be rotated to a predetermined angle in forward/rearward and rightward/leftward directions with respect to the connected portion.

[0028] The perpendicular ones of the suspension unit may be configured to suspend the vibration of the drum elastically and the oblique ones may be configured to dampen the vibration. That is, in a vibration system including a spring and damping means, the perpendicular ones are employed as spring and the oblique ones are employed as damping means.

[0029] The tub front 100 and the tub rear 120 are fixedly secured to the cabinet 110 and the vibration of the drum 32 is suspendedly supported by the suspension unit 180. The supporting structure of the tub 12 and the drum 32 may be called 'separated' substantially, such that the tub 12 may not be vibrated even when the drum 32 is vibrated.

[0030] The bearing housing 400 and the suspension brackets may be connected with each other by first and second weights 431 and 430.

[0031] In case the drum 30 and 32 is rotated after the laundry 1 is loaded in the drum 30 and 32 of the laundry machine according to the above embodiments, quite severe noise and vibration may be generated according to the position of the laundry 1. For example, when the drum

30 and 32 is rotated in a state of the laundry not distributed in the drum 30 and 32 uniformly (hereinafter, 'unbalanced rotation'), much noise and vibration may be generated. Especially, if the drum 30 and 32 is rotated at a high speed to spin the laundry, the noise and vibration may be problematic.

[0032] Because of that, the laundry machine may include the balancer 310 and 330 configured to prevent the noise and vibration generated by the unbalanced rotation of the drum 32. According to this embodiment, a front balancer 310 is mounted to a front portion of the drum and a rear balancer 320 is mounted to a rear portion of the drum. A front mounting groove (not shown) is recessed rearward from the front portion of the drum to mount the front balancer 310 therein and a rear mounting groove (not shown) is recessed forward from the rear portion of the drum to mount the rear balancer 320 therein.

[0033] According to this embodiment, the front balancer 310 is identical to the rear balancer 320. However, it is not necessary to mount the identical balancers to the front and rear portions of the drum, respectively.

[0034] The balancers are mounted to the drum 30 and 32 to reduce the unbalance. Because of that, the balancer may have a movable gravity center. For example, the balancer may include movable bodies having a predetermined weight located therein and a passage the movable bodies move along. If the balancers may be ball balancers, the balancer 70, 310 and 330 may include balls 72, 312 and 332 having a predetermined weight located therein and a passage the ball moves along.

[0035] The balancers 310 and 320 have predetermined inner spaces to form a passage of the balls 312 and 332. Here, the number of the balls located in the inner spaces and the radii of the balls may be determined in consideration of the unbalance amount to reduce and the vibration property of the laundry machine.

[0036] In addition, oil (not shown) is filled in the inner spaces. The amount and the viscosity of the filled oil may affect the movement of the balls. Because of that, the amount and viscosity of the oil may be determined for the balls of the balancer to have the required movement. Also, the vibration property of the laundry machine may be put into the consideration when determining that.

[0037] More specifically, the balls are rotated by the friction generated during the rotation of the drum 30 and 32 and they are not kept unmovable in the drum when the drum is rotated. Because of that, the balls are rotated at a different speed from the rotation speed of the drum. Here, the laundry which generates the unbalance may be rotated at the almost same speed as the speed of the drum because of the friction generated by the close contact with an inner circumferential surface of the drum and the lifters provided in the inner circumferential surface. As a result, the rotation speed of the laundry is different from that of the balls. The rotation speed of the laundry is higher than that of the balls during an initial rotation stage in which the drum is rotated at a relatively low

speed, specifically, a rotation angle speed of the laundry is higher. In addition, a phase difference between the balls and the laundry, which is a phase difference with respect to a rotation center of the drum, may change continuously.

[0038] Hence, when the rotation speed of the drum is getting higher, the balls may be in close contact with an outer circumferential surface of the passage by the centrifugal force. At the same time, the balls are aligned at a predetermined position having approximately 90° to 180° of the phase difference with respect to the laundry. If the rotation speed of the drum is a predetermined value or more, the centrifugal force is getting larger and the friction generated between the outer circumferential surface and the balls is a predetermined value or more and the balls may be rotated at the same speed as the drum. at this time, the balls are rotated at the same speed as the drum, with maintaining the position having the 90° to 180°, preferably, approximately 180° of the phase difference with respect to the laundry. In this specification of the present invention, the rotation of the balls at the predetermined positions as mentioned above may be expressed as 'unbalance corresponding position' or 'balancing'.

[0039] As a result, in case load is concentrated on a predetermined portion of the drum inside by the laundry, the ball located in the balancer 70, 310 and 330 may move to an unbalance corresponding position to reduce the unbalance.

[0040] As follows, a control method of the laundry machine having the above configuration according to the above embodiments will be described. typically, the laundry machine includes washing, rinsing and spinning cycles and the control method according to the present invention which is applicable to the spinning cycle will be described in reference to corresponding drawings.

[0041] FIG. 3 is a graph illustrating RPM change of the drum as the time passes according to the control method of the spinning cycle. According to FIG. 3, a horizontal axis is 'time' and a vertical axis is 'rotation speed' of the drum 30 and 32 which is change of RPM.

[0042] In reference to FIG. 3, the spinning cycle control method according to the present invention includes a laundry distributing step (S100) and a spinning step (S200).

[0043] The laundry distributing step (S100) distributes the laundry uniformly, as rotating the drum at a relatively low speed. The spinning cycle (S200) rotates the drum at a relatively high speed to remove moisture contained in the laundry. Here, such the laundry distributing step and spinning step are named with respect to main functions thereof. The functions of the steps may not be limited to the names. For example, the laundry distributing step may remove the moisture of the laundry by using the rotation of the drum, as well as the laundry distributing.

[0044] The laundry distributing step (S100) composing the control method according to the present invention

may include a wet laundry sensing step (S110), a laundry disentangling step (S130) and an unbalance sensing step (S150). The spinning step (S200) may include a transient region passing step (S210) and an accelerating step (S230). As follows, each one of the above steps will be described.

[0045] Once the rinsing cycle is completed, the laundry located in the drum 30 and 32 is wet by the moisture. A control part senses the amount of the laundry, that is, the amount of the wet laundry located in the drum 30 and 32, when the spinning cycle is put into operation (S110).

[0046] The reason why the amount of the wet laundry is that the amount of the dry laundry measured in an initial stage of the washing cycle is different from the amount of the wet laundry containing the moisture. The sensed amount of the wet laundry may be used as an element configured to determine an allowable condition of the drum accelerating or to determine to re-implement the laundry distributing step after decreasing the speed of the drum 30 and 32 based on an unbalance condition in the transient region passing step (S210).

[0047] According to the control method of the present invention, the amount of the wet laundry located in the drum 30 and 32 is measured in case the drum is rotated at a decreased speed after rotated at a constant speed of approximately 100 to 110 RPM reached by the acceleration for a predetermined time period. If the rotation speed of the drum is decreased, rheostatic braking is used. Specifically, the amount of the wet laundry is measured by using the amount of acceleration period rotation in accelerating the motor 40 and 170 configured to rotate the drum 30 and 32, the amount of the acceleration period rotation in decreasing the speed of the motor 40 and 170, and an applied DC voltage.

[0048] After measuring the amount of the wet laundry, the control part may implement the laundry disentangling step (S130) configured to distribute the laundry inside the drum uniformly.

[0049] The laundry disentangling step distributes the laundry located in the drum 30 and 32 uniformly to prevent the laundry from concentrated on a specific region inside the drum, which might increase the unbalance. If the unbalance is increased, noise and vibration will be increased in case the RPM of the drum is heightened. The laundry disentangling step accelerates the drum in a predetermined single direction with a predetermined oblique and it is implemented until the RPM reaches a rotation speed of the unbalance sensing step which will be described later.

[0050] Hence, the control part senses the unbalance of the drum (S150).

[0051] If the laundry is concentrated on a specific region inside the drum 30 and 32, not distributed uniformly, the unbalance is increased and the noise and vibration will be generated when the RPM of the drum 30 and 32 is heightened. Because of that, the control part senses the unbalance of the drum and it determines whether the drum is accelerated.

[0052] The unbalance sensing uses difference of the accelerated speeds during the rotation of the drum 30 and 32. That is, there is difference of the accelerated speeds when the drum is rotated downward along the gravity and when it is rotated upward reversely according to the level of the generated unbalance. The control part measures the difference of the accelerated speeds by using a speed sensor, for example, a hall sensor provided in the motor 40 and 170 to sense the amount of the unbalance. In case the unbalance is sensed, the laundry located inside the drum keeps the close contact with the inner circumferential surface of the drum, without dropped from the inner circumferential surface, even during the rotation of the drum. The case having the drum rotated at approximately 100 to 110 RPM is corresponding to this case.

[0053] In the meanwhile, when the drum is rotated, the laundry machine according to the above embodiments may adapt the balancer to reduce the noise and vibration generated by the unbalance of the laundry located inside the drum. However, the balls of the balancer may be the unbalance applied to the drum, together with the laundry. Especially, the balls are moved along the rotation of the drum, because of that, when the unbalance is sensed by the laundry machine adapting the balancer, there may be an unbalance curvature looking like a sine wave with a predetermined period. As a result, in case the amount of the unbalance changes periodically like the sine wave, the unbalance amount of the drum cannot be determined by the unbalance amount at a predetermined single point simply. As follows, the control method of prevent invention invented to solve that problem will be described.

[0054] FIG. 4 is a graph illustrating change of the unbalance amount sensed when the drum is rotated in the laundry machine adapting the balancer. A horizontal axis is 'time' and a vertical axis is 'unbalance amount' and 'RPM of the drum'.

[0055] In reference to FIG. 4, the control part determines whether the unbalance wave increases or decreases, in a predetermined time after the rotation of the drum is maintained to be a first rotation speed, which is approximately 100 to 110 RPM, specifically, in 1 period of FIG. 4. When the unbalance is sensed right after the drum is accelerated to be a predetermined RPM, the unbalance wave is not stabilized only to generate an error.

[0056] The control part senses the increasing or decreasing of the unbalance wave in the first period (1 Period) and it senses when the unbalance is the minimum value and the maximum value in the unbalance wave. After that, the control part memorizes 'unbalance_minimum value' and 'unbalance_maximum value'. That is, when the unbalance wave is increasing, the control part recognizes an unbalance_maximum value and an unbalance_minimum value sequentially. When the unbalance wave is decreasing, the control part recognizes an unbalance_minimum value and an unbalance_maximum value sequentially.

[0057] In reference to an unbalance wave shown in

FIG. 4, for example, the unbalance wave of '1 period' decreases and the control part sequentially stores values evaluated when the unbalance is the minimum value and the maximum value in '2 period' and '3 period' as unbalance_minimum value and unbalance_maximum value. Hence, the control part stores an average value of the two unbalance_minimum value and the unbalance_maximum value as the unbalance amount of the drum. That is, in case the drum is rotated at the constant RPM, the control part calculates the unbalance_minimum value and the unbalance_maximum value of the unbalance wave and it recognizes an average value of the two values as unbalance amount of the drum. Because of that, even in case the unbalance amount is changed along the unbalance wave, the amount of the unbalance can be determined accurately.

[0058] The control part may calculate the period of the unbalance wave from the time when the unbalance maximum/minimum values are sensed. In addition, the control part may determine the speed acceleration point of the time based on the period calculated from the time when the unbalance_minimum value is sensed in '3 period'.

[0059] In reference to FIG. 3 again, the amount of the wet laundry sensed in the wet laundry sensing step (S110) and the amount of the unbalance sensed in the unbalance sensing step (S150) may be used as elements to determine whether the speed of the drum 30 and 32 is accelerated to pass a transient region.

[0060] Specifically, if the drum is accelerated at a high speed in case the sensed unbalance amount of the drum having a predetermined amount of wet laundry is a reference unbalance value or more, the vibration and noise of the drum will increase remarkably and it is difficult to accelerate the speed of the drum. Because of that, the control part may store a reference unbalance value, which allows the acceleration of the speed according to the amount of the wet laundry as a table typed data. After that, the control part applies the sensed wet-laundry amount and the unbalance amount to the table and it determines whether the speed of the drum is accelerated. That is, in case the unbalance amount sensed according to the sensed wet-laundry amount is the reference unbalance value or more, it can be determined that the unbalance amount is too much to accelerate the drum speed and the above wet-laundry sensing, laundry disentangling and unbalance sensing steps are repeated.

[0061] As mentioned above, the repetition of the wet laundry sensing step, the laundry disentangling step and the unbalance sensing step may be continued until the sensed unbalance amount meets less than the reference unbalance value. However, if the laundry machine is in an abnormal state or the laundry is entangled severely inside the drum, the sensed unbalance amount cannot meet less than the reference unbalance value and the steps may be repeated. As a result, it is preferable that the control part controls the drum to stop the rotation and

notifies the user that the spinning cycle is not completed normally, if the speed of the drum fails to be accelerated for a predetermined time period, for example, approximately more than 20 to 30 minutes after the spinning cycle starts.

[0062] In reference to FIG. 3 again, in case the unbalance amount sensed according to the sensed wet laundry amount is less than the reference unbalance amount, the RPM accelerating condition is satisfied and the control part implements the transient region passing step (S210).

[0063] Here, the transient region is a predetermined RPM band including at least one resonance frequency which generates resonance according to the system of the laundry machine. When the system of the laundry machine is determined, the transient region is a unique vibration property generated according to the determined system. The transient region is variable according to the system of the laundry machine. For example, the transient region includes a scope of approximately 200 to 270 RPM in the laundry according to the first embodiment and a scope of approximately 200 to 350 RPM in the laundry machine according to the second embodiment.

[0064] FIG. 8 illustrates a graph showing a relation of mass vs. a natural frequency. It is assumed that, in vibration systems of two laundry machines, the two laundry machines have mass of m_0 and m_1 respectively and maximum holding laundry amounts are Δm , respectively. Then, the transition regions of the two laundry machines can be determined taking $\Delta n f_0$ and $\Delta n f_1$ into account, respectively. In this instance, amounts of water contained in the laundry will not be taken into account, for the time being.

[0065] In the meantime, referring to FIG. 8, the laundry machine with smaller mass m_1 has a range of the transition region greater than the laundry machine with greater mass m_0 . That is, the range of the transition region having variation of the laundry amount taken into account becomes the greater as the mass of the vibration system becomes the smaller.

[0066] The ranges of the transition regions will be reviewed on the related art laundry machine and the laundry machine of the embodiment.

[0067] The related art laundry machine has a structure in which vibration is transmitted from the drum to the tub as it is, causing the tub to vibrate. Therefore, in taking the vibration of the related art laundry machine into account, the tub is indispensable. However, in general, the tub has, not only a weight of its own, but also substantial weights at a front, a rear or a circumferential surface thereof for balancing. Accordingly, the related art laundry machine has great mass of the vibration system.

[0068] Opposite to this, in the laundry machine of the embodiment, since the tub, not only has no weight, but also is separated from the drum in view of a supporting structure, the tub may not be put into account in consideration of the vibration of the drum. Therefore, the laundry machine of the embodiment may have relatively small

mass of the vibration system.

[0069] Then, referring to FIG. 8, the related art laundry machine has mass m_0 and the laundry machine of the embodiment has mass m_1 , leading the laundry machine of the embodiment to have a greater transition region, at the end.

[0070] Moreover, if the amounts of water contained in the laundry are taken into account simply, Δm in FIG. 8 will become greater, making a range difference of the transition regions even greater. And, since, in the related art laundry machine, the water drops into the tub from the drum even if the water escapes from the laundry as the drum rotates, an amount of water mass reduction come from the spinning is small. Since the laundry machine of the embodiment has the tub and the drum separated from each other in view of vibration, the water escaped from the drum influences the vibration of the drum, instantly. That is, the influence of a mass change of the water in the laundry is greater in the laundry machine of the embodiment than the related art laundry machine.

[0071] Under above reason, though the related art laundry machine has the transition region of about 200 ~ 270rpm, A start RPM of the transient region of the laundry machine according to this embodiment may be similar to a start RPM of the transient region of the conventional laundry machine. An end RPM of the transient region of the laundry machine according to this embodiment may increase more than a RPM calculated by adding a value of approximately 30% of the start RPM to the start RPM. For example, the transient region finishes at an RPM calculated by adding a value of approximately 80% of the start RPM to the start RPM. According to this embodiment, the transient region may include a RPM band of approximately 200 to 350 rpm.

[0072] In the meantime, by reducing intensity of the vibration of the drum, unbalance may be reduced. For this, even laundry spreading is performed for spreading the laundry in the drum as far as possible before the rotation speed of the drum enters into the transition region.

[0073] In a case, a balancer is used, a method may be put into account, in which the rotation speed of the drum passes through the transition region while movable bodies provided in the balancer are positioned on an opposite side of an unbalance of the laundry. In this instance, it is preferable that the movable bodies are positioned at exact opposite of the unbalance in middle of the transition region.

[0074] However, as described above, the transient region of the laundry machine according to this embodiment is relatively wide in comparison to that of the conventional laundry machine. Because of that, even if the laundry even-spreading step or ball balancing is implemented in a RPM band lower than the transient region, the laundry might be in disorder or balancing might be failed with the drum speed passing the transient region.

[0075] As a result, balancing may be implemented at

least one time in the laundry machine according to this embodiment before and while the drum speed passing the transient region. Here, the balancing may be defined as rotation of the drum at a constant-speed for a predetermined time period. Such the balancing allows the movable body of the balancer to the opposite positions of the laundry, only to reduce the unbalance amount. By extension, the effect of the laundry even-spreading. Eventually, the balancing is implemented while the drum speed passing the transient region and the noise and vibration generated by the expansion of the transient region may be prevented.

[0076] Here, when the balancing is implemented before the drum speed passing the transient region, the balancing may be implemented in a different RPM band from the RPM of the conventional laundry machine. For example, if the transient region starts at 200 RPM, the balancing is implemented in the RPM band lower than approximately 150 RPM. Since the conventional laundry machine has a relatively less wide transient region, it is not so difficult for the drum speed to pass the transient region even with the balancing implemented at the RPM lower than approximately 150 RPM. However, the laundry machine according to this embodiment has the relatively wide expanded transient region as described above. if the balancing is implemented at the such the low RPM like in the conventional laundry machine, the positions of the movable bodies might be in disorder by the balancing implemented with the drum speed passing the transient region. Because of that, the laundry machine according to this embodiment may increase the balancing RPM in comparison to the conventional balancing RPM, when the balancing is implemented before the drum speed enters the transient region. That is, if the start RPM of the transient region is determined, the balancing is implemented in a RPM band higher than a RPM calculated by subtracting a value of approximately 25% of the start RPM from the start RPM. For example, the start RPM of the transient region is approximately 200 RPM, the balancing may be implemented in a RPM band higher than 150RPM lower than 200 RPM.

[0077] Moreover, the unbalance amount may be measured during the balancing. That is, the control method may further include a step to measure the unbalance amount during the balancing and to compare the measured unbalance amount with an allowable unbalance amount allowing the acceleration of the drum speed. If the measured unbalance amount is less than the allowable unbalance amount, the drum speed is accelerated after the balancing to be out of the transient region. In contrast, if the measured unbalance amount is the allowable unbalance amount or more, the laundry even-spreading step may be re-implemented. in this case, the allowable unbalance amount may be different from an allowable unbalance amount allowing the initial accelerating.

[0078] That is, in case the rotation speed of the drum 30 and 32 passes the transient region, the resonance is

generated in the laundry machine and noise and vibration of the laundry machine are generated remarkably. The noise and vibration of the laundry machine will give an unpleasant feeling to the user and they will interfere with the acceleration of the drum speed. As a result, in case the rotation speed of the drum passes the transient region, an acceleration inclination may be adjusted appropriately in the transient region and to noise and vibration may be maintained as little as possible during the acceleration of the drum 30 and 32.

[0079] As follows, a control method of passing the transient region will be described in the accompanying drawings.

[0080] In the transient region passing step (S210), the speed of the drum 30 and 32 is accelerated to a predetermined inclination to pass the transient region. Here, the predetermined inclination is set to reduce noise and vibration generated in the drum as much as possible while the speed passing the transient region.

[0081] As mentioned above, the control method according to the present invention is applicable to the laundry machine including the balancer and the balls provided in the balancer may move to compensate the unbalance. The maximum amount of unbalance which can be compensated by the balancer (hereinafter, 'the amount of compensated unbalance') may be corresponding to a vector sum of the balls. As a result, in case unbalance more than the amount of compensated unbalance is generated, the unbalance compensation enabled by the balancer is not implemented and it is difficult to accelerate the speed of the drum accordingly. Eventually, the amount of the compensated unbalance is corresponding to the reference amount of unbalance allowing the acceleration of the drum speed. In contrast, in case the unbalance amount of the drum is less than the amount of the compensated unbalance, it is possible for the balancer to compensate the unbalance amount and to accelerate the drum speed accordingly.

[0082] However, in case the amount of unbalance generated in the drum is noticeably less than the amount of the compensated unbalance, the weights of the balls are much larger than the generated unbalance amount and the balls could be unbalance generated in the drum. As a result, the control method according to the present invention may be variable with respect to the unbalance amount of the drum in case the drum speed passes the transient region.

[0083] FIG. 5 is a flow chart of the method applied a case of the drum speed passing the transient region.

[0084] In reference to FIG. 5, the unbalance sensing step (S150) senses unbalance and it determines whether the sensed amount of unbalance is a reference unbalance amount_1 or less (S151).

[0085] Here, the reference unbalance amount_1 is the amount of unbalance allowing the acceleration of the drum speed and it is corresponding to the reference unbalance amount mentioned above. In case the sensed amount of unbalance is the reference unbalance

amount_1 or more, the wet laundry sensing step and the laundry disentangling step may be repeated (S152).

[0086] In the meanwhile, in case the sensed unbalance amount is less than the reference unbalance amount_1, the acceleration of the drum can be implemented and the control part compares the sensed unbalance amount with a reference unbalance amount_2 (S 153). Here, the reference unbalance amount_2 is corresponding to a reference value used to select one of methods for passing the transient region, approximately a half of the compensated unbalance amount described above. If the sensed unbalance amount is the reference unbalance amount_2 or more, the control part selects a first method (S 154). If the sensed unbalance amount is less than the second reference, the control part selects a second method (S155).

[0087] First of all, the first method will be described.

[0088] The first method controls the rotation speed of the drum to pass the transient region in a state of the balls located in the unbalance corresponding positions. Here, the compensated unbalance amount may be changeable by the radii, weights and number of balls located in the balancer. For example, the sum of the weights of the balls located in the balancer is approximately 350g and the amount of the compensated unbalance is set to be approximately 700g to 800g. As a result, the above reference unbalance amount_1 may be approximately 700g to 800g, corresponding to the amount of the compensated unbalance amount, and the reference unbalance amount_2 is approximately 350g to 400g corresponding to the half of the compensated unbalance amount.

[0089] If the sensed unbalance amount is the reference unbalance amount_2 or more, the control part determines a point of the drum acceleration from the unbalance wave.

[0090] In the meanwhile, the centrifugal force is little at the rotation speed below the transient region enough for the balancing not to be implemented. Because of that, the control part identifies the positions of the balls, with controlling the drum to be rotated at the constant speed, and it accelerates the drum speed to pass the transient region at a predetermined point and controls the balls to be located in opposite positions of the unbalance. That is, even though the balancing is not implemented, the drum speed may be controlled to pass the transient region, with the balls located in the opposite positions of the unbalance generated portions. For example, while the angle between the laundry (phase difference) generating unbalance and the balls with respect to the shaft of the drum is 90° or more, the drum speed is controlled to pass the transient region. By extension, it is preferable that the above angle (phase difference) is 180° while the drum speed is at the middle RPM of the transient region.

[0091] As a result, in case the drum is accelerated with the balancer provided in the laundry machine, the control part may stores the accelerating points allowing RPM to pass the transient region, with the balls located in the

unbalance corresponding positions, as table data like the table data of the wet laundry amount and the sensed unbalance amount. That is, although the balls are not located at the unbalance corresponding positions at the accelerating points, the drum speed is in the middle of the passing the transient region in the state of the balls located at the unbalance corresponding positions. Preferably, the phase difference between the balls and the laundry may be approximately 180° at the RPM in the middle of the transient region. As a result, the control part applies the sensed wet laundry amount and unbalance amount to the table and it determines the accelerating point while the spinning cycle is operated substantially.

[0092] In the meanwhile, if the sensed unbalance amount is less than the reference unbalance amount₂, the compensated unbalance amount is relatively large, compared with the unbalance amount generated substantially. Because of that, the balls could generate unbalance in the drum. specifically, in case the sensed unbalance amount is less than the reference unbalance amount₂, the balls would be collected in the opposite positions of the unbalance generated portion (180° of phase difference, which is the unbalance corresponding positions), only to generate unbalance. Because of that, in case the sensed unbalance amount is less than the reference unbalance amount₂, the balls are required to be distributed appropriately, not collected in the unbalance corresponding positions. As follows, the second method will be described in reference to the accompanying drawings.

[0093] FIG. 6 is a graph illustrating the second method allowing the drum speed to pass the transient region in case the sensed unbalance amount is less than the reference unbalance amount₂.

[0094] In reference to FIG. 6, the control part differentiates the accelerating inclination gradually to accelerate the drum speed, in case the unbalance amount sensed in the unbalance sensing step (S150) is less than the reference unbalance amount₂.

[0095] Specifically, the drum is accelerated from the first rotation speed (RPM 1) to an intermediate RPM (RPM 1-1), with a first acceleration inclination which is a relatively high speed inclination and then it is accelerated from the intermediate RPM to the highest RPM of the transient region (RPM 1-2), approximately, 350 to 400 RPM, with a second acceleration inclination which is a relatively slow speed inclination (S1600). Although not shown in the drawings, the acceleration inclination of the drum may be categorized into three stages or more to accelerate the drum.

[0096] In the meanwhile, the intermediate RPM (RPM 1-1) may be set to be lower than the transient region, for example, 150 to 200 RPM.

[0097] That is, the control part controls the drum to be accelerated from the RPM of the unbalance sensing step (the first rotation speed, RPM 1) to the intermediate RPM (RPM 1-1) at a relatively speed, for example, 7 to 9 rpm/s. because of that, the time taken to pass the transient re-

gion may be reduced. Especially, the drum is controlled to be accelerated at a relatively low speed in the following period and thus it takes much time to pass the transient region. As a result, it is necessary to accelerate the drum to the intermediate RPM at a high speed as possible to reduce the drum.

[0098] Hence, the control part controls the drum to be accelerated in a period from the intermediate RPM (RPM 1-1) to the highest RPM (RPM 1-2) of the transient region at a relatively low speed, for example, 2 to 3 rpm/s.

[0099] This period is corresponding to the transient region of the laundry machine and the low speed acceleration is more advantageous to the movement and distribution of the balls than the high speed acceleration. Especially, in case the sensed unbalance amount is smaller than the reference unbalance amount₂, the balls of the balancer may be the unbalance and it is required to distribute the balls a predetermined distance along a circumference of the drum. Also, since the drum speed passing the transient region of the laundry machine in the step of S1600, the value(s) and/or time(S) of the first inclination and second inclination may be determined to allow a distribution level of the balls in the second inclination to be higher than a distribution level of the balls in the first inclination.

[0100] The movement of the balls may be generated more efficiently in the low speed acceleration than the high speed acceleration. Because of that, the drum is controlled to be accelerated at the relatively low speed in the period from the intermediate RPM to the highest RPM of the transient region, to reduce the vibration.

[0101] After the transient region passing step, the control part implements the accelerating step (S230). Once passing the transient region, the RPM of the drum 30 and 32 is accelerated at a relatively high speed to remove water elements from the laundry. That is, the RPM of the drum 30 and 32 is increased to a predetermined value and the moisture of the laundry inside the drum 30 and 32 is removed, in the accelerating step (S230).

[0102] However, the accelerating step increases the RPM of the drum 30 and 32 at the high speed and noise and vibration will be generated a lot in the laundry machine. Especially, the noise and vibration may be increasing in proportion to the unbalance amount of the drum 30 and 32.

[0103] In the meanwhile, the laundry machine having the spinning cycle control method applied thereto may include the balancer 310 and 330 configured to prevent the noise and vibration generated by unbalance. The balls provided in the balancer 310 and 330 are configured move to the unbalance corresponding positions to reduce the unbalance amount. Here, the balls of the balancer may moveable more smoothly in the constant RPM than the accelerated speed and in the relatively slow speed than in the high speed. Because of that, if the drum 30 and 32 is accelerated at the relatively high speed, the balls cannot move to the unbalance corresponding positions smoothly. The spinning cycle control method may

include a step of moving the balls to move to the unbalance corresponding positions, passing the transient region, namely, a balancing step.

[0104] In this case, the RPM used to implement the balancing may be set to be higher than the transient region of the laundry machine. The balancing is more and more advantageous to implement, as the RPM of the drum 30 and 32 is getting lower. However, if the RPM is decreased below the transient region again to implement the balancing, the noise and vibration may be generated by resonance. As a result, the balancing of the control method may be implemented at a second RPM (RPM 2), for example, 350 to 400 RPM.

[0105] After implementing the balancing at least one time as mentioned above, the control part increases the RPM of the drum 30 and 32 to a target RPM, to remove the moisture from the laundry. Then, the control part controls the constant speed rotation of the drum to be embodied at the target RPM for a predetermined time period such that it may remove the moisture from the laundry smoothly.

[0106] In the meanwhile, detergent would remain in the laundry or detergent remnants would remain in the wash water of the tub 12, after the rinsing cycle. In this case, when the drum 32 is rotated to implement the spinning cycle, bubbles happen to be generated in the drum 32 or the tub 12 by the rotational force of the drum. The generation of the bubbles inside the drum 32 or the tub 12 will be resistance activated to deteriorate the rotation speed of the drum and it might apply overload to the motor 170. Such the bubble generation might deteriorate washing efficiency of the laundry machine and it might cause a functional error of the motor 170 if severe overload is generated.

[0107] As a result, the control part may implement a bubble sensing step configured to sense bubbles and a bubble removing step configured to remove the bubbles, with implementing the spinning cycle.

[0108] Here, the sensing of the bubbles enabled by the RPM sensing of the motor 170 may be implemented by a hall sensor provided in the driving motor 170. As follows, the bubble sensing implemented by the hall sensor will be described. For the bubble sensing implemented by the hall sensor, the motor 170 is driven to rotate the drum 32 during the spinning cycle. At this time, bubbles are generated inside the drum 32 and the tub or there between and the generated bubbles will be a resistance element configured to interfere with the rotation of the drum. Because of that, the rotation speed of the motor 170 configured to rotate the drum 32 may increase with a little inclination. In case the bubbles are kept continuously, the overload of the motor 170 would be generated enough to deteriorate spinning efficiency.

[0109] The rotation speed inclination of the motor 170 in case the bubbles are generated may be very similar to the rotation speed inclination of the motor 170 in case the second method of passing the transient region in the spinning cycle.

[0110] That is, the second method described above accelerates the rotation speed of the drum 32 with first and second inclination. Especially, in case of the acceleration with the second inclination (S1600, see FIG. 6), the second inclination is relatively smaller than the first inclination. As a result, the rotation speed inclination of the motor when the bubbles are generated in the laundry machine may be very similar to the rotation speed inclination of the motor when the rotation speed of the drum 32 is accelerated with the second inclination in the second method.

[0111] As a result, if the control part simply compares the acceleration inclinations, it is difficult to determine whether the second method is implemented in the transient region or whether bubbles are generated. Because of that, according to this control method, the pulse duty applied to the motor may be sensed together with the RP sensing of the drum, to sense the bubble generation, which will be described in detail.

[0112] As shown in FIG. 7, as the spinning cycle starts (S321), the control part controls the motor 170 to increase the rotation speed of the drum 32, to implement the spinning cycle (S312). At this time, the duty of the pulse or current value supplied to the motor 170 has to be increased to increase the RPM of the motor 170.

[0113] Hence, the control part senses the bubble generation based on the pulse duty applied to the motor 170 configured to rotate the drum during the spinning cycle and RPM change of the motor 170 corresponding to the pulse duty (S323).

[0114] Specifically, the control part increases the pulse duty close to the maximum value or up to the maximum value applied to the motor 170 configured to accelerate the rotation speed of the drum 32 for the spinning cycle. However, if bubbles are generated between the drum 32 and the tub 12 at this time, the bubbles applies rotation resistance to the drum 32 and the RPM change of the motor 170 sensed substantially may be increased differently from the increase ration of the pulse duty.

[0115] As a result, if the amount of the drum speed change is sensed different from the increase ratio of the pulse duty or it is a reference value or more, that is, if the acceleration inclination is less than a predetermined inclination, the control part may determine that bubbles are generated in the drum 32.

[0116] When the second method (S155 or S213B) is implemented for the rotation speed of the drum to pass the transient region, the rotation speed of the motor 170 may be increased according to the pulse duty supplied to the motor. In other words, as the pulse duty supplied to the motor to pass the transient region is increased, the rotation speed of the motor 170 has an accelerating inclination in contrast with the duty ratio of the pulse.

[0117] Because of the difference described above, the control part may distinguish the acceleration inclination of the motor 170 in the second method (S155 or S213B) implemented to pass the transient region from the acceleration inclination of the motor in the bubble generation.

[0118] When determining that the bubbles are generated in the drum 32 as described above, the control part implements the bubble removing step (S324). Specifically, the control part controls the rotation of the drum 32 to stop and controls wash water re-supplied to the tub 12. After that, the control part controls the wash water drained in a predetermined time period to remove the bubbles.

[0119] In the meanwhile, the control part determines whether the spinning cycle is completed after the bubble removing (S325). Here, in case the spinning cycle is not completed based on the result of the determination, the control part continuously implements the sensing of the bubbles and in case the spinning cycle is completed based on the result of the determination, the control part completes the spinning cycle (S326).

[0120] It is preferable that the bubble sensing step described above is continuously implemented during the spinning cycle. If such the bubble sensing step determines the generation of the bubbles, the spinning cycle is stopped to re-start.

[0121] If the bubble sensing step determines the bubble generation during the spinning cycle a predetermined number of times or more, the control part controls the spinning cycle to stop and it notifies the user that much detergent remains or advise the user that an auxiliary rinsing cycle should be implemented.

[0122] First, vibration characteristics of the laundry machine according to the embodiment of the present invention will now be described with reference to FIG. 9.

[0123] As the rotation speed of the drum is increased, a region (hereinafter, referred to as "transient vibration region") where irregular transient vibration with high amplitude occurs is generated. The transient vibration region irregularly occurs with high amplitude before vibration is transitioned to a steady-state vibration region (hereinafter, referred to as "steady-state region"), and has vibration characteristics determined if a vibration system (laundry machine) is designed. Though the transient vibration region is different according to the type of the laundry machine, transient vibration occurs approximately in the range of 200rpm to 270rpm. It is regarded that transient vibration is caused by resonance. Accordingly, it is necessary to design the balancer by considering effective balancing at the transient vibration region.

[0124] In the mean time, as described above, in the laundry machine according to the embodiment of the present invention, the vibration source, i.e., the motor and the drum connected with the motor are connected with the tub 12 through the rear gasket 250. Accordingly, vibration occurring in the drum is little forwarded to the tub, and the drum is supported by a damping means and the suspension unit 180 via a bearing housing 400. As a result, the tub 12 can directly be fixed to a cabinet 110 without any damping means.

[0125] As a result of studies of the inventor of the present invention, vibration characteristics not observed generally have been found in the laundry machine according to the present invention. According to the general

laundry machine, vibration (displacement) becomes steady after passing through the transient vibration region. However, in the laundry machine according to the embodiment of the present invention, a region (hereinafter, referred to as "irregular vibration") where vibration becomes steady after passing through the transient vibration region and again becomes great may be generated. For example, if the maximum drum displacement or more generated in an RPM band lower than the transient region or the maximum drum displacement or more of steady state step in a RPM band higher than the transient region is generated, it is determined that irregular vibration is generated. Alternatively, if an average drum displacement in the transient region, +20% to -20% of the average drum displacement in the transient region or 1/3 or more of the maximum drum displacement in the natural frequency of the transient region are generated, it may be determined that the irregular vibration is generated.

[0126] However, as a result of the studies, irregular vibration has occurred in a RPM band higher than the transient region, for example has occurred at a region (hereinafter, referred to as "irregular vibration region") in the range of 350 rpm to 1000rpm, approximately. Irregular vibration may be generated due to use of the balancer, the damping system, and the rear gasket. Accordingly, in this laundry machine, it is necessary to design the balancer by considering the irregular vibration region as well as the transient vibration region.

[0127] For example, the balancer is provided with a ball balancer, it is preferable that the structure of the balancer, i.e., the size of the ball, the number of balls, a shape of the race, viscosity of oil, and a filling level of oil are selected by considering the irregular vibration region as well as the transient vibration region. When considering the transient vibration region and/or the irregular vibration region, especially considering the irregular vibration region, the ball balancer has a greater diameter of 255.8mm and a smaller diameter of 249.2. A space of the race, in which the ball is contained, has a sectional area of 411.93mm². The number of balls is 14 at the front and the rear, respectively, and the ball has a size of 19.05mm. Silicon based oil such as Poly Dimethylsiloxane (PDMS) is used as the oil. Preferably, oil has viscosity of 300CS at a room temperature, and has a filling level of 350cc.

[0128] In addition to the structure of the balancer, in view of control, it is preferable that the irregular vibration region as well as the transient vibration region is considered. For example, to prevent the irregular vibration, if the irregular vibration region is determined, the balancing may be implemented at least one time before, while and after the drum speed passes the irregular vibration region. Here, if the rotation speed of the drum is relatively high, the balancing of the balancer may not be implemented properly and the balancing may be implemented with decreasing the rotation speed of the drum. However, if the rotation speed of the drum is decreased to be lower than the transient region to implement the balancing, it

has to pass the transient region again. In decreasing the rotation speed of the drum to implement the balancing, the decreased rotation speed may be higher than the transient region.

[0129] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

[0130] The present invention has an industrial applicability.

[0131] According to the control method of the present invention described above, it is possible to calculate the amount of unbalance generated in the laundry machine including the ball balancer.

[0132] Furthermore, it is possible to determine based on the amount of unbalance whether the speed of the drum is increased or decreased within a reduced time.

Claims

1. A control method of a laundry machine having a tub (12), a drum (30) accommodated in the tub (12), a motor (170) configured to rotate the drum (30), and comprising a spinning cycle (S200), the control method comprising:
 - a sensing step configured to sense a rotation speed (rpm) of the motor (170) while increasing (S312) a pulse duty of the motor during the spinning cycle (S200); and
 - a determining step (S323) configured to determine bubble generation inside the tub (12) based on the sensed pulse duty and rotation speed, wherein the determining step (S323) determines bubble generation based on comparing an increasing rate of the pulse duty with an increasing rate of the rpm of the motor (170).
2. The control method as claimed in claim 2, wherein the determining step (S323) determines that bubble generates, in case the increasing rate of the pulse duty is different from the increasing rate of the rpm of the motor (170).
3. The control method as claimed in claim 2, wherein the determining step (S323) determines that bubble generates, in case the increasing rate of the rpm of the motor (170) is a preset value or less comparing with the increasing rate of the pulse duty.
4. The control method as claimed in claim 1, wherein a removing step (S324) configured to remove the bubbles by auxiliary water supply and drainage to and from the tub (12), in case the determining step

(S323) determines that bubbles are generated, is implemented additionally.

5. The control method as claimed in claim 5, wherein the spinning cycle (S200) re-starts after the removing step (S324).
6. The control method as claimed in claim 1, wherein an auxiliary rinsing cycle is implemented in case the determining step (S323) determines that bubbles are generated.

Patentansprüche

1. Steuerverfahren für eine Waschmaschine, die einen Bottich (12), eine Trommel (30), die in dem Bottich (12) untergebracht ist, und einen Motor (170), der konfiguriert ist, die Trommel (30) zu drehen, aufweist, und das einen Schleuderzyklus (S200) umfasst, wobei das Steuerverfahren umfasst:
 - einen Abtastschritt, der konfiguriert ist, eine Drehzahl (min^{-1}) des Motors (170) abzutasten, während ein Pulstastgrad des Motors während des Schleuderzyklus (S200) vergrößert wird; und
 - einen Bestimmungsschritt (S323), der konfiguriert ist, eine Blasenbildung innerhalb des Bottichs (12) basierend auf dem abgetasteten Pulstastgrad und der Drehzahl zu bestimmen, wobei der Bestimmungsschritt (S323) die Blasenbildung basierend auf dem Vergleichen einer zunehmenden Rate des Pulstastgrades mit einer zunehmenden Rate der Drehzahl des Motors (170) bestimmt.
2. Steuerverfahren nach Anspruch 1, wobei der Bestimmungsschritt (S323) bestimmt, dass Blasen erzeugt werden, falls die zunehmende Rate des Pulstastgrades von der zunehmenden Rate der Drehzahl des Motors (170) verschieden ist.
3. Steuerverfahren nach Anspruch 1, wobei der Bestimmungsschritt (S323) bestimmt, dass Blasen erzeugt werden, falls die zunehmende Rate der Drehzahl des Motors (170) ein vorgegebener Wert ist oder im Vergleich mit der zunehmenden Rate des Pulstastgrades kleiner ist.
4. Steuerverfahren nach Anspruch 1, wobei ein Entfernungsschritt (S324), der konfiguriert ist, die Blasen durch eine Hilfswasserzufuhr zu dem und ein Hilfswasserablassen aus dem Bottich (12) zu entfernen, falls der Bestimmungsschritt (S323) bestimmt, dass Blasen gebildet werden, zusätzlich implementiert wird.

5. Steuerverfahren nach Anspruch 4, wobei der Schleuderzyklus (S200) nach dem Entfernungsschritt (S324) erneut beginnt.
6. Steuerverfahren nach Anspruch 1, wobei ein Hilfspülzyklus implementiert wird, falls der Bestimmungsschritt (S323) bestimmt, dass Blasen gebildet werden.

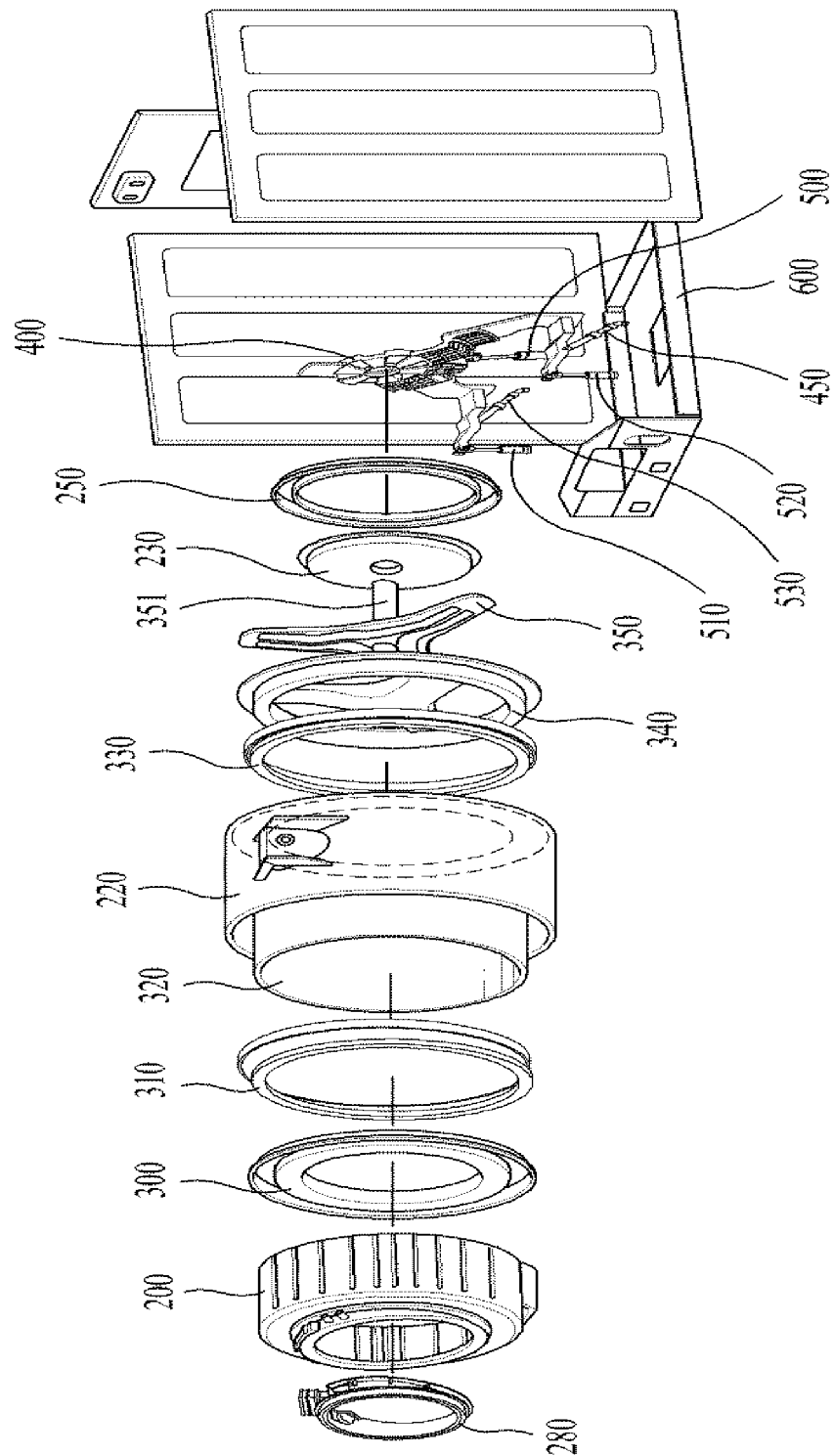
après l'étape d'élimination (S324).

6. Procédé de commande selon la revendication 1, dans lequel un cycle de rinçage auxiliaire est implémenté au cas où l'étape de détermination (S323) détermine que des bulles sont générées.

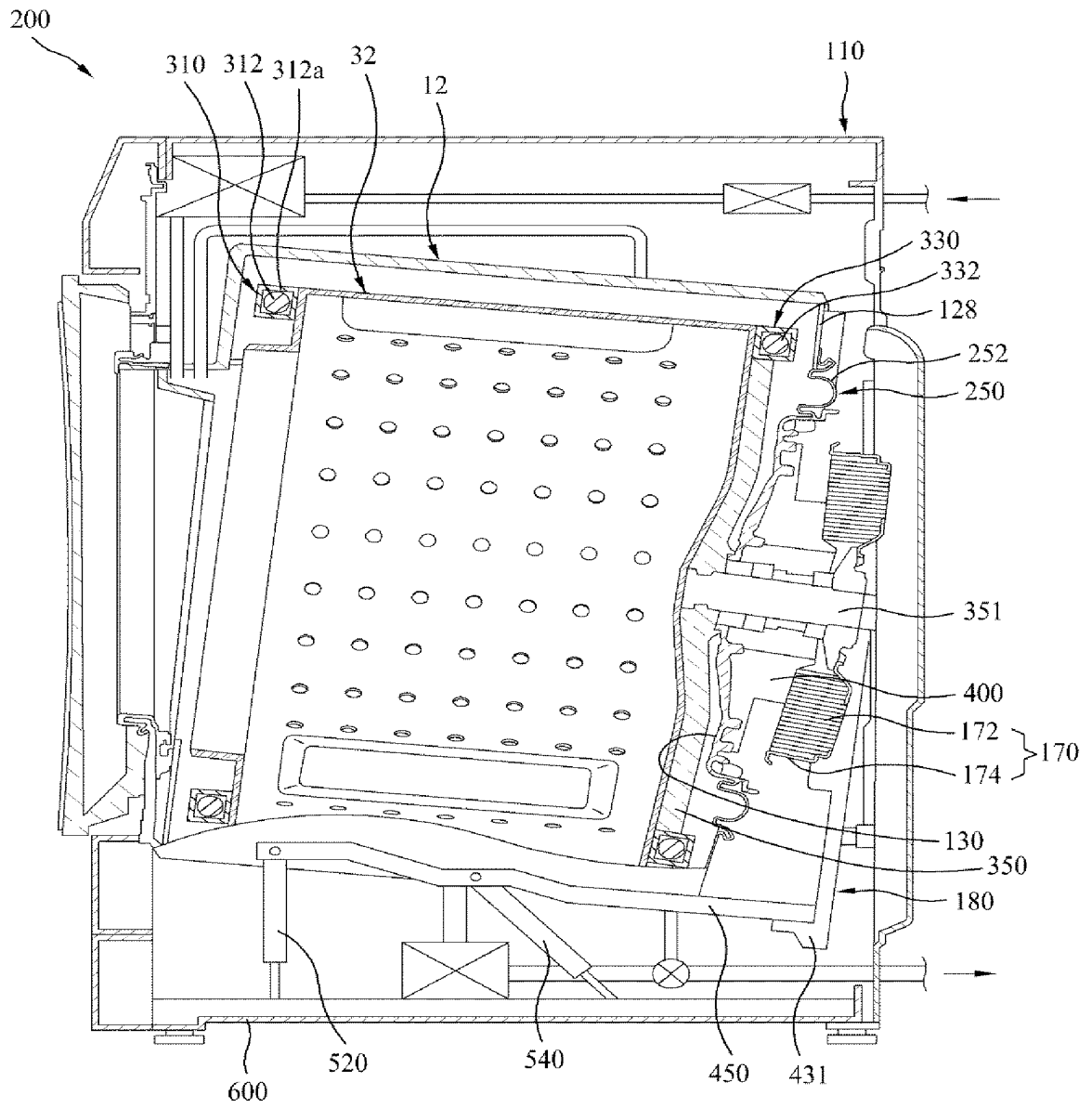
Revendications

1. Procédé de commande d'une machine de blanchissage comportant une cuve (12), un tambour (30) renfermé dans la cuve (12), un moteur (170) configuré pour entraîner en rotation le tambour (30), et comprenant un cycle d'essorage (S200), le procédé de commande comprenant :
 - une étape de détection configurée pour détecter une vitesse de rotation (rpm) du moteur (170) tout en augmentant (S312) un régime d'impulsion du moteur pendant le cycle d'essorage (S200) ; et
 - une étape de détermination (S323) configurée pour déterminer une génération de bulles à l'intérieur de la cuve (12) sur la base du régime d'impulsion et de la vitesse de rotation détectées,
 - dans lequel l'étape de détermination (S323) détermine une génération de bulles sur la base de la comparaison d'un taux croissant du régime d'impulsions avec un taux croissant de rpm du moteur (170).
2. Procédé de commande selon la revendication 1, dans lequel l'étape de détermination (S323) détermine que des bulles sont générées, au cas où le taux croissant du régime d'impulsion est différent du taux croissant de rpm du moteur (170).
3. Procédé de commande selon la revendication 1, dans lequel l'étape de détermination (S323) détermine que des bulles sont générées, au cas où le taux croissant de rpm du moteur (170) est une valeur préétablie ou inférieure comparée au taux croissant du régime d'impulsion.
4. Procédé de commande selon la revendication 1, dans lequel une étape d'élimination (S324) configurée pour éliminer les bulles par une alimentation d'eau auxiliaire dans et un drainage de la cuve (12), au cas où l'étape de détermination (S323) détermine que des bulles sont générées, est implémentée additionnellement.
5. Procédé de commande selon la revendication 4, dans lequel le cycle d'essorage (S200) redémarre

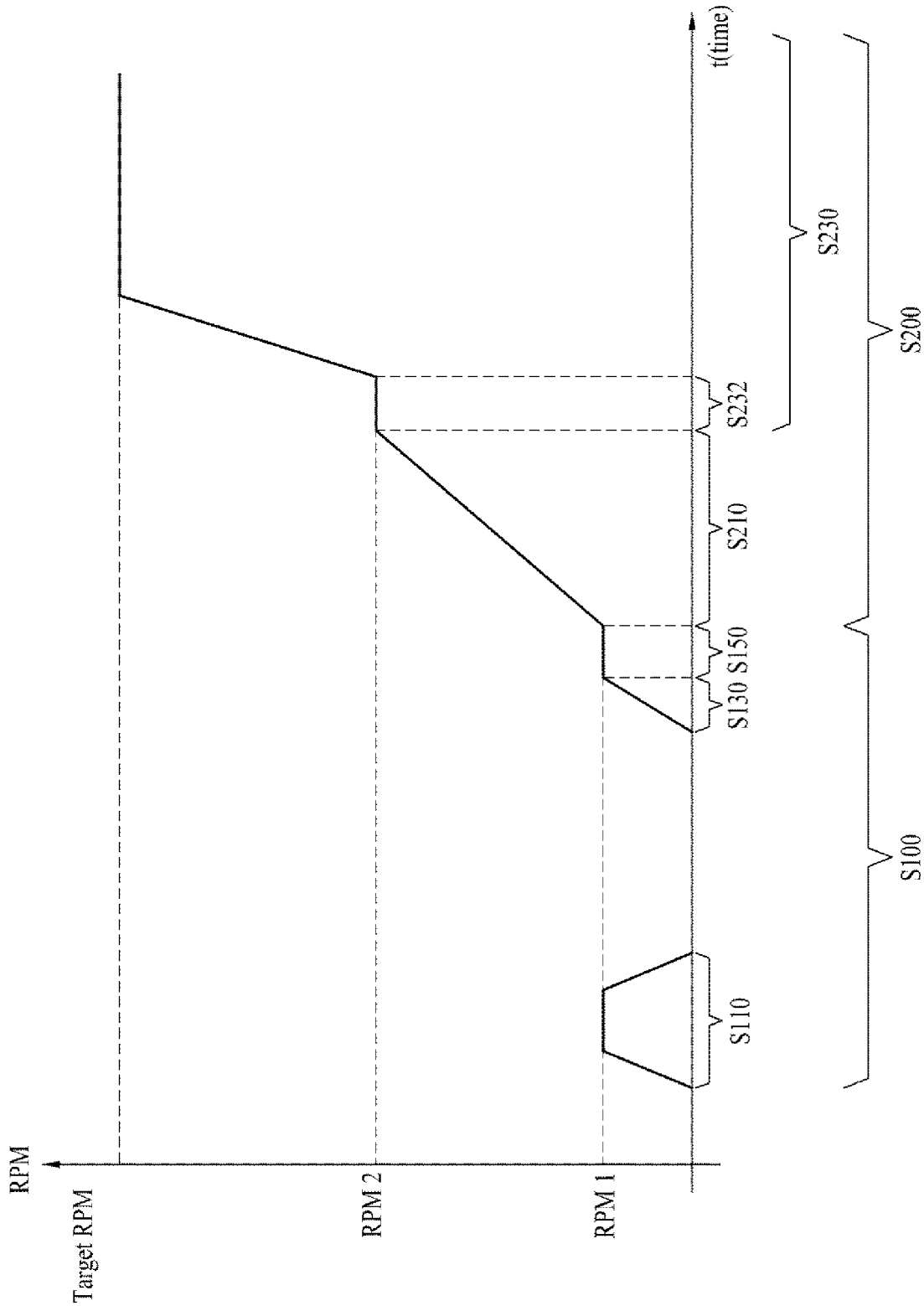
[Fig. 1]



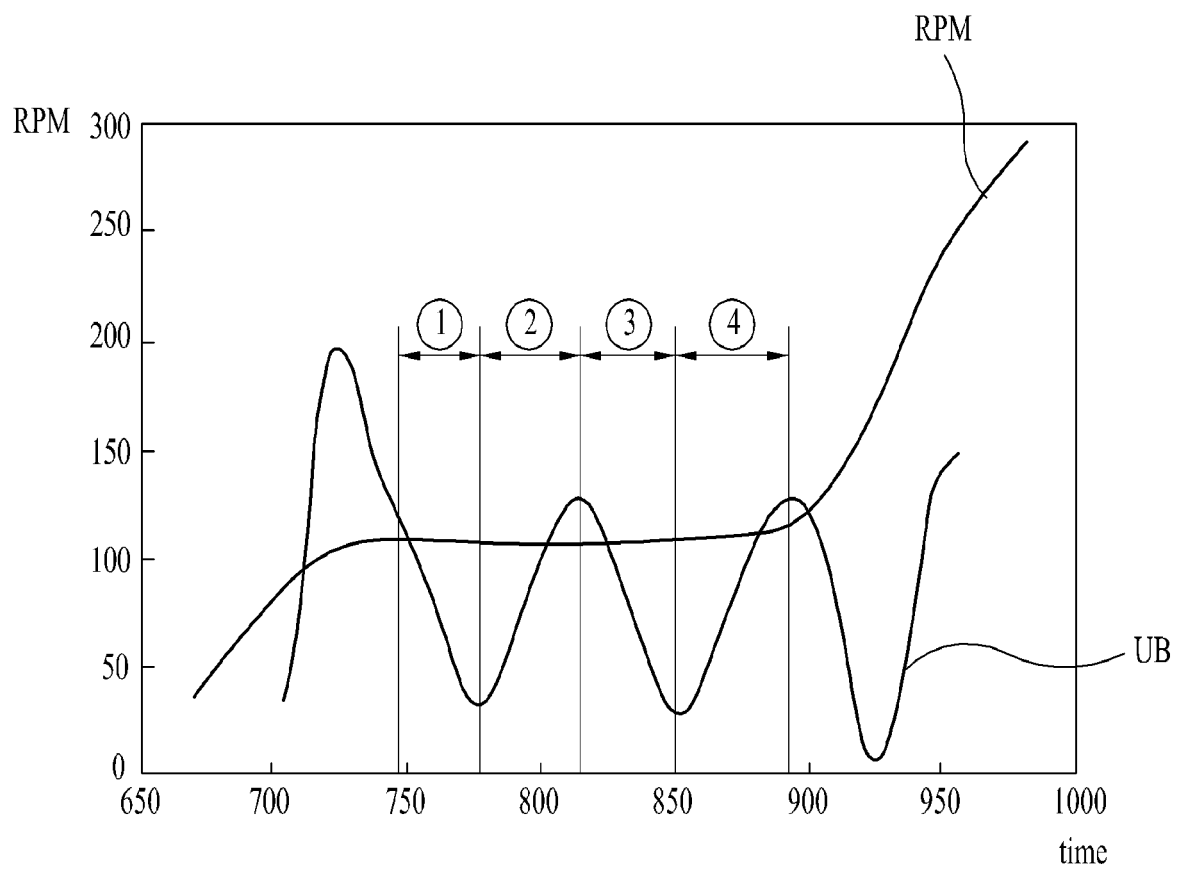
[Fig. 2]



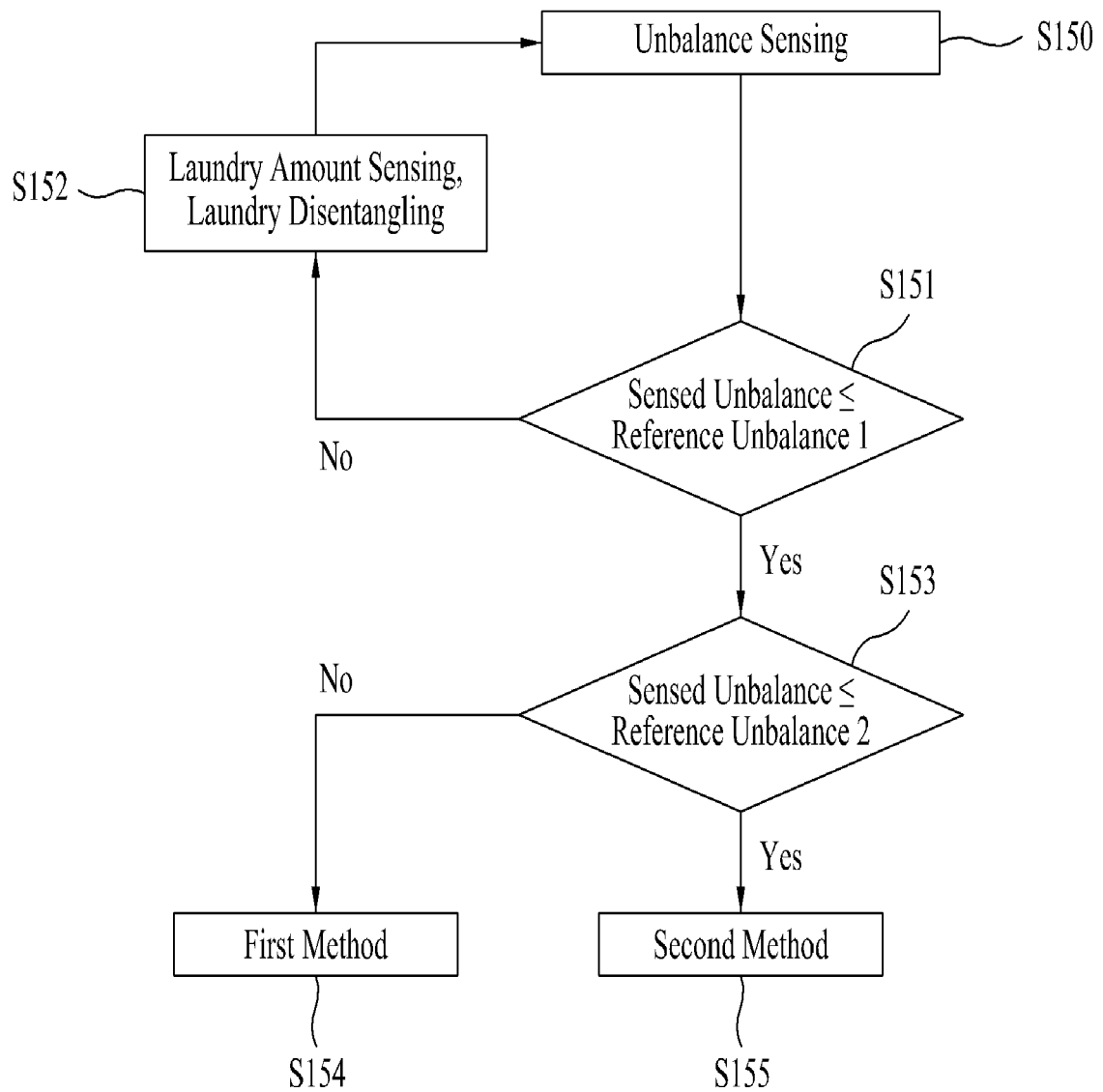
[Fig. 3]



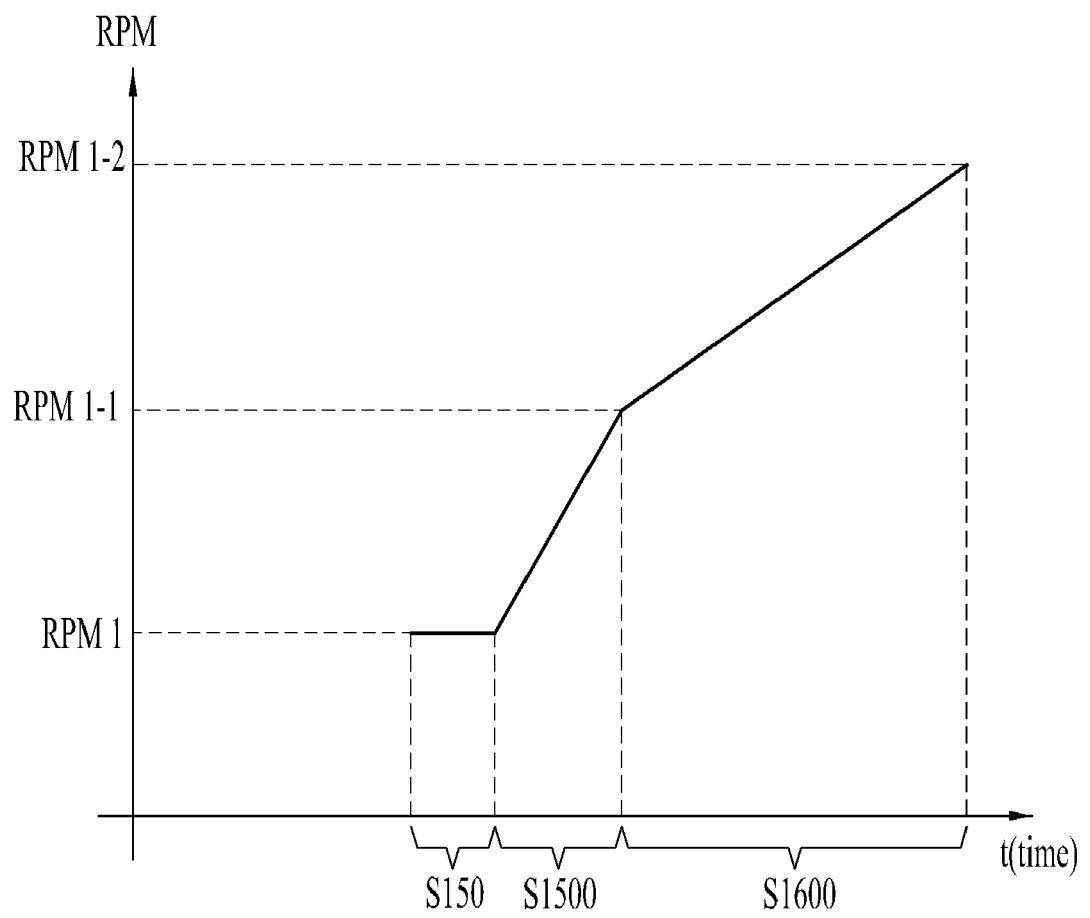
[Fig. 4]



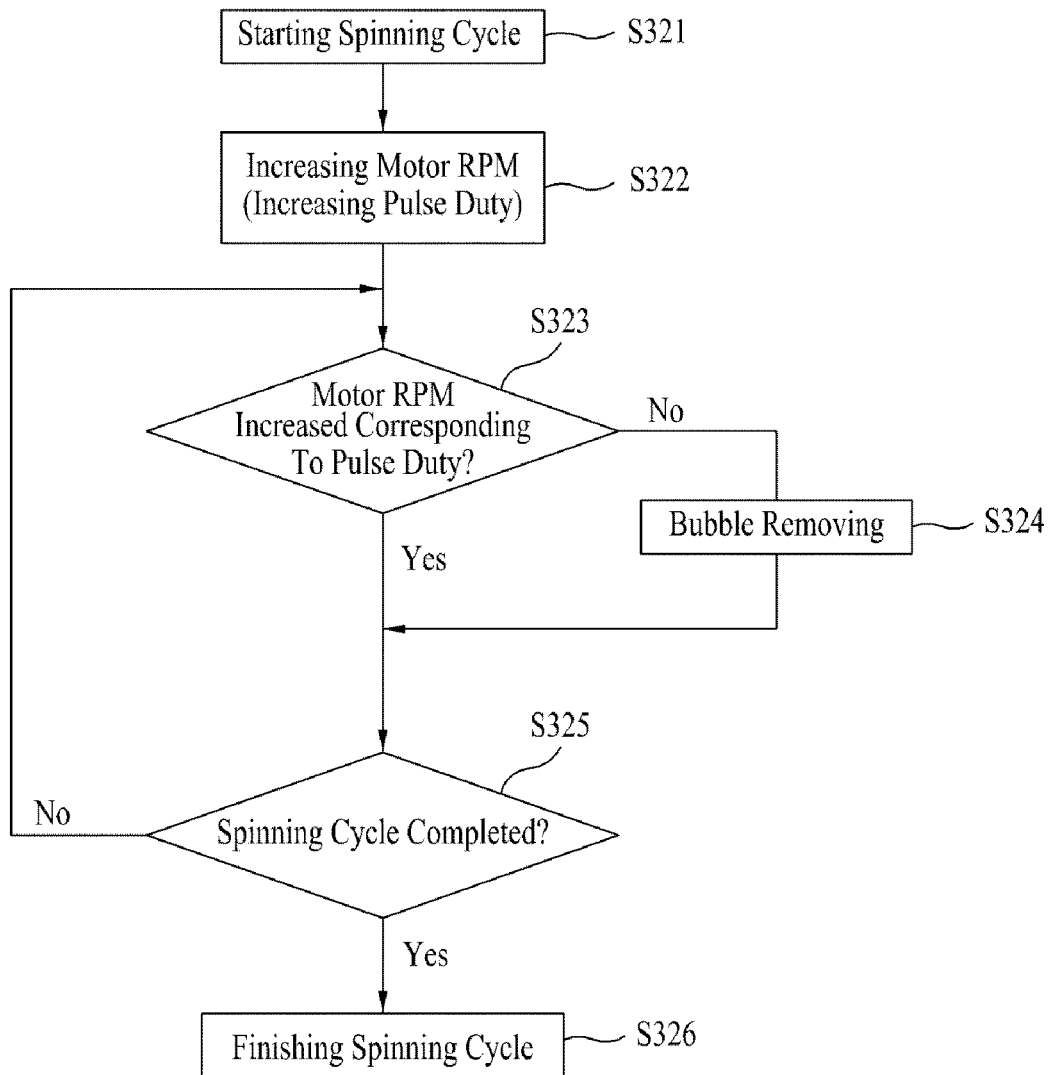
[Fig. 5]



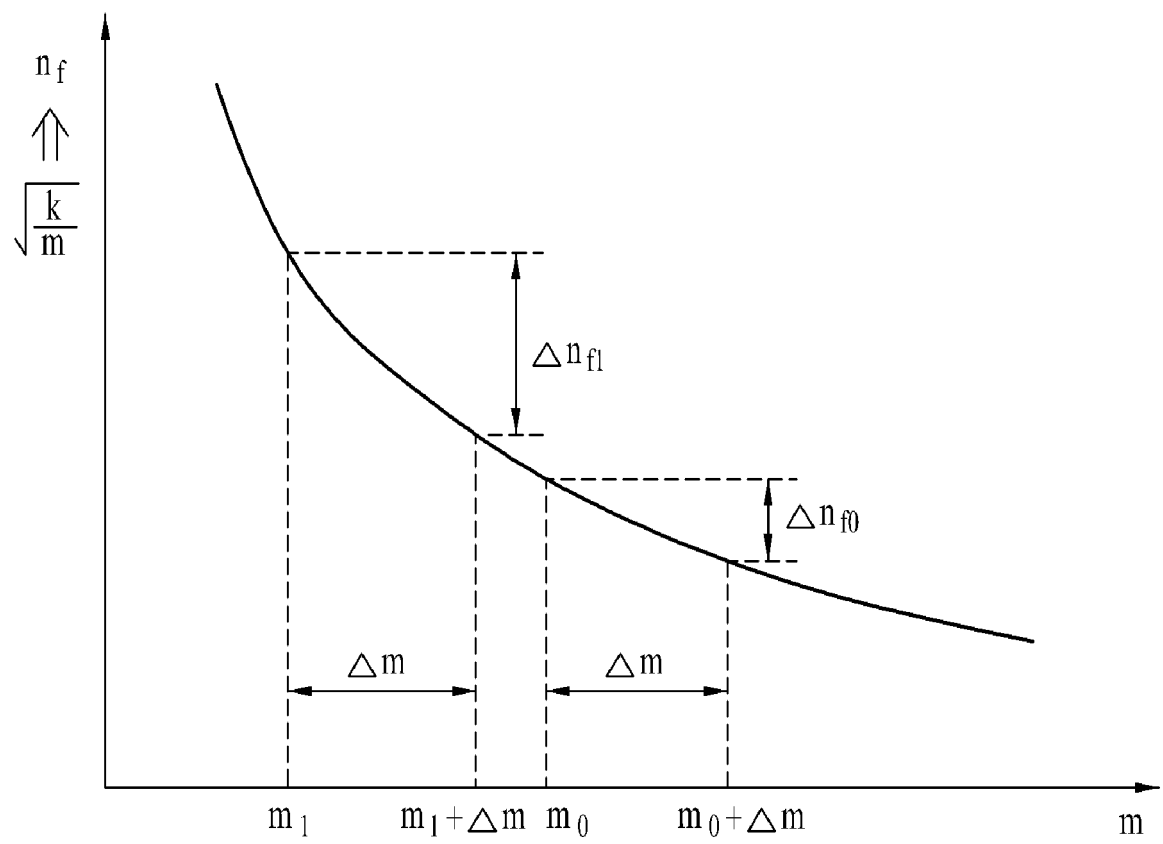
[Fig. 6]



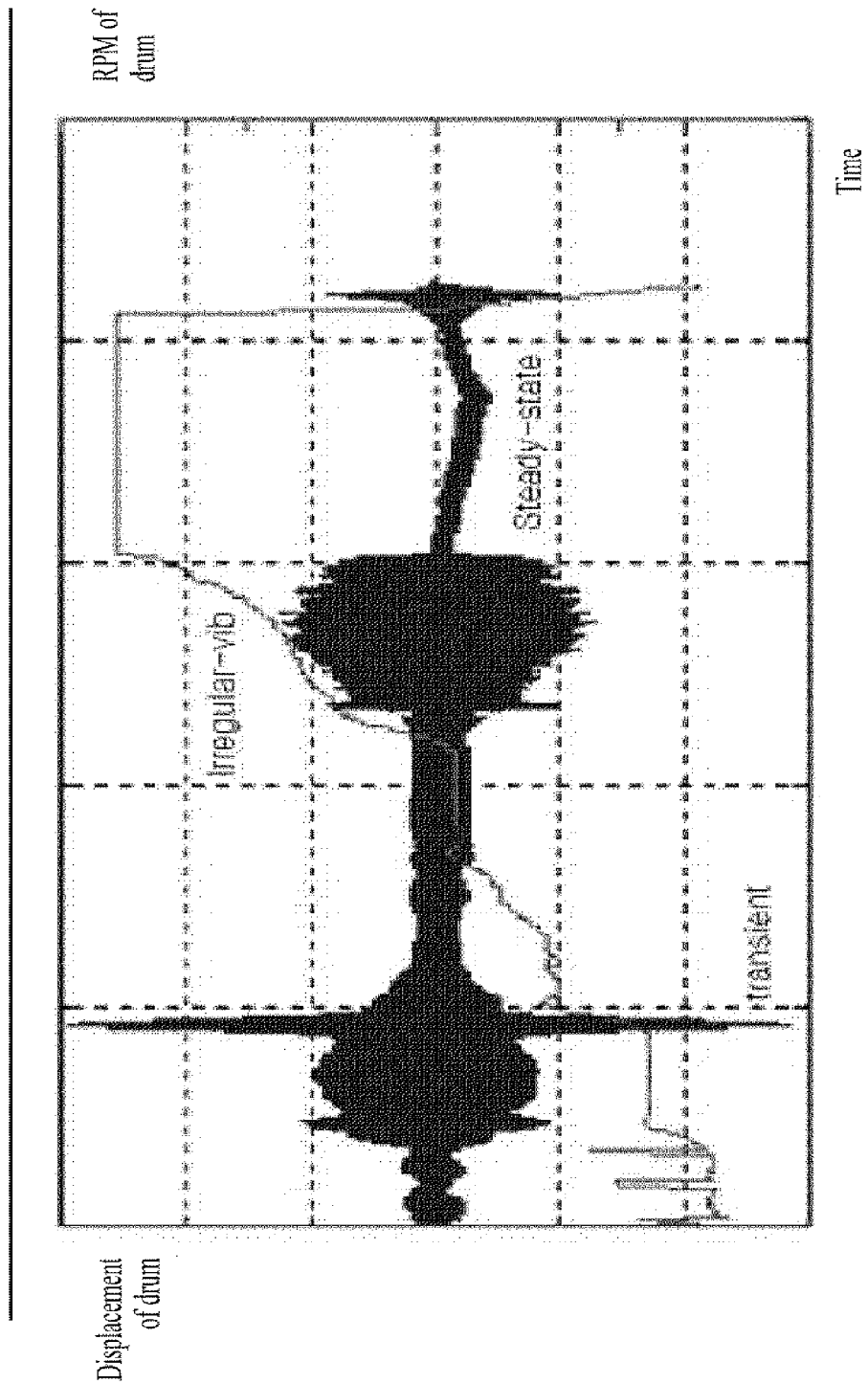
[Fig. 7]



[Fig. 8]



[Fig. 9]



REFERENCES CITED IN THE DESCRIPTION

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