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(54) **Washing machine and method for controlling the same**

Waschmaschine und Regelung hierfür

Machine à laver et contrôle pour celle-ci

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## Description

**[0001]** The present invention relates to washing machines and methods for controlling the same. More particularly the invention relates to a method and device for preventing resonance from occurring during spinning of a washing machine.

**[0002]** In general, a washing machine washes laundry by the softening action of detergent, and friction of the laundry with water circulation caused by rotation of a pulsator or drum. Recently, the demand for drum type washing machines has increased, which can reduce an entire height compared to a pulsator type washing machine, and prevent wrinkles from forming.

**[0003]** FIG 1 illustrates a section of a prior art drum type washing machine.

**[0004]** Referring to FIG 1, the prior art drum type washing machine is provided with a tub 3 inside of a cabinet 5 which forms an outer appearance of the drum type washing machine, and a drum 9 rotatably mounted on an inside of the tub 3. The cabinet 5 has a door 1 on a front for introduction of laundry, with a gasket 2 between the door 1 and the tub 3.

**[0005]** The tub 3 has springs 4 each with one end secured to an upper outside circumference thereof and the other end secured to the cabinet 5, and a friction damper 10 thereunder for damping vibration.

**[0006]** On a rear of the tub 3, there is a motor 6 directly coupled to the drum 9 with a rotation shaft 13. On front and rear portion of the rotation shaft 13, there are bearings 12 provided thereto, and on a rear surface of the tub 3, there is a bearing housing for supporting the bearing 12.

**[0007]** The motor 6 is provided with a stator 7 and a rotor 8, wherein the stator 7 is mounted to the rear surface of the tub 3, and the rotor 8 is fixed to the rotation shaft 13. Therefore, when the rotor 8 rotates, the drum 9 connected to the rotor 8 rotates at the same time.

**[0008]** There is a sensor (not shown) at one side of the motor 6 for detecting a rotation speed of the rotor 8, and on an upper portion of a front surface of the cabinet 5, there is a control panel having various buttons for controlling operation of the washing machine.

**[0009]** Upon introduction of the laundry into the drum 9, and selecting a washing course, a washing cycle and a rinsing cycle are performed, and a spinning cycle is performed after the above cycles are finished.

**[0010]** In the spinning cycle of the laundry, the rotation speed of the motor 6 is increased gradually until the rotation speed reaches a preset speed when the preset speed is maintained for a preset time period. In this instance, even though a water extraction performance is proportional to the rotation speed of the motor 6, the rotation speed may vary with the extent of eccentricity of the laundry. That is, if the eccentricity of the laundry is great, the rotation speed of the drum 9 drops, or the rotation shaft 13 suffers damage. Therefore, it is required to measure the eccentricity before the spinning of the washing machine starts.

**[0011]** During the spinning, there can be resonance of the washing machine installed on a floor at a particular rotation speed of the motor 6. That is, if the rotation speed of the motor and the drum approaches close to a natural frequency of the frame, such as the cabinet and the like, resonance occurs, and once the resonance occurs, vibration and noise become very considerable.

**[0012]** The considerable or "heavy" vibration and noise significantly inconveniences measuring the eccentricity of the laundry or in spinning the laundry, or damages the laundry. Moreover, the heavy vibration and noise reduces reliability of use of the product.

**[0013]** US-B1-6 546 354 relates to a control module to determine actions to balance a system.

**[0014]** Accordingly, the present invention is directed to a washing machine, and a method for controlling the same that substantially obviates one or more problems due to limitations and disadvantages of the prior art.

**[0015]** The present invention is set out in the independent claims. Some optional features are set out in the claims dependent thereto.

**[0016]** According to one embodiment there is provided a washing machine for preventing resonance from occurring during spinning of the washing machine, and a method for controlling the same.

**[0017]** According to one aspect of the present invention there is provided a method for controlling a washing machine having a drum of which rotation speed is adjustable includes a first step for rotating the drum at a first rotation speed set at control unit, a second step for detecting whether resonance occurs or not at the drum rotating at the first rotation speed, and a third step for changing the rotation speed of the drum if the resonance is detected at the drum. Preferably, the third step includes the step of storing the changed rotation speed in the control unit. The drum is rotated at the changed rotation speed when the washing machine is put into operation again after the washing machine is stopped.

**[0018]** The third step may further include the step of measuring eccentricity of laundry held in the drum rotating at the changed rotation speed. The step of decreasing the rotation speed of the drum again after increasing the rotation speed of the drum is repeated, if the eccentricity is greater than a preset value.

**[0019]** The drum may be rotated in regular/reverse directions alternately for a plurality of times, if the eccentricity exceeds a preset value.

**[0020]** When the eccentricity is below the preset value, the third step may further include the steps of rotating the drum at the set second rotation speed for extracting water from the laundry, detecting whether the resonance occurs at the drum rotating at the second rotation speed or not, changing the rotation speed of the drum, if the resonance is detected at the drum, and storing the changed rotation speed in the control unit.

**[0021]** The method may further include the step of measuring the eccentricity of the laundry held in the drum,

if no resonance occurs in the second step. The step of decreasing the rotation speed of the drum again after increasing the rotation speed of the drum is repeated, if the eccentricity is greater than a preset value. The drum is rotated in regular/reverse directions alternately for a plurality of times, if the eccentricity exceeds a preset value.

**[0022]** When the eccentricity is below the preset value, the method may further include the steps of rotating the drum at the set second rotation speed for extracting water from the laundry, detecting whether the resonance occurs at the drum rotating at the second rotation speed or not, changing the rotation speed of the drum, if the resonance is detected at the drum, and storing the changed rotation speed in the control unit.

**[0023]** The rotation speed of the drum may increase in the third step. The rotation speed of the drum may decrease in the third step. The rotation speed of the drum may change by predetermined magnitudes each greater than 50rpm in the third step.

**[0024]** The resonance of the drum may be detected by a resonance detecting device automatically in the second step. The third step may be performed automatically by the control unit which receives a signal from the resonance detecting device.

**[0025]** The second step may include the step of sounding alarm through a speaker if the resonance of the drum is detected. The steps are performed in a state a test mode is selected.

**[0026]** In another aspect of the present invention, there is provided a method for controlling a washing machine having a drum of which rotation speed is adjustable for extracting water from laundry, includes a first step for rotating the drum at a second rotation speed set at a control unit, a second step for increasing the rotation speed from the second rotation speed by predetermined magnitudes of rpm in succession, and whether resonance occurs or not at every rotation speed section is detected, a third step for changing the rotation speed of the drum when resonance of the drum is detected, and a fourth step for storing the changed rotation speed in the control unit.

**[0027]** The first step may include the steps of selecting one of course relevant to a kind of laundry, and rotating the drum at the second rotation speed for the selected course.

**[0028]** The rotation speed of the drum may increase in the third step. The rotation speed of the drum may decrease in the third step. The rotation speed of the drum may change by predetermined magnitudes each greater than 50rpm in the third step.

**[0029]** Preferably, the steps are performed in a state a test mode is selected. The drum may be rotated at the changed rotation speed when the washing machine is put into operation again after the test mode is finished.

**[0030]** Preferably, not the changed rotation speed, but the second rotation speed is displayed on a display, when the washing machine is put into operation again after the washing machine is stopped. The fourth step may include the step of sounding an alarm from a speaker when the changed rotation speed is stored.

**[0031]** Preferably, the third step is performed automatically by the control unit having the signal received from a resonance detecting device. The second step may include the step of automatic detection of resonance occurrence at the drum by the resonance detecting device.

**[0032]** The second step may further include the step of storing a preset maximum rotation speed in the control unit in a case no resonance occurs until the drum rotates up to the preset maximum speed. The second step may further include the step of sounding an alarm from a speaker if the resonance of the drum is detected.

**[0033]** According to another aspect of the present invention, a washing machine includes a motor for generating rotating force, a drum for being rotated upon receiving driving force from the motor, a sensor for sensing rotation speed of the drum, a vibration detecting device for transmitting a signal if vibration greater than a preset value is detected at the drum, and a control unit for adjusting the rotation speed of the motor to prevent the resonance of the drum from occurring upon reception of the signal.

**[0034]** The washing machine may further include a rotary key electrically connected to the control unit for a user to turn to change the rotation speed of the drum. The washing machine may further include a selection button connected to the control unit for selecting a course for a kind of laundry. The washing machine may further include a storage button connected to the control unit for storing an adjusted rotation speed.

**[0035]** The washing machine may further include a test mode button connected to the control unit for performing a test mode to search a rotation speed at which the resonance of the drum occurs. The washing machine may further include a speaker connected to the control unit for sounding an alarm when a working rotation speed is stored. The washing machine may further include a display for displaying a rotation speed of the drum sensed at the sensor.

**[0036]** According to another aspect there is provided a washing machine or method for controlling the same as described herein, wherein the washing machine is a pulsator type.

**[0037]** It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

**[0038]** The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings;

FIG 1 illustrates a section of a prior art drum type

washing machine;

FIG 2A illustrates a frontal perspective view of a washing machine;

FIG 2B illustrates a graph showing variation of rotation speed during progress of spinning of a washing machine;

FIGS. 3A - 3C illustrate control systems of a washing machine in accordance with preferred embodiments of the present invention;

FIG 4 illustrates a flow chart showing the steps of a method for controlling spinning of a washing machine of the present invention;

FIG 5 illustrates a flow chart showing the steps of a method for controlling spinning of a washing machine in accordance with a preferred embodiment of the present invention; and

FIG 6 illustrates a flow chart showing a method for controlling spinning of a washing machine in accordance with another preferred embodiment of the present invention.

**[0039]** Reference will now be made in detail to the preferred 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.

**[0040]** FIG 2A illustrates a perspective view of a washing machine, having a control panel 100 on a front. The control panel 100 includes various buttons, a rotary key 200, and a display 300. The rotary keys 200 and buttons are connected to a control unit 103. As the user rotates the rotary key 200, rotation speeds of the motor and the drum are adjusted.

**[0041]** The buttons include a selection button 101, and a storage button 102. The selection button 101 is provided for selecting an operation course at various speeds depending on the kind of laundry, and the storage button 102 is provided to store the adjusted speed in the control unit. Moreover, a test mode button 110 is provided additionally, for selecting a test mode in which the rotation speed is set separately to avoid the resonance of the drum.

**[0042]** Referring to FIG 2B, the spinning step of the washing machine additionally includes an eccentricity detecting step. That is, in the spinning step, the eccentricity of the laundry and a foam quantity are detected. It is preferable that the detection of the eccentricity is performed at a rotation speed in the vicinity of 108 rpm at which the laundry starts to be in close contact with an inside surface of the drum.

**[0043]** In this instance, the eccentricity is detected by detecting variation of the rotation speed. The eccentricity is small when the rotation speed of the drum is uniform, and the eccentricity is great if the rotation speed of the drum varies sharply and periodically.

**[0044]** It is preferable that the eccentricity is detected, and corrected before performing the spinning step. The spinning of the drum in a state of great laundry eccentricity might damage to the drum and the rotation shaft.

**[0045]** If a resonance occurs between the drum and the rotation shaft, which spin, and the cabinet which supports them, detection of the eccentricity is difficult. That is, when the rotation speed of the drum is the same as the natural frequency of the frame, resonance occurs. Since the vibration and noise produced from the drum increase sharply, and the rotation speed of the drum becomes erratic, accurate measurement of the eccentricity is not possible.

**[0046]** Therefore, it is necessary to know a rotation speed of the drum at which the resonance occurs in advance, for measuring the eccentricity in a range outside of the rotation speed at which the resonance occurs.

**[0047]** Referring to FIG 3A, the washing machine includes a control unit, a motor 104, a sensor 105, a selection button 101, a storage button 102, a rotary key 200, a display 300, and a speaker 400.

**[0048]** The selection button 101 is connected to the control unit 103, for selecting an operation course according to the kind of laundry. Therefore, if one course is selected with the selection button 101, the motor 104 rotates at a rotation speed set to meet the course requirement. The rotation speed of the motor 104 is measured at the sensor 105, and provided to the control unit 103, and displayed on the display 300. The rotary key 200 is provided for the user to change the rotation speed.

**[0049]** If resonance occurs at the drum, vibration or noise increase sharply. In this instance, for avoiding resonance, the user turns the rotary key 200 to adjust the rotation speed, and presses the storage button 102, to store the adjusted rotation speed in the control unit 103.

**[0050]** The washing machine further includes the speaker 400 connected to the control unit 103, so that the speaker 400 sounds an alarm when the resonance of the drum is detected, or the adjusted rotation speed is stored.

**[0051]** Referring to FIG. 3B, the washing machine can detect the resonance at the drum by means of a resonance detecting device 150, automatically.

**[0052]** The resonance detecting device 150 includes a spring and a grounding part. If the spring vibrates more than a preset level, the spring comes into contact with the grounding part, when a signal indicating that the resonance is occurred is generated.

**[0053]** That is, if the resonance occurs at the drum, an amplitude of the vibration becomes great suddenly, and the resonance detecting device 150 provides the signal that the resonance occurs to the control unit 103 when a vibration value exceeds a preset value. In this instance, the control unit 103 having received the signal adjusts

the rotation speed of the drum, automatically. Of course, the adjustment of the rotation speed may be made by the user manually by turning the rotary key.

**[0054]** When the speaker 400 connected to the control unit 103 sounds an alarm when resonance of the drum is detected, or the adjusted rotation speed is stored. It is preferable that the adjusted rotation speed is stored automatically by the control unit 103.

**[0055]** When referring to FIG 3C, the washing machine further includes test mode buttons 110 connected to the control unit 103.

**[0056]** It is preferable that the step of adjusting the rotation speed for avoiding the resonance of the drum is made before a regular spinning operation of the washing machine. Therefore, the step of adjusting the rotation speed is performed after the user selects the test mode button 110. The adjusted rotation speed is stored in the control unit before the test mode is finished.

**[0057]** Accordingly, when the regular spinning operation is performed again after the test mode is finished, the drum rotates at the adjusted rotation speed.

**[0058]** A method for controlling spinning of the washing machine will now be described.

**[0059]** At first, the drum is rotated at a first rotation speed set at the control unit (S1). In order to detect the eccentricity of the laundry, it is preferable that the first rotation speed is in the vicinity of 108 rpm. As described before, it is preferable that the detection of the eccentricity is made when no resonance occurs at the drum.

**[0060]** Occurrence of resonance at the drum rotating at the first rotation speed is detected (S2). If the resonance is detected at the drum, the rotation speed of the drum is changed, automatically, or manually (S3). It is preferable that an alarm sounds from the speaker if the resonance occurs at the drum for the user to know.

**[0061]** It is preferable that the rotation speed is increased or decreased, by a preset unit greater than 50 rpm. The resonance range of the drum varies at a certain level with a small variation of the eccentricity of the laundry, for changes of the rotation speed of the drum greater than a variation range. That is, for securer avoidance of the resonance occurrence, the rotation speed is changed by a predetermined magnitude each greater than a certain rpm.

**[0062]** Even if the user can know the occurrence of resonance at the drum from sudden increase of vibration and noise in the step (S2) of detecting resonance of the drum, it is preferable that the occurrence of resonance is detected automatically by the resonance detecting device.

**[0063]** The resonance detecting device provides the signal that the resonance has occurred to the control unit, automatically. It is preferable that the rotation speed is changed by the control unit which received the signal for avoiding the resonance, and the changed rotation speed is stored in the control unit as a new first rotation speed. Accordingly, when the washing machine is put into operation again, after the washing machine is stopped, the drum is controlled to rotate at the changed rotation speed.

**[0064]** After a change of the rotation speed, step (S5) to measure the eccentricity of the laundry held in the drum is performed.

**[0065]** If the eccentricity is greater than a preset value, the step of decreasing the rotation speed of the drum after increasing the rotation speed of the drum is repeated. That is, by repeating the step of varying the rotation speed, the laundry is made to be spread evenly on an inside surface of the drum, so that the eccentricity of the laundry is corrected to an appropriate level.

**[0066]** Alternatively, for correcting the eccentricity to a desired level, the drum may be rotated in regular/reverse directions alternately a plurality of times. When the eccentricity is corrected to a value below the preset level, or the detected eccentricity is below the preset level, the rotation speed of the drum is increased, to progress the spinning.

**[0067]** When no resonance occurs at the drum rotating at the first rotating speed, instead of changing the rotation speed of the drum, a step (S6) for measuring eccentricity of the laundry held in the drum is progressed, directly.

**[0068]** In this instance, as described before, if the measured eccentricity is greater than the preset value, the step of decreasing the rotation speed of the drum after increasing the rotation speed of the drum is repeated, or the drum is rotated in regular/reverse directions alternately a plurality of times.

**[0069]** When the eccentricity is corrected to a value below the preset level, or the detected eccentricity is below the preset level, the rotation speed of the drum is increased, to progress the spinning.

**[0070]** It is preferable that the step (SA) of changing the rotation speed to avoid resonance, and the detection (S5, and S6) of eccentricity of the laundry are performed in a state when the test mode is selected.

**[0071]** As described before, after detection and correction of the eccentricity of the laundry held in the drum is finished, the spinning step is progressed.

**[0072]** Referring to FIG 5, the drum is rotated at a constant speed of a preset second rotation speed for extraction of water from the laundry (S7).

**[0073]** The second rotation speeds corresponding to kinds of laundry, such as lingerie, blue jeans, general clothes, and blankets, are set at the control unit. Therefore, once a desired course is selected by the user by pressing the selection button according to the kind of the laundry initially, the drum is rotated at the second rotation speed of the selected course. It is preferable that the second rotation speed is higher than 600 rpm for smooth extraction of water from the laundry.

**[0074]** Referring to FIG. 2B, it is preferable that a step is further performed, for detecting a volume of foam inside of the drum while rotating the drum at a constant speed of a third rotation speed (W12) before the rotation speed is increased from the first rotation speed W1 to the second rotation speed W2.

**[0075]** Then, if resonance occurs at the drum rotating

at the second rotation speed W2 detected (S8), if the resonance is detected, the rotation speed of the drum is changed (S9). The changed rotation speed is stored in the control unit (S10).

**[0076]** It is preferable that the change of the rotation speed is made by predetermined magnitudes each greater than 50 rpm. This is for changing the rotation speed of the drum greater than a change range of a resonance range of the drum caused by a minute change of the eccentricity of the laundry.

**[0077]** It is preferable that the rotation speed change for avoidance of the resonance is made in a state when the test mode is selected. After the finish of the rotation speed change, the test mode is finished automatically, and, then, the spinning step proceeds for a preset time period by spinning the drum.

**[0078]** For an example, if the initially set second rotation speed is 700 rpm for a selected course, and the resonance occurs at the rotation speed, the rotation speed is changed by turning the rotary key, or automatically by the control unit. Then, the rotation speed is changed to 650rpm, and stored in the control unit. Thereafter, when the test mode is finished, and the washing machine is put into operation again, the drum performs the spinning at the 650rpm which is newly stored second rotation speed.

**[0079]** In this instance, the rotation speed of the drum is displayed on the display 300, wherein, even if the spinning is progressed at 650rpm, it is preferable that the rotation speed is displayed on the display as 700rpm as set initially. That is, at a time the washing machine is put into operation again after the washing machine is stopped, not the changed rotation speed, but the second rotation speed set initially is displayed on the display 300. This is for preventing the user from being confused by the rotation speed.

**[0080]** When the display may display the changed rotation speed and the initially set second rotation speed alternately at regular time intervals.

**[0081]** A method for controlling a washing machine will be described with reference to FIG 6, in which a rotation speed of a drum is controlled for extraction of water from the laundry.

**[0082]** At first, the drum is rotated at the second rotation speed set at the control unit (S 12). In the spinning step, it is preferable that the second rotation speed is set different from each other according to the kind of laundry. For this, the spinning step further includes a step for selecting a courses corresponding to a kind of the laundry, and a step for rotating the drum at a second rotation speed relevant to the selected course.

**[0083]** That is, second rotation speeds are set at the control unit for various kinds of laundry, such as lingerie, blue jeans, general clothes, and blankets, respectively. Therefore, once the user selects a desired course by pressing the selection button according to the kind of the laundry, the drum is rotated at the second rotation speed of the selected course.

**[0084]** The rotation speed is increased in succession by a predetermined magnitude of rpm from the second rotation speed (S 15, and S17), and whether the resonance occurs at the drum or not is detected at every rotation speed section (S 14, S16, and S 18). It is preferable that the predetermined magnitude of rpm is 50rpm or 100rpm.

**[0085]** That is, if the resonance is detected at any one section of the rotation speed, the rotation speed of the drum is changed (S20), and if no resonance is detected, after the rotation speed is increased by predetermined magnitudes of rpm, whether the resonance occurs or not is again detected.

**[0086]** For an example, a case is assumed in which the drum rotates at 500rpm which is initially set second rotation speed. If no resonance occurs, the rotation speed is increased to 600rpm. If the resonance occurs at the increased rotation speed, the rotation speed is decreased to 650rpm or increased to 700rpm.

**[0087]** When resonance is detected at the drum, the rotation speed of the drum is increased or decreased, preferably by predetermined magnitudes each greater than 50rpm. According to this, occurrence of the resonance at the changed rotation speed can be prevented, securely.

**[0088]** Thus, the rotation speed is adjusted for preventing occurrence of the resonance at the drum, and the adjusted rotation speed is stored in the control unit. If the resonance of the drum is detected, an alarm sounds from the speaker, by which the user can easily know occurrence of the resonance.

**[0089]** In the meantime, the control unit has a maximum rotation speed set therein, and, when no resonance occurs until the drum rotates up to the set maximum rotation speed, the maximum speed is stored in the control unit.

**[0090]** It is preferable that the detection of resonance at the drum S14, S16, and S18, the change of the rotation speed S20, and the storage of the changed rotation speed S21 are performed in a state when the test mode is selected S21.

**[0091]** Since the changed rotation speed is stored as a newly set second rotation speed in the control unit, when the washing machine is put into operation again after the test mode is finished, the drum is rotated at the changed rotation speed directly, instead of increasing the rotation speed gradually.

**[0092]** In the meantime, an alarm sounds from the speaker when the changed rotation speed is stored in the control unit, and the storage of the changed rotation speed is performed automatically by the control unit in response to the signal from the resonance detecting device. Moreover, it is preferable that the occurrence of the resonance at the drum is detected by the resonance detecting device, automatically.

**[0093]** It is preferable that the washing machine is provided with a reset button for returning the rotation speed to the initial set second rotation speed, for making the

next operation by the user in performing the test mode easy.

**[0094]** As has been described, the washing machine and the method for controlling the same have the following advantages.

**[0095]** First, the method for controlling a washing machine of the present invention permits more accurate measurement of an eccentricity by detecting resonance and adjusting the rotation speed in measuring eccentricity of the laundry held in the drum.

**[0096]** Second, the detection of resonance at a rotation speed of the drum and adjustment of the rotation speed to avoid the resonance in the spinning step permits to enhanced reliability of the product.

**[0097]** The foregoing method for controlling spinning in a washing machine is applicable not only to the drum type washing machine, but also other general washing machines, such as a pulsator type washing machine.

**[0098]** 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 covers the modifications and variations provided they come within the scope of the appended claims and their equivalents.

## Claims

1. A method for controlling a washing machine having a drum (a) with adjustable rotation speed, comprising:

   a first step of rotating the drum at a first rotation speed set at a control unit (103);
   a second step (S2) of detecting whether resonance of the drum occurs or not at the first rotation speed;
   a third step (S3) of changing the rotation speed of the drum if resonance is detected;
   **characterized by** when resonance is detected, the third step further including measuring (S5, S6) an cecentricity of laundry held in the drum rotating at the changed rotation speed.

2. The method as claimed in claim 1, wherein the third step includes storing the changed rotation speed, comprising the speed after the third step of changing the rotation speed, in the control unit; and preferably wherein the drum is rotated at the changed rotation speed when the washing machine is put into operation again after the washing machine is stopped.

3. The method as claimed in claim 2, further including changing the rotation speed of the drum again after the third step change in rotation speed, if the eccentricity is greater than a preset value.

4. The method of claim 2 wherein the further change of speed comprises decreasing the rotation speed, and the third step change comprises increasing the rotation speed.

5. The method of claim 2 wherein the drum is rotated in regular/reverse directions alternately a plurality of times, if the eccentricity exceeds a preset value.

6. The method of claim 2 wherein, when the eccentricity is below the preset value, the third step further includes;
   rotating the drum at the set second rotation speed for extracting water from the laundry, detecting whether the resonance occurs with the drum rotating at the second rotation speed or not, changing the rotation speed of the drum, if resonance is detected at the drum, and storing the changed rotation speed in the control unit.

7. The method as claimed in claim 1, further comprising the step of measuring the eccentricity of the laundry held in the drum, if no resonance occurs in the second step.

8. The method as claimed in claim 7, wherein the step of changing the rotation speed of the drum again after increasing the second step change of rotation speed of the drum is repeated, if the eccentricity is greater than a preset value.

9. The method of claim 7 wherein the step of changing the rotation speed of the drum again comprises decreasing the speed, and the second stage change of rotation comprises increasing the speed.

10. The method of claim 7 wherein the drum is rotated in regular/reverse directions alternately a plurality of times, if the eccentricity exceeds a preset value.

11. The method of claim 7 wherein, when the eccentricity is below the preset value, the method further includes rotating the drum at the set second rotation speed for extracting water from the laundry, detecting whether resonance occurs with the drum rotating at the second rotation speed or not,
    changing the rotation speed of the drum, if the resonance is detected at the drum, and storing the changed rotation speed in the control unit.

12. The method as claimed in claim1, wherein the rotation speed of the drum increases in the third step.

13. The method of claim 1 wherein the rotation speed of the drum decreases in the third step.

14. The method of claim 1 wherein the rotation speed of the drum changes by predetermined magnitudes

each greater than 50rpm in the third step.

**15.** The method of claim 1 wherein the second step includes the step of sounding an alarm through a speaker (400) if the resonance of the drum is detected; wherein the steps are performed when a test mode is selected.

**16.** The method as claimed in claim 1, wherein the resonance of the drum is detected by a resonance detecting device automatically in the second step.

**17.** The method of claim 16 wherein the third step is performed automatically by the control unit which receives a signal from the resonance detecting device.

**18.** The method of claim 1, further comprising;
rotating the drum at a second rotation speed set at a control unit;
increasing the rotation speed from the second rotation speed by predetermined magnitudes of rpm in succession, and whether resonance occurs or not at every rotation speed is detected;
changing the rotation speed of the drum when resonance of the drum is detected;
and
storing the changed rotation, comprising storing the speed of the drum in the control unit after the changing the rotation speed of the drum step.

**19.** The method as claimed in claim 18, wherein the rotating the drum step includes the steps of;
selecting a course for rotation speeds relevant to a kind of laundry, and
rotating the drum at the second rotation speed for the selected course.

**20.** The method of claim 19 wherein the rotation speed of the drum increases in the changing the rotation speed of the drum step.

**21.** The method of claim 19 wherein the rotation speed of the drum decreases in the changing the rotation speed of the drum step.

**22.** The method of claim 19 wherein the rotation speed of the drum changes by predetermined magnitudes each greater than 50rpm in the changing the rotation speed of the drum step.

**23.** The method of claim 19 wherein the storing the changed rotation step includes the step of sounding an alarm from a speaker when the changed rotation speed is stored.

**24.** The method of claim 19 wherein the changing the rotation speed of the drum step is performed automatically by the control unit having the signal received from a resonance detecting device.

**25.** The method of claim 19 wherein the increasing the rotation speed step includes the step of automatic detection of resonance occurrence at the drum by the resonance detecting device.

**26.** The method of claim 19 wherein the increasing the rotation speed step further includes the step storing a preset maximum rotation speed in the control unit when no resonance occurs until the drum rotates up to the preset maximum speed.

**27.** The method of claim 19 wherein the increasing the rotation speed step further includes the step of sounding an alarm from a speaker if the resonance of the drum is detected.

**28.** The method as claimed in claim 18, wherein the steps are performed when a test mode is selected.

**29.** The method as claimed in claim 28, wherein the drum is rotated at the changed rotation speed when the washing machine is put into operation again after the test mode is finished; and preferably wherein, not the changed rotation speed, but the second rotation speed is displayed on a display, when the washing machine is put into operation again after the washing machine is stopped.

**Patentansprüche**

**1.** Verfahren zum Steuern bzw. Regeln einer Waschmaschine mit einer Trommel (a) mit verstellbarer Drehzahl, umfassend:

einen ersten Schritt des Drehens der Trommel mit einer ersten Drehzahl, die an einer Steuer/Regeleinheit (103) eingestellt wird;
einen zweiten Schritt (S2) des Feststellens, ob bei der ersten Drehzahl eine Resonanz der Trommel auftritt oder nicht;
einen dritten Schritt (S3) des Veränderns der Drehzahl der Trommel bei Festellen einer Resonanz;

**dadurch gekennzeichnet, dass** bei Festellen einer Resonanz der dritte Schritt weiters das Messen (S5, S6) einer Exzentrizität der Wäsche umfasst, die in der mit der geänderten Drehzahl rotierenden Trommel aufgenommen ist.

**2.** Verfahren nach Anspruch 1, wobei der dritte Schritt das Speichern der geänderten Drehzahl mit der Geschwindigkeit nach dem dritten Schritt des Ändern der Drehzahl in der Steuer/Regeleinheit umfasst, und wobei die Trommel vorzugsweise mit der ver-

änderten Drehzahl gedreht wird, wenn die Waschmaschine nach Stoppen der Waschmaschine wieder in Betrieb gesetzt wird.

**3.** Verfahren nach Anspruch 2, weiters umfassend das neuerliche Verändern der Drehzahl der Trommel nach der Veränderung der Drehzahl im dritten Schritt, wenn die Exzentrizität größer als ein vorgegebener Wert ist.

**4.** Verfahren nach Anspruch 2, wobei die weitere Geschwindigkeitsänderung ein Verringern der Drehzahl umfasst und die Änderung des dritten Schritts ein Erhöhen der Drehzahl umfasst.

**5.** Verfahren nach Anspruch 2, wobei die Trommel alternativ mehrmals in normaler/entgegengesetzter Richtung gedreht wird, wenn die Exzentrizität einen vorgegebenen Wert übersteigt.

**6.** Verfahren nach Anspruch 2, wobei, wenn die Exzentrizität unter einem vorgegebenen Wert liegt, der dritte Schritt weiters umfasst:

Rotieren der Trommel mit der eingestellten Drehzahl zum Entfernen des Wassers aus der Wäsche, Feststellen, ob eine Resonanz auftritt oder nicht, wenn sich die Trommel mit der zweiten Drehzahl dreht, Ändern der Drehzahl der Trommel, wenn eine Resonanz an der Trommel festgestellt wird, und Speichern der geänderten Drehzahl in der Steuer/Regeleinheit.

**7.** Verfahren nach Anspruch 1, weiters umfassend den Schritt des Messens der Exzentrizität der in der Trommel aufgenommenen Wäsche, wenn keine Resonanz im zweiten Schritt auftritt.

**8.** Verfahren nach Anspruch 7, wobei der Schritt des neuerlichen Änderns der Drehzahl der Trommel nach Erhöhen der Änderung der Drehzahl der Trommel des zweiten Schritts wiederholt wird, wenn die Exzentrizität größer als ein vorgegebener Wert ist.

**9.** Verfahren nach Anspruch 7, wobei der Schritt des neuerlichen Änderns der Drehzahl der Trommel ein Verringern der Geschwindigkeit umfasst und die Änderung der Rotation des zweiten Schritts ein Erhöhen der Geschwindigkeit umfasst.

**10.** Verfahren nach Anspruch 7, wobei die Trommel alternativ mehrmals in normaler/entgegengesetzter Richtung gedreht wird, wenn die Exzentrizität einen vorgegebenen Wert übersteigt.

**11.** Verfahren nach Anspruch 7, wobei, wenn die Exzentrizität unter dem vorgegebenen Wert liegt, das Verfahren weiters das Drehen der Trommel mit der zweiten vorgegebenen Drehzahl zum Entfernen von Wasser aus der Wäsche, das Feststellen, ob bei Drehen der Trommel mit der zweiten Drehzahl eine Resonanz auftritt oder nicht, das Ändern der Drehzahl der Trommel bei Festellen einer Resonanz an der Trommel und das Speichern der geänderten Drehzahl in der Steuer/Regeleinheit umfasst.

**12.** Verfahren nach Anspruch 1, wobei die Drehzahl der Trommel im dritten Schritt ansteigt.

**13.** Verfahren nach Anspruch 1, wobei die Drehzahl der Trommel im dritten Schritt abnimmt .

**14.** Verfahren nach Anspruch 1, wobei sich die Drehzahl der Trommel im dritten Schritt um vorherbestimmte Werte, die jeweils über 50 UpM liegen, ändert.

**15.** Verfahren nach Anspruch 1, wobei der zweite Schritt den Schritt des Ertönens eines Alarms über einen Lautsprecher (400) umfasst, wenn eine Resonanz der Trommel festgestellt wird, wobei die Schritte durchgeführt werden, wenn ein Testmodus gewählt wird.

**16.** Verfahren nach Anspruch 1, wobei die Resonanz der Trommel mit Hilfe einer Resonanz-Detektionseinrichtung automatisch im zweiten Schritt festgestellt wird.

**17.** Verfahren nach Anspruch 16, wobei der dritte Schritt automatisch durch die Steuer/Regeleinheit ausgeführt wird, die ein Signal von der Resonanz-Detektionseinrichtung empfängt.

**18.** Verfahren nach Anspruch 1, weiters umfassend:

Drehen der Trommel mit einer in der Steuer/Regeleinheit eingestellten zweiten Drehzahl;
Erhöhen der Drehzahl von der zweiten Drehzahl um vorherbestimmte aufeinanderfolgende UpM-Werte und Feststellen, ob bei jeder Drehzahl eine Resonanz auftritt oder nicht;
Ändern der Drehzahl der Trommel bei Feststellen einer Resonanz der Trommel; und
Speichern der geänderten Rotation, umfassend das Speichern der Geschwindigkeit der Trommel in der Steuer/Regeleinheit nach dem Schritt des Änderns der Drehzahl der Trommel.

**19.** Verfahren nach Anspruch 18, wobei der Schritt des Drehens der Trommel folgende Schritte umfasst:

Auswählen eines Verlaufs für Drehzahlen, die für eine Art von Wäsche relevant sind, und
Drehen der Trommel mit der zweiten Drehzahl für den ausgewählten Verlauf.

**20.** Verfahren nach Anspruch 19, wobei die Drehzahl der Trommel im Schritt des Änderns der Drehzahl der Trommel ansteigt.

**21.** Verfahren nach Anspruch 19, wobei die Drehzahl der Trommel im Schritt des Änderns der Drehzahl der Trommel abnimmt.

**22.** Verfahren nach Anspruch 19, wobei sich die Drehzahl der Trommel im Schritt des Änderns der Drehzahl der Trommel um vorherbestimmte Werte, die jeweils über 50 UpM liegen, ändert.

**23.** Verfahren nach Anspruch 19, wobei der Schritt des Speicherns der geänderten Rotation den Schritt des Ertönens eines Alarms aus einem Lautsprecher umfasst, wenn die geänderte Drehzahl gespeichert wird.

**24.** Verfahren nach Anspruch 19, wobei der Schritt des Ändern der Drehzahl der Trommel automatisch durch die Steuer/Regeleinheit ausgeführt wird, die das Signal von einer Resonanz-Detektionseinrichtung empfangen hat.

**25.** Verfahren nach Anspruch 19, wobei der Schritt des Erhöhens der Drehzahl den Schritt des automatischen Feststellens des Auftretens von Resonanz an der Trommel durch die Resonanz-Detektionseinrichtung umfasst.

**26.** Verfahren nach Anspruch 19, wobei der Schritt des Erhöhens der Drehzahl weiters den Schritt des Speicherns einer vorgegebenen maximalen Drehzahl in der Steuer/Regeleinheit umfasst, wenn keine Resonanz auftritt, bis sich die Trommel bis zu der vorgegebenen maximalen Drehzahl dreht.

**27.** Verfahren nach Anspruch 19, wobei der Schritt des Erhöhens der Drehzahl weiters den Schritt des Ertönens eines Alarms aus einem Lautsprecher umfasst, wenn die Resonanz der Trommel festgestellt wird.

**28.** Verfahren nach Anspruch 18, wobei die Schritte durchgeführt werden, wenn ein Testmodus gewählt wird.

**29.** Verfahren nach Anspruch 28, wobei die Trommel mit der geänderten Drehzahl gedreht wird, wenn die Waschmaschine nach Beendigung des Testmodus wieder in Betrieb gesetzt wird, und wobei vorzugsweise nicht die geänderte Drehzahl, sondern die zweite Drehzahl auf einer Anzeige angezeigt wird, wenn die Waschmaschine nach Stoppen der Waschmaschine wieder in Betrieb gesetzt wird.

**Revendications**

**1.** Procédé de commande d'une machine à laver comportant un tambour (a) avec une vitesse de rotation réglable, comprenant :

une première étape de mise en rotation du tambour à une première vitesse de rotation établie au niveau d'une unité de commande (103) ;
une deuxième étape (S2) de détection pour savoir si une résonnance du tambour a lieu ou non à la première vitesse de rotation ;
une troisième étape (S3) de modification de la vitesse de rotation du tambour si une résonnance est détectée ;

**caractérisé en ce que**, lorsqu'une résonnance est détectée, la troisième étape comprend en outre la mesure (S5, S6) d'une excentricité du linge contenu dans le tambour mis en rotation à la vitesse de rotation modifiée.

**2.** Procédé selon la revendication 1, dans lequel la troisième étape comprend la mémorisation de la vitesse de rotation modifiée, comprenant la vitesse après la troisième étape de modification de la vitesse de rotation, dans l'unité de commande ; et de préférence dans lequel le tambour est mis en rotation à la vitesse de rotation modifiée lorsque la machine à laver est remise en fonctionnement après l'arrêt de la machine à laver.

**3.** Procédé selon la revendication 2, comprenant en outre la modification de la vitesse de rotation du tambour à nouveau après la modification de la vitesse de rotation de la troisième étape, si l'excentricité est supérieure à une valeur préétablie.

**4.** Procédé selon la revendication 2, dans lequel la modification supplémentaire de la vitesse comprend la diminution de la vitesse de rotation, et la modification de la troisième étape comprend l'augmentation de la vitesse de rotation.

**5.** Procédé selon la revendication 2, dans lequel le tambour est mis en rotation dans des sens normaux/inverses de façon alternée à plusieurs reprises, si l'excentricité dépasse une valeur préétablie.

**6.** Procédé selon la revendication 2, dans lequel, lorsque l'excentricité est en dessous de la valeur préétablie, la troisième étape comprend en outre :

la mise en rotation du tambour à la seconde vitesse de rotation établie pour extraire l'eau du linge, la détection pour savoir si une résonnance a lieu ou non lorsque le tambour est en rotation à la seconde vitesse de rotation, la modification

de la vitesse de rotation du tambour, si une résonnance est détectée au niveau du tambour, et la mémorisation de la vitesse de rotation modifiée dans l'unité de commande.

**7.** Procédé selon la revendication 1, comprenant en outre l'étape de mesure de l'excentricité du linge contenu dans le tambour, si aucune résonnance n'a lieu à la deuxième étape.

**8.** Procédé selon la revendication 7, dans lequel l'étape de modification de la vitesse de rotation du tambour à nouveau après l'augmentation de la vitesse de rotation du tambour de la deuxième étape de modification est répétée, si l'excentricité est supérieure à une valeur préétablie.

**9.** Procédé selon la revendication 7, dans lequel l'étape de modification de la vitesse de rotation du tambour à nouveau comprend la diminution de la vitesse, et la modification de la rotation de la deuxième étape comprend l'augmentation de la vitesse.

**10.** Procédé selon la revendication 7, dans lequel le tambour est mis en rotation dans des sens normaux/inverses de façon alternée à plusieurs reprises, si l'excentricité dépasse une valeur préétablie.

**11.** Procédé selon la revendication 7, dans lequel, lorsque l'excentricité est en dessous de la valeur préétablie, le procédé comprend en outre la mise en rotation du tambour à la seconde vitesse de rotation établie pour extraire l'eau du linge, la détection pour savoir si une résonnance a lieu ou non lorsque le tambour est en rotation à la seconde vitesse de rotation,
la modification de la vitesse de rotation du tambour, si la résonnance est détectée au niveau du tambour, et la mémorisation de la vitesse de rotation modifiée dans l'unité de commande.

**12.** Procédé selon la revendication 1, dans lequel la vitesse de rotation du tambour augmente à la troisième étape.

**13.** Procédé selon la revendication 1, dans lequel la vitesse de rotation du tambour diminue à la troisième étape.

**14.** Procédé selon la revendication 1, dans lequel la vitesse de rotation du tambour est modifiée par des grandeurs prédéterminées, chacune étant supérieure à 50 tr/min à la troisième étape.

**15.** Procédé selon la revendication 1, dans lequel la deuxième étape comprend l'étape de retentissement d'une alarme à travers un haut-parleur (400) si la résonnance du tambour est détectée ; dans lequel les étapes sont réalisées lorsqu'un mode d'essai est choisi.

**16.** Procédé selon la revendication 1, dans lequel la résonnance du tambour est détectée automatiquement par un dispositif de détection de résonnance à la deuxième étape.

**17.** Procédé selon la revendication 16, dans lequel la troisième étape est réalisée automatiquement par l'unité de commande qui reçoit un signal du dispositif de détection de résonnance.

**18.** Procédé selon la revendication 1, comprenant en outre :

la mise en rotation du tambour à une seconde vitesse de rotation établie au niveau d'une unité de commande ;
l'augmentation de la vitesse de rotation à partir de la seconde vitesse de rotation par des grandeurs prédéterminées de tr/min consécutivement, et la détection du fait qu'une résonnance a lieu ou non à chaque vitesse de rotation ;
la modification de la vitesse de rotation du tambour lorsqu'une résonnance du tambour est détectée ; et
la mémorisation de la rotation modifiée, comprenant la mémorisation de la vitesse du tambour dans l'unité de commande après l'étape de modification de la vitesse de rotation du tambour.

**19.** Procédé selon la revendication 18, dans lequel l'étape de mise en rotation du tambour comprend les étapes de :

choix d'un programme pour des vitesses de rotation appropriées à une sorte de linge, et
mise en rotation du tambour à la seconde vitesse de rotation pour le programme choisi.

**20.** Procédé selon la revendication 19, dans lequel la vitesse de rotation du tambour augmente dans l'étape de modification de la vitesse de rotation du tambour.

**21.** Procédé selon la revendication 19, dans lequel la vitesse de rotation du tambour diminue dans l'étape de modification de la vitesse de rotation du tambour.

**22.** Procédé selon la revendication 19, dans lequel la vitesse de rotation du tambour est modifiée par des grandeurs prédéterminées, chacune étant supérieure à 50 tr/min dans l'étape de modification de la vitesse de rotation du tambour.

**23.** Procédé selon la revendication 19, dans lequel l'éta-

pe de mémorisation de la rotation modifiée comprend l'étape de retentissement d'une alarme par un haut-parleur lorsque la vitesse de rotation modifiée est mémorisée.

**24.** Procédé selon la revendication 19, dans lequel l'étape de modification de la vitesse de rotation du tambour est réalisée automatiquement par l'unité de commande ayant le signal reçu d'un dispositif de détection de résonnance.

**25.** Procédé selon la revendication 19, dans lequel l'étape d'augmentation de la vitesse de rotation comprend l'étape de détection automatique d'une occurrence de résonnance au niveau du tambour par le dispositif de détection de résonnance.

**26.** Procédé selon la revendication 19, dans lequel l'étape d'augmentation de la vitesse de rotation comprend en outre l'étape de mémorisation d'une vitesse de rotation maximale préétablie dans l'unité de commande lorsqu'aucune résonnance n'a lieu jusqu'à ce que le tambour soit mis en rotation jusqu'à la vitesse maximale préétablie.

**27.** Procédé selon la revendication 19, dans lequel l'étape d'augmentation de la vitesse de rotation comprend en outre l'étape de retentissement d'une alarme par un haut-parleur si la résonnance du tambour est détectée.

**28.** Procédé selon la revendication 18, dans lequel les étapes sont réalisées lorsqu'un mode d'essai est choisi.

**29.** Procédé selon la revendication 28, dans lequel le tambour est mis en rotation à la vitesse de rotation modifiée lorsque la machine à laver est remise en fonctionnement après la fin du mode d'essai ; et de préférence dans lequel, non pas la vitesse de rotation modifiée, mais la seconde vitesse de rotation est affichée sur un écran d'affichage, lorsque la machine à laver est remise en fonctionnement après l'arrêt de la machine à laver.

FIG. 1

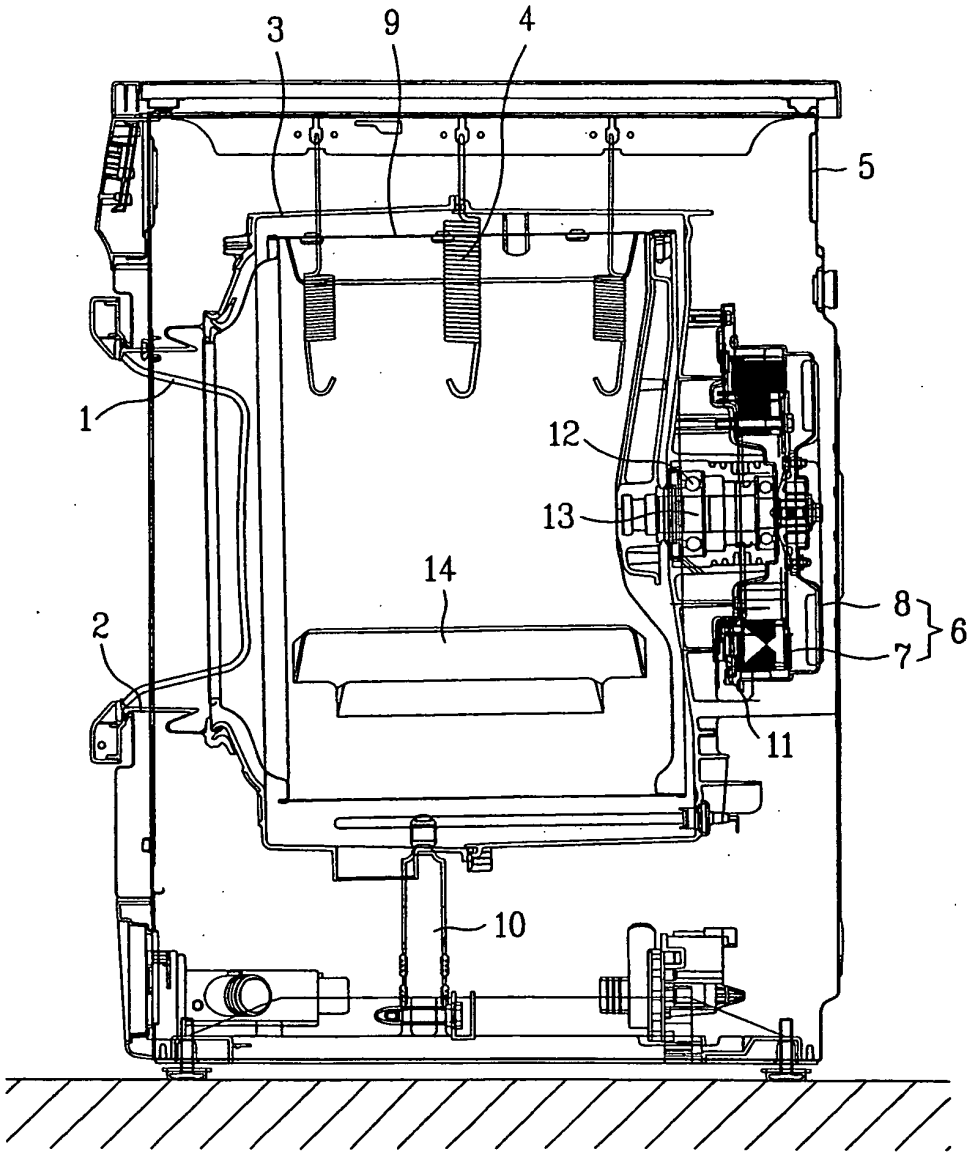


FIG. 2A

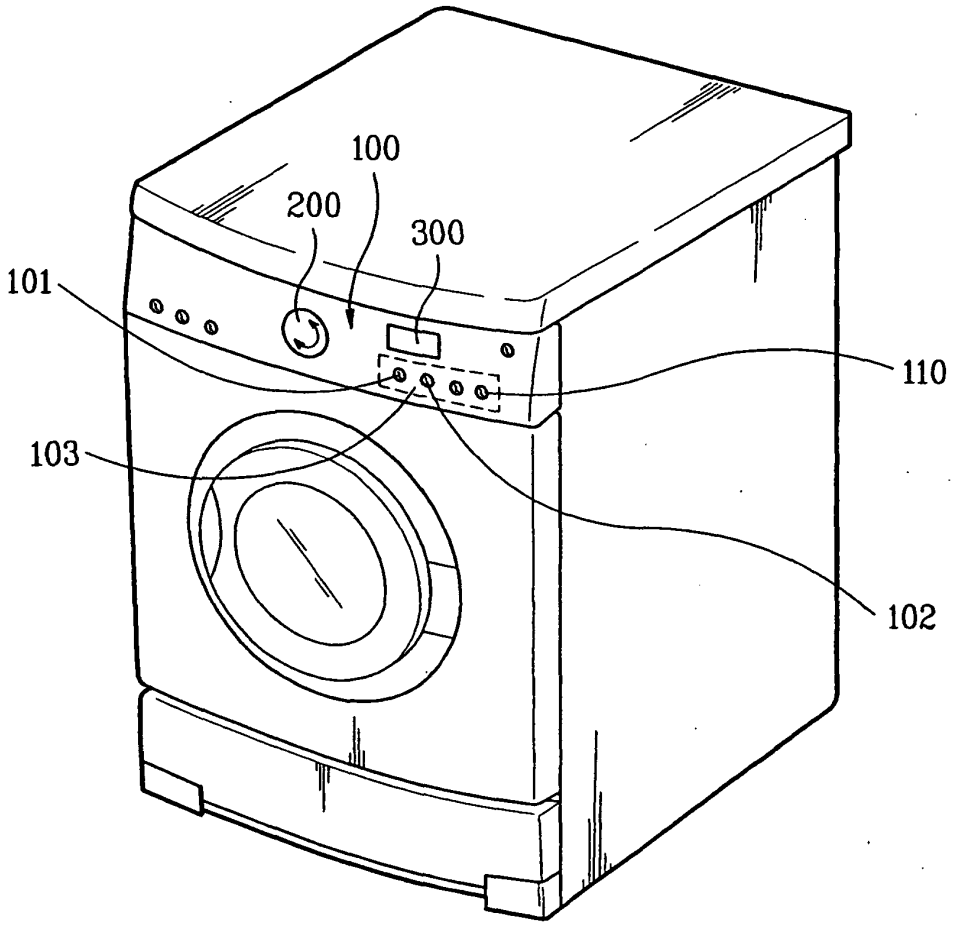


FIG. 2B

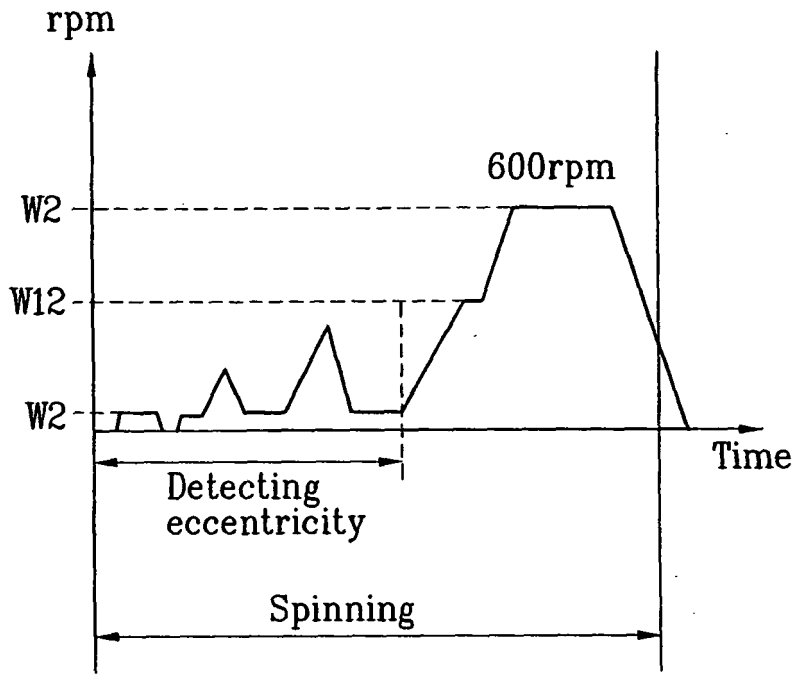


FIG. 3A

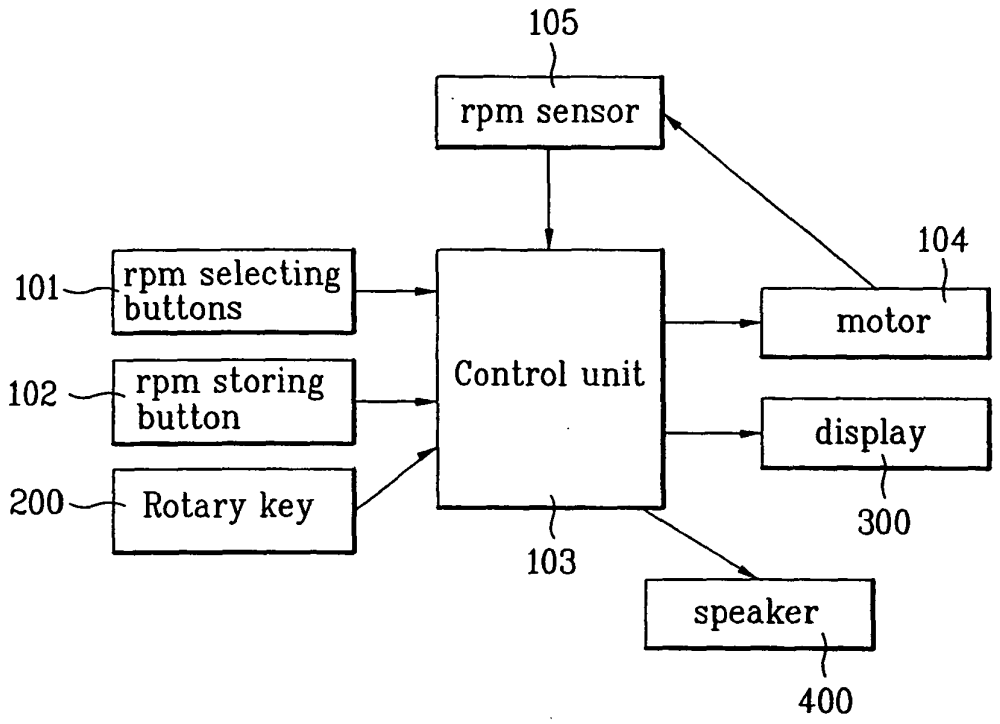

105
rpm sensor
104
101
rpm selecting buttons
motor
Control unit
102
rpm storing button
display
200
Rotary key
300
103
speaker
400

FIG. 3B

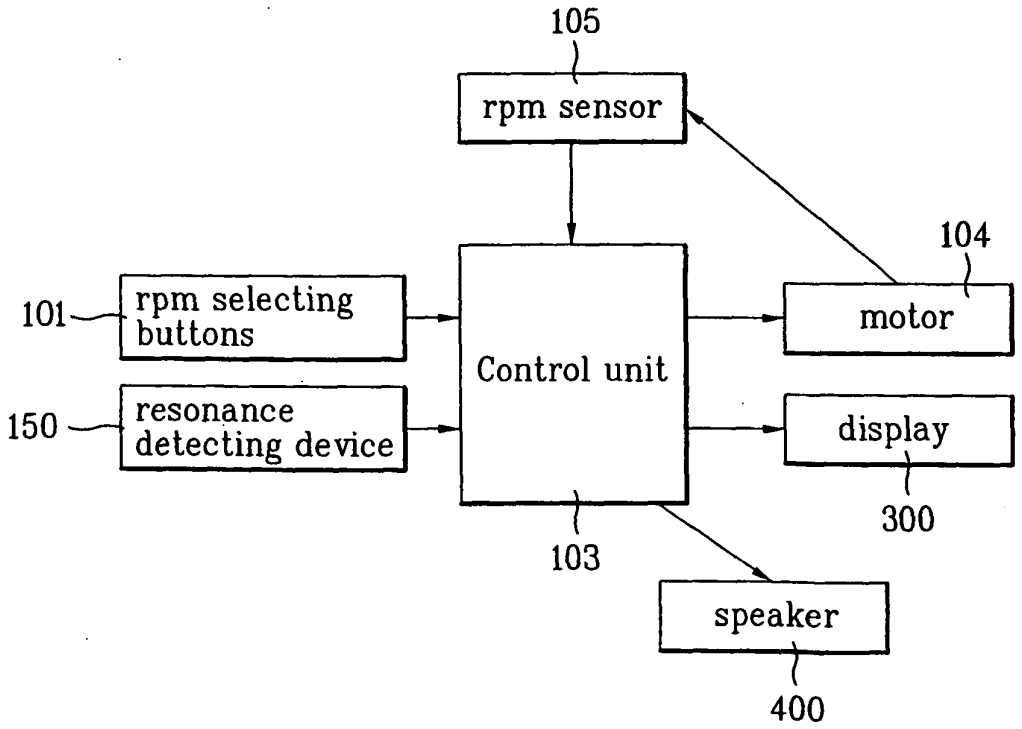

105
rpm sensor
104
101
rpm selecting buttons
motor
Control unit
150
resonance detecting device
display
300
103
speaker
400

FIG. 3C

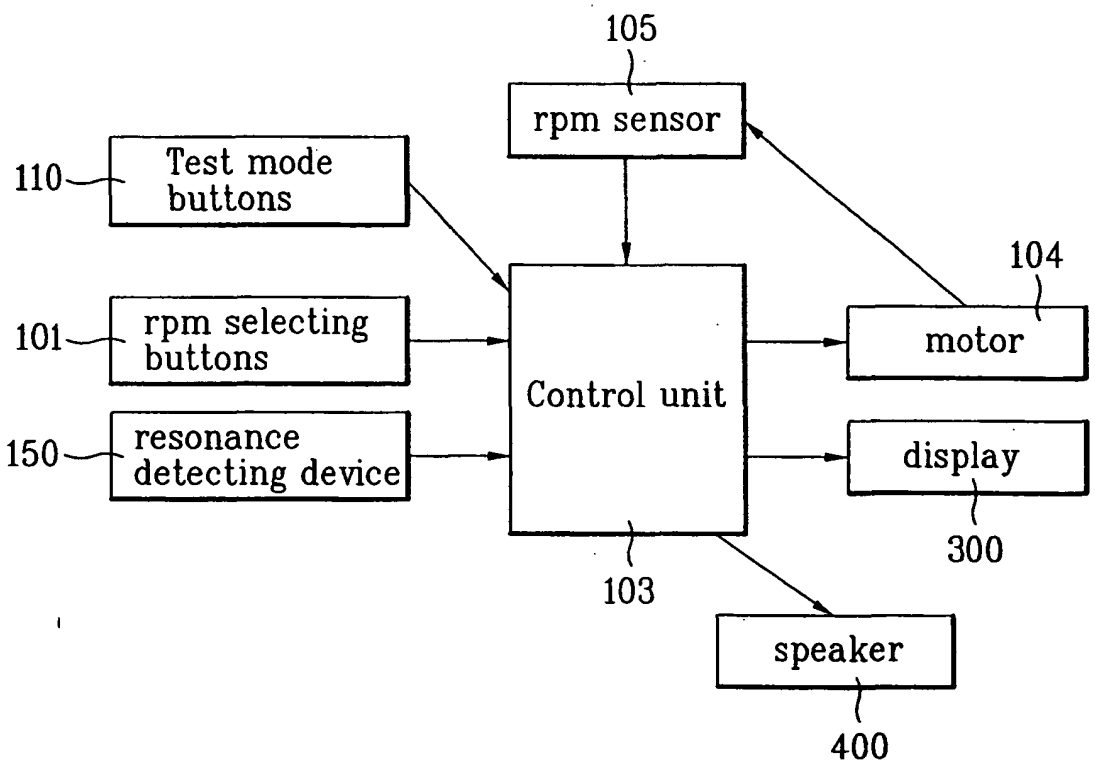

105
rpm sensor
110
Test mode buttons
104
101
rpm selecting buttons
Control unit
motor
150
resonance detecting device
display
300
103
speaker
400

FIG. 4

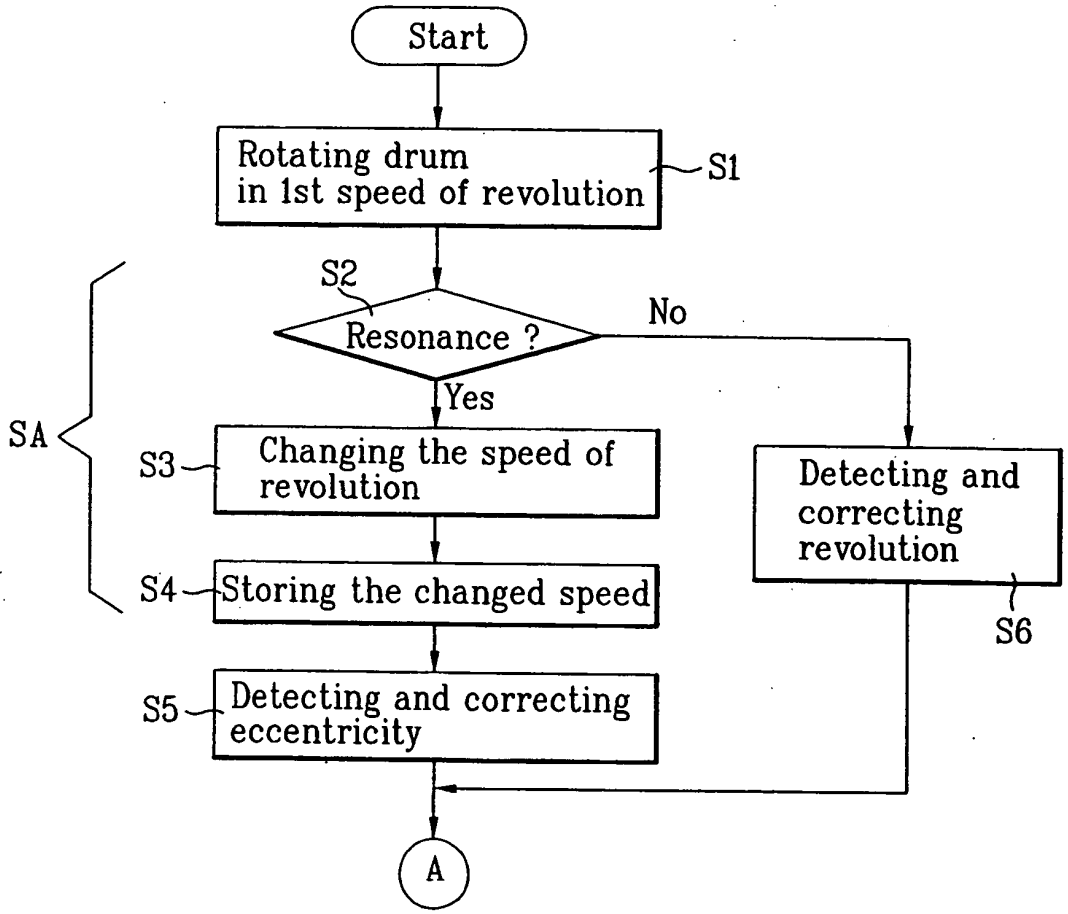

Start
Rotating drum in 1st speed of revolution
S1
S2
Resonance ?
No
Yes
SA
S3
Changing the speed of revolution
S4
Storing the changed speed
S5
Detecting and correcting eccentricity
Detecting and correcting revolution
S6
A

FIG. 5

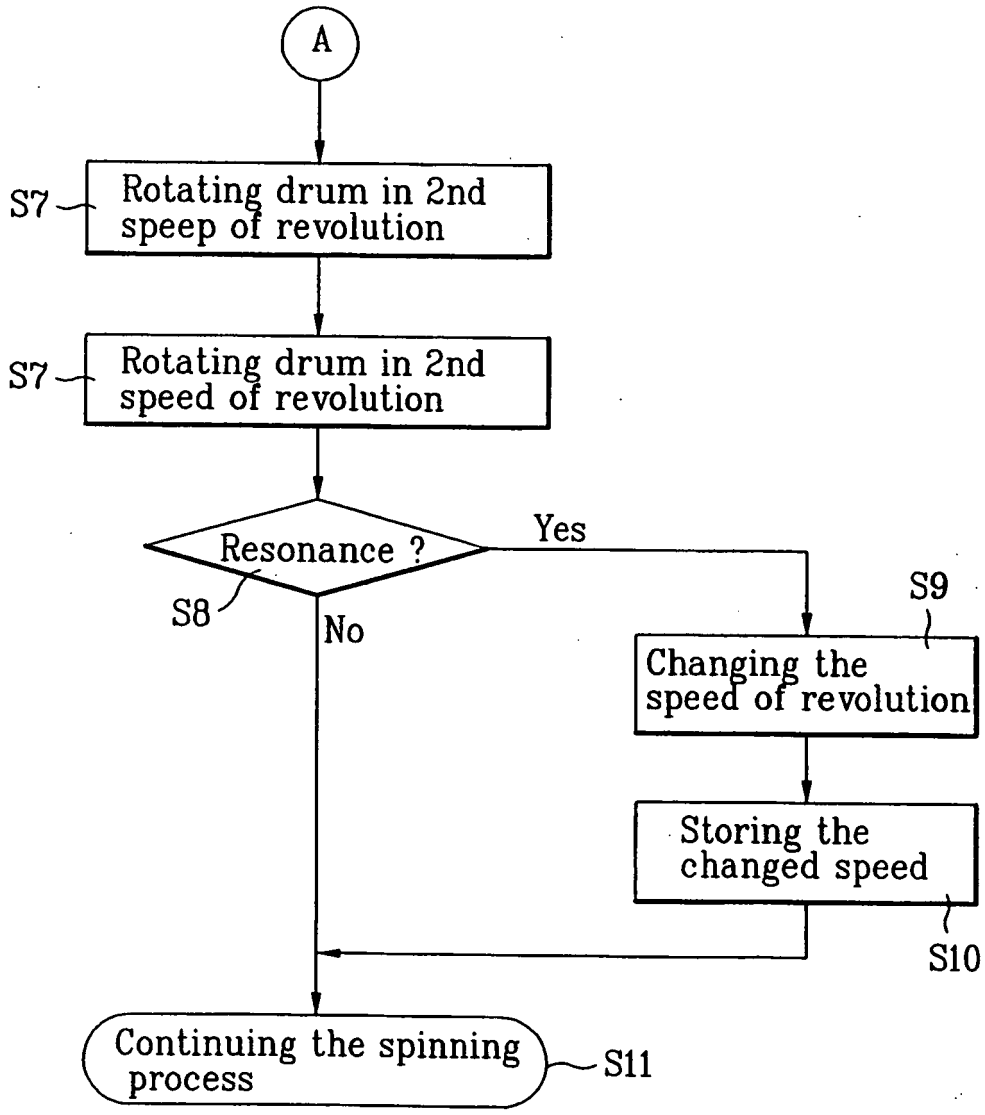
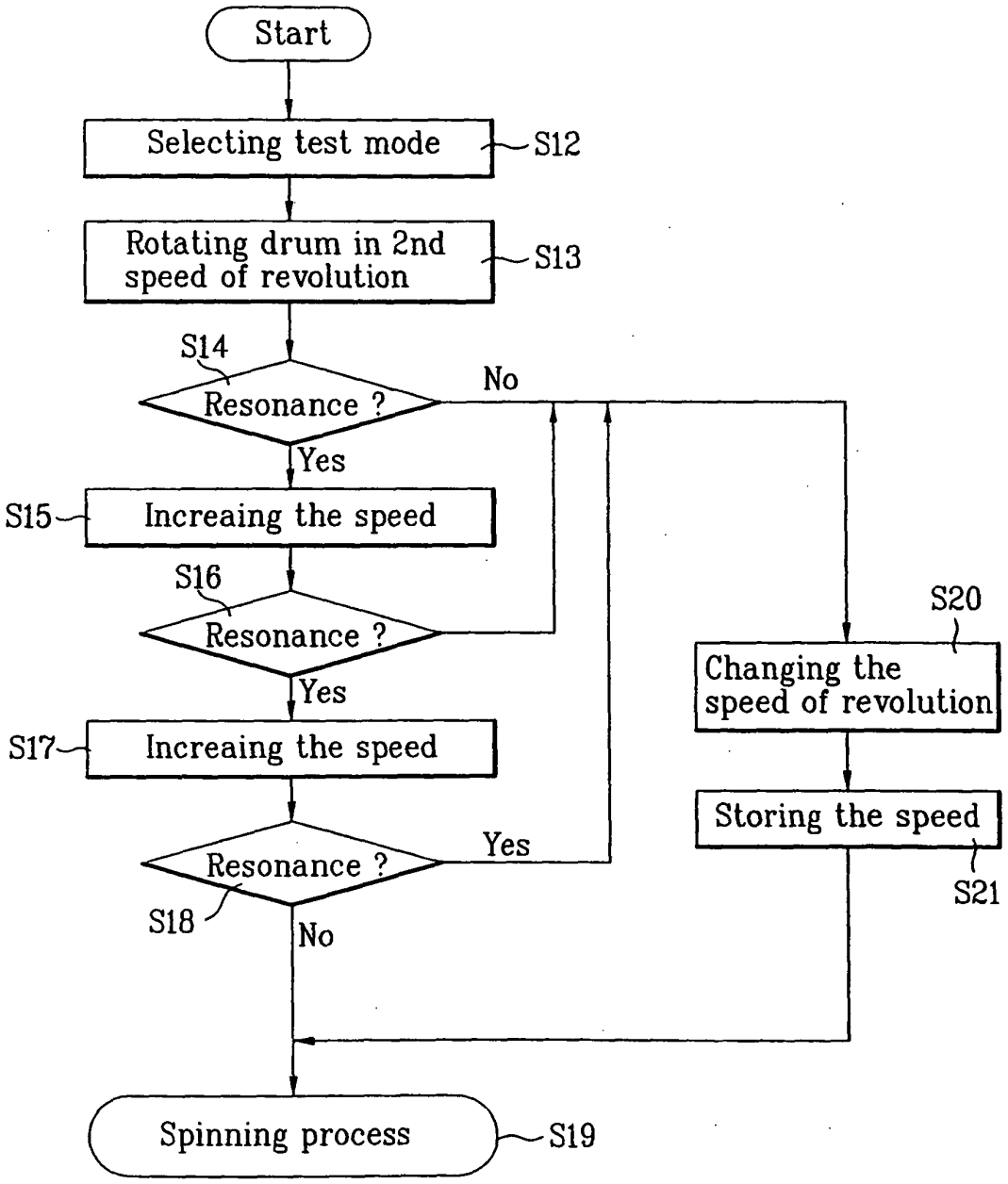

A
S7
Rotating drum in 2nd speep of revolution
S7
Rotating drum in 2nd speed of revolution
Resonance ?
Yes
S8
No
S9
Changing the speed of revolution
Storing the changed speed
S10
Continuing the spinning process
S11

FIG. 6


Start
Selecting test mode
S12
Rotating drum in 2nd speed of revolution
S13
S14
Resonance ?
No
Yes
S15
Increaing the speed
S16
Resonance ?
Yes
S17
Increaing the speed
Resonance ?
Yes
S18
No
S20
Changing the speed of revolution
Storing the speed
S21
Spinning process
S19

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- US 6546354 B1 **[0013]**