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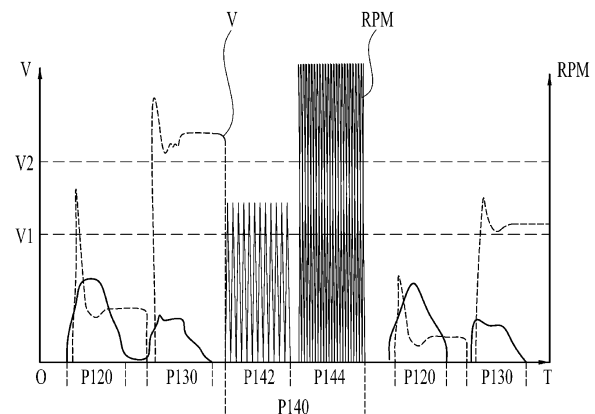
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(54) **CLOTHES TREATMENT APPARATUS**

(57) A clothes treatment apparatus is disclosed. The clothes treatment apparatus according to one embodiment of the present disclosure includes a cabinet, a tub, a drum, a driving part and a control part, wherein the control part performs: an unbalance measurement process of measuring the unbalance of clothes before a spin-drying operation; a measurement preparation process in which the maximum rotational speed of the drum corresponds to a first rotational speed and the drum is continuously rotated in one direction while water is accommodated in the tub, before the unbalance measurement process is performed; and the unbalance measurement process after the measurement preparation process, and controls the driving part such that, during the unbalance measurement process, the maximum rotational speed of the drum corresponds to a second rotational speed that is lower than the first rotational speed, and the drum is continuously rotated in either one direction or the other direction.

FIG. 7



Description

TECHNICAL FIELD

[0001] The present disclosure relates to a laundry treating apparatus, and more particularly, to a laundry treating apparatus that treats laundry accommodated inside a rotatable drum.

BACKGROUND

[0002] A laundry treating apparatus is an apparatus that puts in clothing, bedding, and the like (hereinafter referred to as laundry) into a drum and removes contamination from laundry. The laundry treating apparatus may perform processes such as washing, rinsing, dehydration, and drying and may be classified into a top loading method and a front loading method based on a method of putting laundry into the drum.

[0003] The laundry treating apparatus may include a housing defining an outer appearance, a tub accommodated inside the housing, and a drum that is rotatably mounted inside the tub and into which laundry is put.

[0004] When the drum is rotated by a motor while washing water is supplied to the laundry accommodated in the drum, dirt on the laundry may be removed from the laundry by friction between the drum and the washing water.

[0005] The laundry treating apparatus may perform various treating cycles such as a rinsing cycle for rinsing detergent or remaining foreign substances from laundry and a spin-drying cycle for removing moisture from laundry in addition to a washing cycle for washing laundry.

[0006] However, when the laundry inside the drum is not evenly distributed during the laundry treating cycle, a load on a driver for rotating the drum may increase and the amount of vibration may increase, causing inconvenience in use.

[0007] To reduce an imbalance degree of the laundry as described above, a controller of the laundry treating apparatus may determine imbalance of the laundry after draining before the spin-drying cycle, and when the imbalance degree is excessively high, the controller may perform an laundry untangling process for resolving the imbalance after supplying water back into the tub.

[0008] However, discharging the washing water to determine the imbalance degree and then supplying the washing water to perform the laundry untangling process may result in waste of washing water and cause a time delay in the laundry treating process, and thus research is currently conducted to resolve this.

[0009] In this regard, cited reference US 2017-02985531 A1 discloses a laundry treating apparatus that determines an imbalance degree of clothing while washing water is supplied inside a tub. The laundry treating apparatus in the cited reference determines the imbalance degree of clothing while washing water is supplied to the tub and performs a spin-drying cycle after

draining when the imbalance degree is equal to or less than a reference value.

[0010] However, as described above, a method of determining imbalance when washing water is supplied to the tub has different drain states and environment conditions, and thus it is difficult to measure imbalance assuming a drain state.

[0011] It is important to apply the imbalance measurement results to establish a driver control strategy of the laundry untangling process to effectively resolve imbalance from laundry in a water supply state.

[0012] Accordingly, it is in the field of this technology to effectively measure the imbalance degree of laundry while preventing waste of washing water and time and to establish the driver control strategy for performing an effective laundry untangling process depending on the imbalance degree of laundry.

DISCLOSURE

Technical Problem

[0013] An object of the present disclosure is to provide a laundry treating apparatus for efficiently measuring an imbalance degree of laundry.

[0014] An object of the present disclosure is to provide a laundry treating apparatus for effectively preventing waste of washing water.

[0015] An object of the present disclosure is to provide a laundry treating apparatus for effectively preventing unnecessary increases in a time required for treating laundry.

[0016] An object of the present disclosure is to provide a laundry treating apparatus for efficiently performing a laundry untangling process depending on an imbalance degree of laundry.

Technical Solution

[0017] A laundry treating apparatus according to embodiments of the present disclosure may perform an imbalance measuring process for measuring imbalance of clothing accommodated in a drum. During the imbalance measurement process, water is accommodated in the drum, and the controller performs a measurement preparation process to measure imbalance of a drainage environment in a state in which water is present.

[0018] In the measurement preparation process, the controller controls a driver to perform alpha motion to rotate the drum in one direction, creating a state close to the drainage environment.

[0019] For efficient imbalance determination in a water supply environment, an imbalance measurement reference may be corrected by applying a water level inside the tub and/or a moisture rate of laundry. In the imbalance measurement process, the water level in the tub may also be adjusted depending on the amount of laundry or a moisture rate.

[0020] According to embodiments of the present disclosure, when an imbalance degree is high, a laundry untangling process may be performed to adjust a rotation speed or a rotation angle of a drum depending on the imbalance degree, and when the imbalance degree of the drum is excessively high, a laundry arrangement process may also be performed to initialize arrangement of laundry before the laundry untangling process.

[0021] A laundry treating apparatus according to an embodiment of the present disclosure includes a cabinet, a tub, a drum, a driver, and a controller. The tub is provided inside the cabinet and accommodates water.

[0022] The drum is provided inside the tub, and laundry is accommodated. The driver is provided inside the cabinet and provides a rotational force to the drum. The controller controls the driver to rotate the drum and performs a spin-drying cycle of laundry.

[0023] The controller performs an imbalance measurement process to measure imbalance of laundry before the spin-drying cycle and performs a measurement preparation process in which the maximum rotation speed of the drum corresponds to a first rotation speed and the drum is continuously rotated in one direction in a state in which water is accommodated inside the tub before performing the imbalance measurement process.

[0024] The controller performs the imbalance measurement process after the measurement preparation process and controls the driver such that the maximum rotation speed of the drum corresponds to a second rotation speed lower than the first rotation speed in the imbalance measurement process and the drum is continuously rotated in any one of the one direction and another direction

[0025] An embodiment of the present disclosure may further include a drain part connected to the tub to drain water from the tub to the outside of the cabinet, and a vibration measurer mounted on the drum or the tub to measure the amount of vibration.

[0026] When a measured value of the vibration measurer is equal to or less than a reference vibration value in the imbalance measurement process, the controller may control the drain part to drain all water from the tub and perform the spin-drying cycle.

[0027] The controller may correct the reference vibration value to be lower as the water level in the tub rises. The controller may correct the reference vibration value to be lower as the moisture rate of laundry inside the drum increases.

[0028] The controller may perform a moisture rate determination process to measure a moisture rate of laundry accommodated in the drum before the spin-drying cycle.

[0029] An embodiment of the present disclosure may further include a water level measurer mounted on the tub and configured to measure a water level of the tub. In the moisture rate determination process, the controller may determine a moisture rate of laundry through a measured value of the water level measurer while continuously

rotating the drum in the one direction or the other direction in a state in which water is accommodated in the tub.

[0030] When a measured value of the vibration measurer exceeds the reference vibration value in the imbalance measurement process, the controller may control the driver to perform an imbalance resolving process for reducing imbalance of laundry.

[0031] The controller may perform the measurement preparation process and the imbalance measurement process again after performing the imbalance resolving process.

[0032] In the imbalance resolving process, the controller may perform the laundry untangling process to control the driver such that the maximum rotation speed of the drum corresponds to a third rotation speed, a rotation angle corresponds to a first rotation angle, and a rotation direction alternates between the one direction and the other direction.

[0033] In the imbalance resolving process, the controller may correct at least one of the third rotation speed and the first rotation angle to be increased as the measured value of the vibration measurer increases.

[0034] When the measured value of the vibration measurer exceeds an additional vibration value higher than the reference vibration value, the controller performs a laundry arrangement process in which the maximum rotation speed and rotation angle of the drum are different from the laundry untangling process in the imbalance resolving process.

[0035] In the laundry arrangement process, the controller may control the driver such that the maximum rotation speed of the drum corresponds to a fourth rotation speed lower than the third rotation speed, a rotation angle corresponds to a second rotation angle greater than the first rotation angle, and a rotation direction alternates between the one direction and the other direction.

[0036] When the measured value of the vibration measurer exceeds the reference vibration value and is equal to or less than the additional vibration value in the imbalance measurement process, the controller may omit the laundry arrangement process from the imbalance resolving process and perform the laundry untangling process.

[0037] When the measured value of the vibration measurer exceeds the additional vibration value in the imbalance measurement process, the controller may perform the laundry untangling process after performing the laundry arrangement process in the imbalance resolving process.

[0038] The controller may perform a washing cycle to wash laundry by injecting detergent into the tub before the spin-drying cycle and perform a rinsing cycle to discharge detergent and contaminants to an outside of the tub by separating the detergent and the contaminants from laundry before the spin-drying cycle after the washing cycle, and

[0039] The controller may perform the measurement

preparation process and the imbalance measurement process in at least one of between the washing cycle and the rinsing cycle and between the rinsing cycle and the spin-drying cycle.

[0040] An embodiment of the present disclosure may further include a drain part connected to the tub and configured to drain water of the tub to an outside of the cabinet, and a water level measurer provided in the tub and configured to measure a water level of the tub, and a water level measurer provided in the tub and configured to measure a water level of the tub.

[0041] The controller may correct the measurement water level to be higher as a weight or moisture rate of laundry accommodated in the drum increases in the water level preparation process.

Advantageous Effects

[0042] Embodiments of the present disclosure may provide a laundry treating apparatus for efficiently measuring an imbalance degree of laundry.

[0043] Embodiments of the present disclosure may provide a laundry treating apparatus for effectively preventing waste of washing water.

[0044] Embodiments of the present disclosure may provide a laundry treating apparatus for effectively preventing unnecessary increases in a time required for treating laundry.

[0045] Embodiments of the present disclosure may provide a laundry treating apparatus for efficiently performing a laundry untangling process depending on an imbalance degree of laundry.

BRIEF DESCRIPTION OF THE DRAWINGS

[0046]

FIG. 1 is a perspective view showing a laundry treating apparatus according to an embodiment of the present disclosure.

FIG. 2 is a cross-sectional view showing an internal portion of a laundry treating apparatus according to an embodiment of the present disclosure.

FIG. 3 is an operation diagram showing a laundry treating process of a laundry treating apparatus according to an embodiment of the present disclosure.

FIG. 4 is an operation diagram showing each process included in an imbalance response cycle of FIG. 3.

FIG. 5 shows a graph showing a change in a rotation speed of a drum according to an embodiment of the present disclosure.

FIG. 6 shows a graph showing a change in a rotation speed of a drum in an imbalance measurement process according to an embodiment of the present disclosure.

FIG. 7 shows a graph showing a rotation speed of a drum of an imbalance resolving process performed

when a vibration value of a drum exceeds an additional vibration value according to an embodiment of the present disclosure.

FIG. 8 shows a graph showing a rotation speed of a drum of a laundry arrangement process and a laundry untangling process according to an embodiment of the present disclosure.

FIG. 9 shows a graph showing a rotation speed of a drum of an imbalance resolving process performed when a vibration value of a drum exceeds a reference vibration value and is equal to or less than an additional vibration value according to an embodiment of the present disclosure.

FIG. 10 is a flowchart showing a control method of a laundry treating apparatus according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0047] Exemplary embodiments of the present disclosure are described in detail so as for those of ordinary skill in the art to easily implement with reference to the accompanying drawings.

[0048] However, the present disclosure may be implemented in various different forms and is not limited to these embodiments. To clearly describe the present disclosure, a part without concerning to the description is omitted in the drawings, and like reference numerals in the specification denote like elements.

[0049] In the specification, a repeated explanation of like reference numerals will not be given.

[0050] It will be understood that when an element is referred to as being "on", "connected to" or "coupled to" another element, it may be directly on, connected or coupled to the other element or intervening elements may be present. In contrast, when an element is referred to as being "directly on", "directly connected to" or "directly coupled to" another element or layer, there are no intervening elements present.

[0051] The terms used herein are for the purpose of describing particular embodiments only and are not intended to be limiting of the present disclosure.

[0052] In the specification, the singular forms are intended to include the plural forms as well, unless the context clearly indicates otherwise.

[0053] In the specification, it will be further understood that the terms "comprises" and/or "comprising" when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0054] In this specification, the term "and/or" includes a combination of a plurality of listed items or any item from among a plurality of listed items. In this specification, "A or B" may include "A", "B", or "both A and B".

[0055] FIG. 1 shows an outer appearance of a laundry treating apparatus 1 according to an embodiment of the

present disclosure. Referring to FIG. 1, the laundry treating apparatus 1 according to an embodiment of the present disclosure includes a cabinet 10.

[0056] The cabinet 10 may have a space inside which a tub 20 and a drum 30 are located. The cabinet 10 may have a substantially polyhedral shape, and FIG. 1 shows the cabinet 10 having a rectangular parallelepiped shape according to an embodiment of the present disclosure.

[0057] The cabinet 10 may be formed by combining a plurality of plates. For example, the cabinet 10 may include a front plate, a rear plate, a lateral plate, an upper plate, and a lower plate.

[0058] The cabinet 10 may include a laundry opening 12. The laundry opening 12 may correspond to a hole that communicates the outside and inside of the cabinet 10 with each other, and a user may insert laundry from the outside of the cabinet 10 into the cabinet 10 through the laundry opening 12.

[0059] The laundry opening 12 may be formed in the upper plate. That is, the laundry treating apparatus 1 according to an embodiment of the present disclosure may be a top loader type apparatus in which a rotation shaft of the drum 30 is directed upward from the ground.

[0060] An embodiment of the present disclosure is not necessarily limited to a top loader, and therefore, an embodiment of the present disclosure may be a front loader type, but hereinafter, for convenience of explanation, a top loader type as shown in FIG. 1 will be described.

[0061] The cabinet 10 may include a laundry door 14. The laundry door 14 may be a device of opening and closing the laundry opening 12 and may be rotatably coupled to the cabinet 10. For example, the laundry door 14 may be rotatably coupled to the upper plate of the cabinet 10 and may open or close the laundry opening 12 depending on a rotation state.

[0062] The cabinet 10 may include a control part 16, at least a portion of which is exposed to the outside. The control part 16 may provide various information to the user or a command signal may be input to the control part 16 by the user.

[0063] For example, the control part 16 may include a display part that provides visual information to the user and a speaker part that provides auditory information, and may include various buttons that are operated by the user to generate command signals.

[0064] The cabinet 10 may include a detergent supply part 18. The detergent supply part 18 may be exposed to the outside of the cabinet 10 or may be provided inside the cabinet 10. FIG. 1 shows the detergent supply part 18 provided inside the cabinet 10 according to an embodiment of the present disclosure.

[0065] The detergent supply part 18 may be located at an upper portion of the inside the cabinet 10, and the user may access the detergent supply part 18 through the laundry opening 12 by opening the laundry door 14. The user may supply detergent to the detergent supply part 18, and the detergent supplied to the detergent supply

part 18 may be supplied into the drum 30 during the laundry treating cycle.

[0066] FIG. 2 shows an internal portion of the laundry treating apparatus 1 according to an embodiment of the present disclosure. Referring to FIG. 2, an embodiment of the present disclosure may include the drum 30 and the tub 20. The tub 20 may be provided inside the cabinet 10 and may contain water therein. The water contained inside the tub 20 may correspond to washing water.

[0067] The tub 20 may include a tub opening 25 that opens toward the laundry opening 12. According to an embodiment of the present disclosure, the tub 20 may be provided in a cylindrical shape and may include the tub opening 25 formed in an upper surface thereof.

[0068] The drum 30 may be provided inside the tub 20 and may be installed to be rotatable. The drum 30 may have a space inside to accommodate laundry. The drum 30 may include a drum opening 35 that opens toward the laundry opening 12 and the tub opening 25.

[0069] The drum 30 may include the drum opening 35 on one side thereof, and an opposite surface located on an opposite side of the one surface may be connected to a driver 60. For example, the drum 30 may include the drum opening 35 on an upper surface thereof and have a lower surface connected to the driver 60 to receive a rotational force. The drum opening 35 may be located to face the laundry opening 12 and the tub opening 25, and thus laundry input from the outside of the cabinet 10 may be accommodated inside the drum 30 through the laundry opening 12, the tub opening 25, and the drum opening 35.

[0070] A plurality of holes may be formed on a circumferential surface of the drum 30. Accordingly, water contained inside the tub 20 may flow into the inside of the drum 30 through the hole formed on the circumferential surface of the drum 30, and laundry may be submerged in water inside the drum 30.

[0071] An embodiment of the present disclosure may include a water supply part 40 and a drain part 50. The water supply part 40 may be connected to an external water supply source located outside the cabinet 10 to receive water from the outside and deliver water supplied from the external water supply source to the inside of the tub 20.

[0072] The drain part 50 may be connected to the tub 20 and may discharge water inside the tub 20 to the outside of the cabinet 10. The drain part 50 may include a drain pump and may discharge water inside the tub 20 to the outside of the cabinet 10 as a washing course ends.

[0073] An embodiment of the present disclosure may include the driver 60. The driver 60 may be provided inside the cabinet 10 and connected to the drum 30. The driver 60 may be located outside the tub 20, for example, below the tub 20 and may have a drive shaft that passes through the tub 20 to be connected to the lower surface of the drum 30.

[0074] An embodiment of the present disclosure may include a controller 100. The controller 100 may signally

connected to the control part 16, the water supply part 40, the drain part 50, and the driver 60. The controller 100 may receive a command signal of a user from the control part 16 to perform a washing course, and the like and may also provide status information on the washing course to the user through the control part 16.

[0075] The controller 100 may control a water supply valve of the water supply part 40 to regulate a flow of water supplied to the tub 20 and control a drain pump of the drain part 50 to regulate water discharged from the tub 20.

[0076] An embodiment of the present disclosure may further include a vibration measurer 70. The vibration measurer 70 may be provided to measure vibration generated from the drum 30. The vibration measurer 70 may be provided in various types for measuring displacement or vibration.

[0077] The vibration measurer 70 may be provided directly on the drum 30 or may be provided on the tub 20, the cabinet 10, or the driver 60 to measure the amount of vibration generated from the drum 30. FIG. 2 shows the vibration measurer 70 provided on a bottom surface of the tub 20 from the outside of the tub 20 according to an embodiment of the present disclosure, but the vibration measurer 70 is not necessarily limited to this location.

[0078] The vibration measurer 70 may be signally connected to the controller 100 to transmit a measured vibration value V to the controller 100, and the controller 100 may use the measured value of the vibration measurer 70 to perform the washing course or the like.

[0079] An embodiment of the present disclosure may further include a water level measurer 80. The water level measurer 80 may be provided to measure a level of water contained in the tub 20. The water level measurer 80 may be provided in various types and shapes to measure the water level of the tub 20.

[0080] The water level measurer 80 may be provided in the tub 20 or the drum 30 to directly measure the water level, or may be provided to measure a load inside the tub 20 such that the water level measurer 80 or the controller 100 may also calculate the water level from the measured value of the water level measurer 80.

[0081] FIG. 3 shows a plurality of treating cycles provided in a washing course according to an embodiment of the present disclosure. The laundry treating apparatus 1 according to an embodiment of the present disclosure may include a plurality of treating courses for treating laundry, and the plurality of treating courses may include a washing course, a rinsing course, and a spin-drying course.

[0082] FIG. 3 shows an operation process for the washing course from among among the plurality of treating courses. According to an embodiment of the present disclosure, the washing course for washing laundry may include at least one or more treating cycles, and each of the plurality of treating cycles may include one or more treating processes.

[0083] Referring to FIG. 3, in an embodiment of the

present disclosure, the washing course for laundry may include a washing cycle P10 and may further include at least one of a rinsing cycle P20 and a spin-drying cycle P30 and may further include one or more imbalance response cycle P100.

[0084] The washing cycle P10 may be a cycle that removes contaminants from laundry. In the washing cycle P10, the controller 100 may supply a detergent into the drum 30 through the detergent supply part 18, supplies water into the tub 20 through the water supply part 40, and control the driver 60 to rotate the drum 30 to remove contaminants from laundry. That is, the washing cycle P10 may include a detergent supply process, a water supply process, a washing process, and a drainage process.

[0085] The rinsing cycle P20 is a cycle that rinses away contaminants and detergents separated from laundry. The controller 100 may supply water into the tub 20 during the rinsing cycle and rotate the drum 30 to rinse contaminants or detergents from laundry. That is, the rinsing cycle P20 may include a water supply process, a rinsing cycle, and a drainage process.

[0086] The spin-drying cycle P30 is a cycle that removes moisture from laundry. The controller 100 may perform a spin-drying process to separate and remove moisture from laundry through centrifugal force by rotating the drum 30 in the spin-drying cycle P30.

[0087] The imbalance response cycle P100 is a cycle that determines imbalance of laundry accommodated inside the drum 30 and improves an imbalance degree if necessary. FIG. 3 shows the imbalance response cycle P100 performed before the rinsing cycle P20 and before the spin-drying cycle P30 according to an embodiment of the present disclosure, but the number or timing of the imbalance response cycle P100 is necessarily limited thereto.

[0088] FIG. 4 shows each of processes to be performed in the imbalance response cycle P100 according to an embodiment of the present disclosure. Referring to FIG. 4, in an embodiment of the present disclosure, the controller 100 may perform the imbalance response cycle P100 before performing the spin-drying cycle P30, and the imbalance response cycle P100 may include a measurement preparation process P120 and an imbalance measurement process P130.

[0089] In an embodiment of the present disclosure, the imbalance measurement process P130 may correspond to a process in which the controller 100 determines even distribution of laundry accommodated in the drum 30. That is, the controller 100 may determine an imbalance degree of laundry and respond accordingly.

[0090] When the imbalance degree of the laundry is high in the washing course, for example, in the rinsing cycle P20 or the spin-drying cycle P30, a load acting on the driver 60 due to a difference in the center of gravity and the center of rotation of the drum 30 may increase, and accordingly, power consumption for an operation of the driver 60 may increase.

[0091] When the load on the driver 60 is excessively increased, a short circuit in the driver 60 may occur. The amount of vibration generated by the drum 30 may increase during rotation, which may generate noise and cause discomfort to the user.

[0092] Accordingly, in an embodiment of the present disclosure, the controller 100 may determine the imbalance degree of laundry through the imbalance measurement process P130 and apply this to adjust subsequent processes.

[0093] For example, in an embodiment of the present disclosure, when the imbalance degree is excessively high, the controller 100 may perform an imbalance resolving process P140 to reduce imbalance. The imbalance resolving process P140 is a process of adjusting distribution of laundry, and thus may be performed with water present inside the tub 20 to facilitate movement of the laundry.

[0094] Imbalance may be measured to reduce the load on the driver 60 generated when the drum 30 rotates, and therefore, the importance of the imbalance degree may be high when a rotation speed of the drum 30 is high or the spin-drying cycle P30 with a large rotation angle is performed.

[0095] Accordingly, it may be advantageous to measure the imbalance in a state in which all the water is discharged from the tub 20, such as in the spin-drying cycle P30, to effectively utilize the imbalance degree.

[0096] However, as described above, when all the water in the tub 20 is discharged in the imbalance measurement process P130, if the imbalance degree is excessively high and the imbalance resolving process P140 is required, water needs to be supplied to the tub 20 again, and thus, unnecessary waste of water may occur and time may be consumed due to water supply and drainage.

[0097] Therefore, in an embodiment of the present disclosure, to prevent waste of water and minimize time consumption, the imbalance measurement process P130 may be performed with water present inside the tub 20, but the measurement preparation process P120 may be performed before performing the imbalance measurement process P130 to obtain measurement results close to a drainage state even when water is present.

[0098] In other words, in an embodiment of the present disclosure, the measurement preparation process P120 may correspond to a process of preparing for measurement such that the imbalance measurement result of laundry in a state in which water is present corresponds to a result close to a state in which all the water is drained, and a detailed explanation of the measurement preparation process P120 will be given below.

[0099] In an embodiment of the present disclosure, the imbalance response cycle P100 may further include a water level preparation process P110 or the imbalance resolving process P140 as needed, and a detailed description thereof will also be given below.

[0100] FIG. 5 shows a graph showing a rotation speed of the drum 30 to be used during the imbalance measurement process P130 according to an embodiment of the present disclosure.

5 **[0101]** In detail, in an embodiment of the present disclosure, the controller 100 may determine imbalance based on the amount of vibration generated when the drum 30 rotates. The amount of vibration may be measured by the vibration measurer 70 described above.

10 **[0102]** The controller 100 may rotate the drum 30 in the imbalance measurement process P130 to generate vibration of the drum 30. However, the amount of vibration of the drum 30 may have a proportional relationship with the imbalance degree of laundry, but may not have a proportional relationship with the rotation speed of the drum 30.

15 **[0103]** In FIG. 5, the horizontal axis represents RPM corresponding to a rotation speed of the drum 30, and the vertical axis represents a vibration value V measured by the vibration measurer 70. As seen from FIG. 5, under conditions in which distributions of laundry inside the drum 30 are the same, as the RPM increases, the vibration value V gradually increases and then decreases again.

20 **[0104]** In other words, it is not necessarily advantageous to increase the RPM when measuring the vibration value V, and it may be important to select the RPM to increase measurement accuracy.

25 **[0105]** In particular, the vibration value V measured when water is present inside the tub 20 may tend to decrease compared to the drain state, and thus in an embodiment of the present disclosure, it may be important to improve the measurement sensitivity of the vibration value V.

30 **[0106]** Therefore, in an embodiment of the present disclosure, the controller 100 may control the driver 60 such that RPM of the drum 30 follows the optimal RPM A that most sensitively represents the vibration value V in the imbalance measurement process P130.

35 **[0107]** However, the RPM used in the imbalance measurement process P130 may not necessarily correspond to the RPM corresponding to the highest vibration value V in the graph of FIG. 5, and the optimal RPM A may be determined within an arbitrary range including a RPM at which the highest vibration value V is measured or may be determined considering a control strategy aspect.

40 **[0108]** FIG. 6 is a graph showing a change in RPM in the measurement preparation process P120 and the imbalance measurement process P130 according to an embodiment of the present disclosure. With reference to FIG. 6, the measurement preparation process P120 and the imbalance measurement process P130 according to the present disclosure will be described in detail as follows.

45 **[0109]** First, an embodiment of the present disclosure may include the above-described cabinet 10, tub 20, drum 30, driver 60, and controller 100. The tub 20 may be provided inside the cabinet 10 and may contain water

therein.

[0110] The drum 30 may be provided inside the tub 20 and may accommodate laundry. The driver 60 may be provided inside the cabinet 10 and may provide a rotational force to the drum 30. The controller 100 may controls the driver 60 to rotate the drum 30 and perform the spin-drying cycle P30 of laundry.

[0111] The controller 100 may perform the imbalance measurement process P130 to measure the imbalance of laundry before the spin-drying cycle P30. Before performing the imbalance measurement process P130, the controller 100 may perform the measurement preparation process P120 in which the tub 20 is continuously rotated in one direction and has a first rotation speed corresponding to the maximum rotation speed of the drum 30 in a state in which water is accommodated in the tub 20.

[0112] FIG. 6 shows a change in RPM during the measurement preparation process P120. In an embodiment of the present disclosure, in the measurement preparation process P120, the drum 30 may be rotated at the first rotation speed, thereby moving laundry to a circumferential side of the drum 30 to amplify the imbalance even when water is present.

[0113] As described above, the imbalance degree in a state in which water is present tends to decrease compared to that in the drain state, and thus, in an embodiment of the present disclosure, laundry may be moved to a circumferential side of the drum 30 through the measurement preparation process P120 to rotate the drum 30 at the first rotation speed, and thus the imbalance degree of the laundry may be increased such that the vibration value V approaches the measurement result in the drain state.

[0114] The first rotation speed may be determined based on theoretical/experimental results and may be determined in various ways by considering a control strategy aspect. The first rotation speed may correspond to the maximum rotation speed of the drum 30 in the measurement preparation process P120.

[0115] In the measurement preparation process P120, the drum 30 may be continuously rotated in one direction to effectively move laundry toward the circumferential side of the drum 30. The one direction may be clockwise or counterclockwise.

[0116] A rotation time of the drum 30 may be preset in the controller 100. In the measurement preparation process P120, the first rotation speed or the rotation time may be corrected based on a moisture rate or weight of laundry.

[0117] For example, when the weight of laundry is equal to or greater than a reference value, the controller 100 may perform the measurement preparation process P120 by increasing the first rotation speed or the rotation time.

[0118] In the present disclosure, a specific rotation speed or the measured value may be understood as a range including a corresponding value instead of a single

value or a representative value that represents a concept represented by the corresponding value based on those skilled in the art.

[0119] In an embodiment of the present disclosure, the controller 100 may perform the imbalance measurement process P130 after the measurement preparation process P120, and the controller 100 may control the driver 60 such that the maximum rotation speed of the drum 30 corresponds to a second rotation speed lower than the first rotation speed in the imbalance measurement process P130 and the drum 30 is continuously rotated in either one direction or the other direction.

[0120] In detail, the controller 100 may perform the above-described imbalance measurement process P130 when the measurement preparation process P120 is completed. The controller 100 may continuously rotate the drum 30 in one direction or the other direction in the imbalance measurement process P130, and in this case, the maximum rotation speed of the drum 30 may correspond to the second rotation speed.

[0121] The second rotation speed may be lower than the first rotation speed, which is the rotation speed of the drum 30 in the measurement preparation process P120. For example, the second rotation speed may correspond to the optimal RPM A at which the vibration value V is amplified, as described with reference to FIG. 5, and the first rotation speed may correspond to a higher value than the second rotation speed to induce movement of laundry.

[0122] In an embodiment of the present disclosure, the load of the driver 60 for the spin-drying cycle P30 may be predetermined and applied by performing the imbalance measurement process P130 before the spin-drying cycle P30. When there is a need to resolve imbalance by performing the imbalance measurement process P130 while water is present inside the tub 20, it is not necessary to supply water into the tub 20 again, and thus waste of water may be prevented and a time required for the washing course may be effectively shortened.

[0123] In an embodiment of the present disclosure, the measurement preparation process P120 may be performed before the imbalance measurement process P130, and thus the imbalance degree determined through the vibration value V in a state in which water is present may be effectively approximated as the result of the drain state.

[0124] In an embodiment of the present disclosure, laundry may be moved toward the circumferential side of the drum 30 by rotating the drum 30 at the first rotation speed in the measurement preparation process P120, and thus the vibration value V of the drum 30 may be accurately measured by rotating the drum 30 at the second rotation speed lower than the first rotation speed in the imbalance measurement process P130.

[0125] An embodiment of the present disclosure may further include the drain part 50 and the vibration measurer 70, as described above. The drain part 50 may be connected to the tub 20 and may drain water inside the

tub 20 to the outside of the cabinet 10. The vibration measurer 70 may be mounted on the drum 30 or the tub 20 to measure the amount of vibration.

[0126] When a measured value V of the vibration measurer 70 is less than or equal to a reference vibration value V1 in the imbalance measurement process P130, the controller 100 may control the drain part 50 to drain all water in the tub 20 and perform the spin-drying cycle P30.

[0127] The reference vibration value V1 can be determined theoretically/experimentally. The reference vibration value V1 may correspond to the vibration value V corresponding to a state in which the load of the driver 60 increases to a predetermined value or more in the spin-drying cycle P30.

[0128] In an embodiment of the present disclosure, when the vibration value V measured in the imbalance measurement process P130 is equal to or less than a preset reference vibration value V1, the controller 100 may determine that a situation in which the load of the driver 60 increases abnormally is prevented in the spin-drying cycle P30 and control the drain part 50 to perform the spin-drying cycle P30 after discharging all the water in the tub 20.

[0129] In FIG. 6, the horizontal axis corresponds to time, the left vertical axis corresponds to the vibration value V, and the right vertical axis corresponds to the RPM of the drum 30. FIG. shows a case in which the vibration value V measured in the imbalance measurement process P130 performed after the measurement preparation process P120 is equal to or less than the reference vibration value V1 according to an embodiment of the present disclosure.

[0130] In an embodiment of the present disclosure, the controller 100 may correct the reference vibration value V1 to be lower as a water level of the tub 20 increases.

[0131] A water level in the tub 20 may change depending on the amount of laundry accommodated inside the drum 30 or settings of a user. However, when the water level of the tub 20 changes, the measured vibration value V may change even with the same amount of laundry and imbalance degree.

[0132] In an embodiment of the present disclosure, to improve the accuracy of the measured value of the imbalance measurement process P130, as the water level of the tub 20 increases, the reference vibration value V1 described above may be corrected to be lower, thereby improving reliability.

[0133] In an embodiment of the present disclosure, a laundry weight measurement process may be performed to measure the weight of laundry before the imbalance measurement process P130. The laundry weight measurement process may be performed in one or more of the washing cycle P10, the rinsing cycle P20, and the spin-drying cycle P30.

[0134] The controller 100 may perform the laundry weight measurement process before the water supply process of the washing cycle P10. The laundry weight measurement process may be performed in various

ways to measure the amount or load of laundry.

[0135] For example, the controller 100 may calculate the weight of laundry through the load of the driver 60 generated by rotating the drum 30 during the laundry weight measurement process, for example, a current value or voltage value of the driver 60.

[0136] The controller 100 may correct the reference vibration value V1 to be lower as a moisture rate of laundry inside the drum 30 increases.

[0137] When the moisture rate of laundry is high, the amount of moisture removed from the laundry in the spin-drying cycle P30 is large, and thus, as the spin-drying cycle P30 proceeds, moisture may be removed and the imbalance degree in the laundry may increase.

[0138] Accordingly, in an embodiment of the present disclosure, as a moisture rate of laundry increases, the reference vibration value V1 may be corrected to be lower to ensure the reliability of a result value of the imbalance measurement process P130 and ensure the stability of the spin-drying cycle P30.

[0139] The controller 100 may perform a moisture rate determination process to measure the moisture rate of laundry inside the drum 30 before the spin-drying cycle P30. The moisture rate determination process may be performed in at least one cycle of the washing cycle P10, the rinsing cycle P20, and the imbalance response cycle P100.

[0140] The moisture rate determination process may be performed in various ways. For example, the controller 100 may determine the moisture rate by using the load or weight measured value of the driver 60 that changes while rotating the drum 30 at a rotation speed equal to or greater than a certain level.

[0141] For example, an embodiment of the present disclosure may further include the water level measurer 80 described above, and the controller 100 may also determine the moisture rate through the measured value of the water level measurer 80.

[0142] In detail, the water level measurer 80 may be mounted in the tub 20 and may measure the water level of the tub 20. In the moisture rate determination process, the controller 100 may determine the moisture rate of laundry through the measured value of the water level measurer 80 while continuously rotating the drum 30 in the one direction or the other direction in a state in which water is accommodated in the tub 20.

[0143] When the moisture rate is high, a change in the measured value of the water level measurer 80 according to rotation of the drum 30 is relatively large, and when the moisture rate is low, the change in the measured value is relatively small. This may be understood as if a change in the measured value increases as the amount of water separated from laundry increases by centrifugal force. Based thereon, the controller 100 may determine the moisture rate of laundry through the measured value of the water level measurer 80.

[0144] FIG. 7 shows a graph in which the vibration value V measured in the imbalance measurement pro-

cess P130 exceeds the reference vibration value V1 according to an embodiment of the present disclosure. Referring to FIG. 7, in an embodiment of the present disclosure, when the measured value of the vibration measurer 70 exceeds the reference vibration value V1 in the imbalance measurement process P130, the controller 100 may control the driver 60 to perform the imbalance measurement process P130 to reduce imbalance of the laundry.

[0145] The imbalance resolving process P140 corresponds to a process of reducing the imbalance of the laundry by controlling the driver 60 to control the rotation speed, rotation direction, and rotation angle of the drum 30.

[0146] As described above, when the vibration value V generated by imbalance of laundry exceeds the reference vibration value V1, the load applied to the driver 60 in the spin-drying cycle P30 may exceed a preset limit load, and a short circuit of the driver 60 may occur.

[0147] The controller 100 may reduce the imbalance degree of laundry through the imbalance resolving process P140 and perform the spin-drying cycle P30. There may be various ways to improve the distribution of laundry in the imbalance resolving process P140.

[0148] For example, the controller 100 may control the driver 60 to rotate the drum 30 to alternately rotate the drum 30 in one direction and the other direction depending on a preset rotation speed, thereby resolving the imbalance of the laundry. In this case, the rotation speed and rotation angle of the drum 30 may vary.

[0149] The controller 100 may control the control part 16 to transmit visual or auditory information requesting rearrangement of laundry to the user.

[0150] The controller 100 may perform the measurement preparation process P120 and the imbalance measurement process P130 again after performing the imbalance resolving process P140. Even after the imbalance resolving process P140, there may be cases in which the imbalance of laundry is not reduced below a certain level.

[0151] Accordingly, the controller 100 may reconfirm the imbalance degree by performing the measurement preparation process P120 and the imbalance measurement process P130 after performing the imbalance resolving process P140. In an embodiment of the present disclosure, imbalance may be measured in a state in which water is present in the tub 20 in the imbalance measurement process P130, and thus the imbalance measurement process P130 may be again performed quickly and efficiently without performing water supply or drainage after the imbalance resolving process P140.

[0152] The imbalance resolving process P140 may correspond to a process of distributing the laundry inside the drum 30, and therefore, before the imbalance measurement process P130, the controller 100 may obtain the measured value corresponding to the drain state by moving the laundry to the circumferential side of the drum 30 again through the measurement preparation process

P120.

[0153] An embodiment of the present disclosure in which the imbalance resolving process P140 is performed after the measurement preparation process P120 and the imbalance measurement process P130 through RPM of the drum 30 and the measurement preparation process P120 and the imbalance measurement process P130 are performed again may be seen from FIG. 7.

[0154] FIG. 8 shows a graph showing the RPM of the drum 30 of a laundry arrangement process P142 and a laundry untangling process P144 of the imbalance resolving process P140 according to an embodiment of the present disclosure. In the graph of FIG. 8, the horizontal axis corresponds to time and the vertical axis corresponds to RPM.

[0155] In an embodiment of the present disclosure, in the imbalance resolving process P140, the controller 100 may perform the laundry untangling process P144 to control the driver 60 such that the maximum rotation speed of the drum 30 corresponds to a third rotation speed, a rotation angle corresponds to a first rotation angle, and a rotation direction alternates between the one direction and the other direction.

[0156] In detail, the laundry untangling process P144 may correspond to a process of releasing laundry that are clumped together and increase imbalance. In the laundry untangling process P144, the controller 100 may control the driver 60 to implement a motion of the drum 30 that agitates the laundry.

[0157] For example, the controller 100 may rotate the drum 30 alternately in one direction and the other direction, implement the rotation angle in one direction as a preset first rotation angle, and implement the rotation speed as the third rotation speed.

[0158] The first rotation angle and the third rotation speed may be determined in various ways. The third rotation speed may be set to be the same as the above-described first rotation speed and the second rotation speed, or may be set differently.

[0159] FIG. 7 shows RPM of a laundry untangling process P144 in which the third rotation speed is set higher than the first rotation speed and the second rotation speed to effectively untangle laundry.

[0160] In the imbalance resolving process P140, the controller 100 may correct at least one of the third rotation speed and the first rotation angle to be increased as the measured value of the vibration measurer 70 increases.

[0161] That is, the controller 100 may increase at least one of the third rotation speed and the first rotation angle to untangle more laundry as the vibration value V measured by the vibration measurer 70 increases in the imbalance measurement process P130.

[0162] When the measured value of the vibration measurer 70 exceeds an additional vibration value V2 higher than the reference vibration value V1 in the imbalance measurement process P130, the controller 100 may perform the laundry arrangement process P142 in which the

maximum rotation speed and the rotation angle of the drum 30 are set differently from the laundry untangling process P144.

[0163] FIG. 7 shows a state in which the vibration value V measured in the imbalance measurement process P130 exceeds the additional vibration value V2, and accordingly, shows RPM of the drum 30 when the laundry arrangement process P142 of the imbalance resolving process P140 is performed.

[0164] The additional vibration value V2 may correspond to a higher value than the reference vibration value V1. Specific determination of the additional vibration value V2 may be determined in various ways theoretically/experimentally.

[0165] For example, the additional vibration value V2 may correspond to an imbalance degree in which a short circuit of the driver 60 is expected in the spin-drying cycle P30, and the reference vibration value V1 may correspond to an imbalance degree in which a load of the driver 60 exceeds a preset reference value and damage to the driver 60 or excessive power consumption is expected in the spin-drying cycle P30.

[0166] In an embodiment of the present disclosure, as described above, the imbalance resolving process P140 may include the laundry untangling process P144 and the laundry arrangement process P142. In the laundry arrangement process P142, the drum 30 may be rotated at a different rotation speed and rotation angle from the laundry untangling process P144.

[0167] The number of times and order of performing of the laundry untangling process P144 and the laundry arrangement process P142 may vary. Referring to FIG. 7, in an embodiment of the present disclosure, the controller 100 may perform the laundry untangling process P144 after performing the laundry arrangement process P142 of the imbalance resolving process P140.

[0168] The laundry untangling process P144 may be a process of untangling laundry in a locally tangled state, and the laundry arrangement process P142 may be a process of relatively uniformly rearranging the entire laundry.

[0169] According to an embodiment of the present disclosure, laundry may be untangled as a whole to induce rearrangement through the laundry arrangement process P142 and some of the laundry may be additionally untangled through the laundry untangling process P144, and thus the imbalance degree of the laundry may be effectively reduced in various ways.

[0170] Referring to FIG. 8, in an embodiment of the present disclosure, in the laundry arrangement process P142, the controller 100 may control the driver 60 such that the maximum rotation speed of the drum 30 corresponds to a fourth rotation speed lower than the third rotation speed, a rotation angle corresponds to a second rotation angle higher than the first rotation angle, and a rotation direction alternates between the one direction and the other direction.

[0171] In detail, the laundry arrangement process

P142 may be to resolve a situation in which a certain amount of laundry or more is tangled at one side of the inside of the drum 30, and thus the drum 30 may be rotated at a second rotation angle higher than the laundry untangling process P144.

[0172] The laundry arrangement process P142 requires a relatively large amount of movement of laundry compared to the laundry untangling process P144, and thus the drum 30 may be rotated at a fourth rotation speed lower than the third rotation speed of the laundry untangling process P144 to effectively induce the movement of laundry.

[0173] In other words, in the laundry arrangement process P142, the drum 30 may be rotated with a large rotational displacement at a lower speed than the laundry untangling process P144, and thus the distribution of the laundry inside the drum 30 may be improved while the laundry is moved in the overall circumferential direction of the drum 30.

[0174] FIG. 9 shows a graph showing RPM of the imbalance resolving process P140 including the laundry untangling process P144 excluding the laundry arrangement process P142 according to an embodiment of the present disclosure.

[0175] Referring to FIG. 9, in an embodiment of the present disclosure, when the measured value of the vibration measurer 70 exceeds the reference vibration value V1 and is equal to or less than the additional vibration value V2 in the imbalance measurement process P130, the controller 100 may omit the laundry arrangement process P142 and perform the laundry untangling process P144 in the imbalance resolving process P140.

[0176] In an embodiment of the present disclosure, the imbalance resolving process P140 may be adjusted depending on the magnitude of the vibration value V. In the imbalance resolving process P140, the rotation angle and rotation speed as well as the content performed may vary depending on the magnitude of the vibration value V.

[0177] As described above, in an embodiment of the present disclosure, when the vibration value V exceeds the additional vibration value V2, the imbalance resolving process P140 including the laundry arrangement process P142 and the laundry untangling process P144 may be performed. However, when the vibration value V exceeds the reference vibration value V1 but is equal to or less than the additional vibration value V2, the controller 100 may omit the laundry arrangement process P142 from the imbalance resolving process P140 and perform the laundry untangling process P144 only.

[0178] When the vibration value V exceeds the reference vibration value V1, it may be necessary to perform the imbalance resolving process P140, but the vibration value V that does not exceed the additional vibration value V2 may be understood as a case in which there is no need to consider the rearrangement of laundry, and accordingly, the laundry arrangement process P142 may

be omitted from the imbalance resolving process P140.

[0179] FIG. 9 shows the vibration value V that exceeds the reference vibration value V1 and is equal to or less than the additional vibration value V2 and is measured in the imbalance measurement process P130 and thus shows RPM in the imbalance resolving process P14 in which the laundry arrangement process P142 is omitted and only the laundry untangling process P144 is performed.

[0180] However, when the laundry arrangement process P142 is omitted and the laundry untangling process P144 is performed in the imbalance resolving process P140, this does not mean that other additional improvement processes are excluded. For example, even if the vibration value V exceeds the reference vibration value V1 and is equal to or less than the additional vibration value V2, the imbalance resolving process P140 may also include a process to resolve the imbalance of laundry in addition to the laundry arrangement process P142 and the laundry untangling process P144.

[0181] In the imbalance resolving process P140, the controller 100 may perform the laundry untangling process P144 multiple times instead of the laundry arrangement process P142. FIG. 9 shows RPM at which the laundry untangling process P144 is repeated twice instead of the laundry arrangement process P142, but the number of times the laundry untangling process P144 is performed may vary beyond two.

[0182] In an embodiment of the present disclosure, as described above, the controller 100 may perform the washing cycle P10 to wash laundry by injecting detergent into the tub 20 before the spin-drying cycle P30 and perform the rinsing cycle P20 to separate detergent and contaminants from the laundry and discharge the separated detergent and contaminants to the outside of the tub 20 before the spin-drying cycle P30 after the washing cycle P10.

[0183] The controller 100 may perform the measurement preparation process P120 and the imbalance measurement process P130 in at least one of between the washing cycle P10 and the rinsing cycle P20 and between the rinsing cycle P20 and the spin-drying cycle P30.

[0184] In other words, the imbalance response cycle P100 may be performed not only immediately before the spin-drying cycle P30 but also before the rinsing cycle P20. In an embodiment of the present disclosure, when the imbalance degree of laundry is equal to or greater than a certain level and is disadvantageous in terms of washing efficiency and operation of the driver 60, the imbalance response cycle P100 may be performed prior to various cycles other than the spin-drying cycle P30.

[0185] In an embodiment of the present disclosure, the controller 100 may perform the water level preparation process P110 to control the drain part 50 such that a water level of the tub 20 corresponds to a measurement water level for measuring imbalance before the measurement preparation process P120 is performed.

[0186] For example, when the imbalance response cycle P100 is performed before the spin-drying cycle P30 after the rinsing cycle P20, water for rinsing may be accommodated in the tub 20 before the imbalance response cycle P100 through the rinsing cycle P20.

[0187] However, a level of water accommodated in the tub 20 in the rinsing cycle P20 may be higher than a water level required for the imbalance response cycle P100. That is, the water accommodated in the tub 20 through the rinsing cycle P20 may be greater than the amount of water required for the imbalance response cycle P100.

[0188] In this case, as described above, it may be disadvantageous to accurately measure the imbalance of laundry, and accordingly, in an embodiment of the present disclosure, the controller 100 may control the drain part 50 before the measurement preparation process P120 in the imbalance response cycle P100 to perform the water level preparation process P110 to a water level of the tub 20 to the measurement water level.

[0189] Accordingly, in an embodiment of the present disclosure, to perform the imbalance measurement process P130 after the rinsing cycle P20, the imbalance response cycle P100 may be performed to drain all the water inside the tub 20 and adjust the amount of water of the tub 20 to the measurement water level required to measure imbalance and resolve imbalance even if water is not supplied again.

[0190] In an embodiment of the present disclosure, the controller 100 may correct the measurement water level to be higher as the weight or moisture rate of laundry accommodated in the drum 30 increases in the water level preparation process P110.

[0191] When the amount or moisture rate of laundry is large, the measurement water level required for the imbalance resolving process P140 of the corresponding laundry may increase. Accordingly, in an embodiment of the present disclosure, the weight and moisture rate of laundry may be determined through the aforementioned determination process of the weight of laundry or the moisture rate determination process and may appropriately correct the measurement water level according to the weight of laundry and the moisture rate to perform the imbalance response cycle P100.

[0192] FIG. 10 shows a flowchart of a control method of the laundry treating apparatus 1 according to an embodiment of the present disclosure.

[0193] Hereinafter, the control method of the laundry treating apparatus 1 according to an embodiment of the present disclosure will be described with reference to FIG. 10, and a repetition of the previously given description related to the laundry treating apparatus 1 is omitted if possible.

[0194] The control method of the laundry treating apparatus 1 according to an embodiment of the present disclosure may include a laundry weight determination operation S10. In the laundry weight determination operation S10, the controller 100 may analyze the current or electric value characteristics of the driver 60 according to

rotation of the drum 30 or determine the amount or load of laundry by using a load sensor or the like.

[0195] The control method of the laundry treating apparatus 1 according to an embodiment of the present disclosure may include a moisture rate determination operation S20. In the moisture rate determination operation S20, the controller 100 may determine a moisture rate of laundry based on a change in water level as the drum 30 rotates.

[0196] The control method of the laundry treating apparatus 1 according to an embodiment of the present disclosure may include a water level preparation operation S100. In the water level preparation operation S100, the controller 100 may perform the water level preparation process P110. In the water level preparation process P110, the controller 100 may control the water supply part 40 and the drain part 50 such that the water level inside the tub 20 satisfies the measured water level required for the imbalance response cycle P100.

[0197] The control method of the laundry treating apparatus 1 according to an embodiment of the present disclosure may include a measurement preparation operation S200. The controller 100 may perform the measurement preparation process P120 in the measurement preparation operation S200. The controller 100 may control the driver 60 to adjust the maximum rotation speed of the drum 30 to the first rotation speed and may continuously rotate the drum 30.

[0198] The control method of the laundry treating apparatus 1 according to an embodiment of the present disclosure may include an imbalance measurement operation S300. The controller 100 may perform the imbalance measurement process P130 in the imbalance measurement operation S300. The controller 100 may continuously rotate the drum 30 at the second rotation speed that is lower than the first rotation speed and measure the vibration value V.

[0199] The control method of the laundry treating apparatus 1 according to an embodiment of the present disclosure may include a reference vibration value determination operation S400. In the reference vibration value determination operation S400, the controller 100 may determine whether the vibration value measured in the imbalance measurement operation S300 is less than or equal to a preset reference vibration value V1.

[0200] The control method of the laundry treating apparatus 1 according to an embodiment of the present disclosure may include an additional vibration value determination operation S450. When the vibration value V exceeds the reference vibration value V1 in the reference vibration value determination operation S400, the controller 100 may perform the additional vibration value determination operation S450.

[0201] In the additional vibration value determination operation S450, the controller 100 may determine whether the vibration value V exceeds the additional vibration value V2 set to a higher value than the reference vibration value V1.

[0202] The control method of the laundry treating apparatus 1 according to an embodiment of the present disclosure may include an imbalance resolving operation S500 after the additional vibration value determination operation S450. The controller 100 may perform the imbalance resolving process P140 in the imbalance resolving operation S500.

[0203] The imbalance resolving operation S500 may include a laundry untangling operation S520. When the vibration value V is equal to or less than the additional vibration value V2 in the additional vibration value determination operation S450, the controller 100 may perform the laundry untangling operation S520. The controller 100 may perform the untangling process P144 in the laundry untangling operation S520.

[0204] The controller 100 may rotate the drum 30 at the third rotation speed in the laundry untangling process P144, rotate the drum 30 at the first rotation angle, and rotate the drum 30 in a rotation direction that alternates between one direction and the other direction.

[0205] The imbalance resolving operation S500 may include a laundry arrangement operation S510. When the vibration value V exceeds the additional vibration value V2 in the additional vibration value determination operation S450, the controller 100 may perform the laundry arrangement operation S510. The controller 100 may perform the laundry arrangement process P142 in the laundry arrangement operation S510.

[0206] The controller 100 may rotate the drum 30 at the fourth rotation speed lower than the third rotation speed in the laundry arrangement process P142, rotate the drum 30 at the second rotation angle higher than the first rotation angle, and rotate the drum 30 in a rotation direction that alternates between one direction and the other direction.

[0207] The controller 100 may perform the laundry untangling operation S520 in the laundry arrangement operation S510. The controller 100 may perform the water level preparation operation S100 or the measurement preparation operation S200 again after the laundry untangling operation S520.

[0208] Although the present disclosure has been shown and described in relation to specific embodiments, it is obviously understood by those skilled in the art that the present disclosure may be improved and changed in various ways without departing from the technical spirit of the present disclosure provided by the following claims.

Claims

1. A laundry treating apparatus comprising:

- a cabinet;
- a tub provided inside the cabinet and configured to accommodate water therein;
- a drum provided inside the tub and configured to accommodate laundry;

- a driver provided inside the cabinet and configured to provide a rotational force to the drum; and
 a controller configured to control the driver to rotate the drum and perform a spin-drying cycle of the laundry,
 wherein the controller performs an imbalance measurement process to measure imbalance of the laundry before the spin-drying cycle,
 the controller performs a measurement preparation process in which a maximum rotation speed of the drum corresponds to a first rotation speed and the drum is continuously rotated in one direction in a state in which water is accommodated in the tub before performing the imbalance measurement process, and
 the controller performs the imbalance measurement process after the measurement preparation process and controls the driver such that the maximum rotation speed of the drum corresponds to a second rotation speed lower than the first rotation speed in the imbalance measurement process and the drum is continuously rotated in any one of the one direction and another direction.
2. The laundry treating apparatus of claim 1, further comprising:
- a drain part connected to the tub and configured to drain water of the tub to an outside of the cabinet; and
 a vibration measurer mounted in the cabinet or the tub and configured to measure an amount of vibration,
 wherein, based on a measured value of the vibration measurer being equal to or less than a reference vibration value in the imbalance measurement process, the controller controls the drain part to drain all water from the tub and performs the spin-drying cycle.
3. The laundry treating apparatus of claim 2, wherein the controller corrects the reference vibration value to be lower as a water level of the tub increases in the imbalance measurement process.
4. The laundry treating apparatus of claim 2, wherein the controller corrects the reference vibration value to be lower as a moisture rate of the laundry inside the drum increases in the imbalance measurement process.
5. The laundry treating apparatus of claim 4, wherein the controller performs a moisture rate determination process to measure a moisture rate of the laundry accommodated in the drum before the spin-drying cycle.
6. The laundry treating apparatus of claim 5, further comprising:
- a water level measurer provided in the tub and configured to measure a water level of the tub, wherein, in the moisture rate determination process, the controller determines a moisture rate of the laundry based on a measured value of the water level measurer while continuously rotating the drum in the one direction or the other direction in a state in which water is accommodated in the tub.
7. The laundry treating apparatus of claim 2, wherein, based on a measured value of the vibration measurer exceeding the reference vibration value in the imbalance measurement process, the controller controls the driver to perform an imbalance resolving process for reducing imbalance of the laundry.
8. The laundry treating apparatus of claim 7, wherein the controller performs the measurement preparation process and the imbalance measurement process again after performing the imbalance resolving process.
9. The laundry treating apparatus of claim 7, wherein the imbalance resolving process includes a laundry untangling process in which the controller controls the driver such that the maximum rotation speed of the drum corresponds to a third rotation speed, a rotation angle corresponds to a first rotation angle, and a rotation direction alternates between the one direction and the other direction.
10. The laundry treating apparatus of claim 9, wherein, in the imbalance resolving process, the controller corrects at least one of the third rotation speed or the first rotation angle to increase as a measured value of the vibration measurer increases.
11. The laundry treating apparatus of claim 9, wherein, based on the measured value of the vibration measurer exceeding an additional vibration value higher than the reference vibration value, the controller performs a laundry arrangement process in which the maximum rotation speed and rotation angle of the drum are different from the laundry untangling process in the imbalance resolving process.
12. The laundry treating apparatus of claim 11, wherein, in the laundry arrangement process, the controller controls the driver such that the maximum rotation speed of the drum corresponds to a fourth rotation speed lower than the third rotation speed, a rotation angle corresponds to a second rotation angle greater than the first rotation angle, and a rotation direction alternates between the one direction and the other

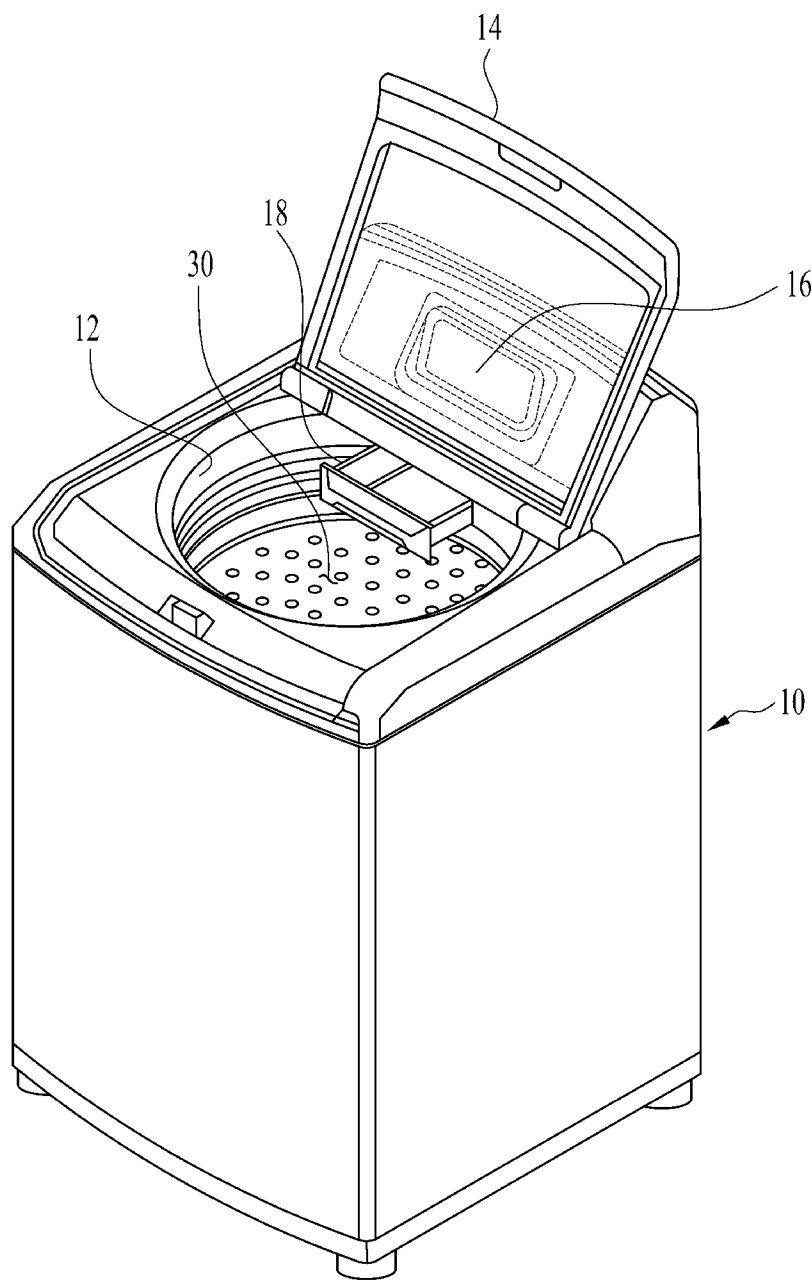
direction.

13. The laundry treating apparatus of claim 11, wherein,
based on the measured value of the vibration mea-
surer exceeding the reference vibration value and
being equal to or less than the additional vibration
value in the imbalance measurement process, the
controller omits the laundry arrangement process
from the imbalance resolving process and performs
the laundry untangling process. 5 10
14. The laundry treating apparatus of claim 11, wherein,
based on the measured value of the vibration mea-
surer exceeding the additional vibration value in the
imbalance measurement process, the controller per-
forms the laundry untangling process after perform-
ing the laundry arrangement process in the imbal-
ance resolving process. 15
15. The laundry treating apparatus of claim 1, wherein 20
the controller performs a washing cycle to wash the
laundry by injecting detergent into the tub before the
spin-drying cycle and performs a rinsing cycle to
discharge detergent and contaminants to an outside
of the tub by separating the detergent and the con-
taminants from the laundry before the spin-drying
cycle after the washing cycle, and 25
the controller performs the measurement prepara-
tion process and the imbalance measurement pro-
cess in at least one of between the washing cycle and 30
the rinsing cycle or between the rinsing cycle and the
spin-drying cycle.
16. The laundry treating apparatus of claim 15, further
comprising: 35

a drain part connected to the tub and configured
to drain water of the tub to the outside of the
cabinet; and
a water level measurer mounted in the tub and 40
configured to measure a water level of the tub,
wherein the controller performs a water level
preparation process to control the drain part
such that a water level of the tub before the
measurement preparation process is performed 45
corresponds to a measurement water level for
measuring imbalance.
17. The laundry treating apparatus of claim 16, wherein 50
the controller corrects the measurement water level
to be higher as a weight or moisture rate of the
laundry accommodated in the drum increases in
the water level preparation process.

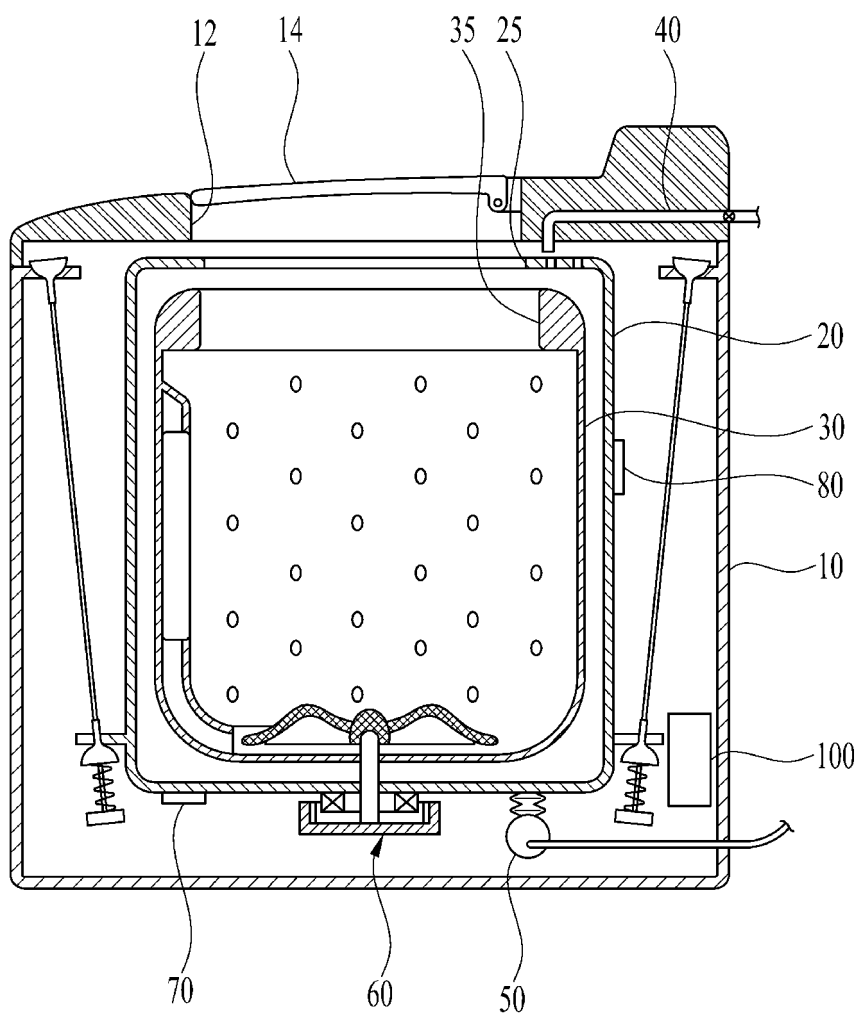
55

FIG. 1



1

FIG. 2



1

FIG. 3

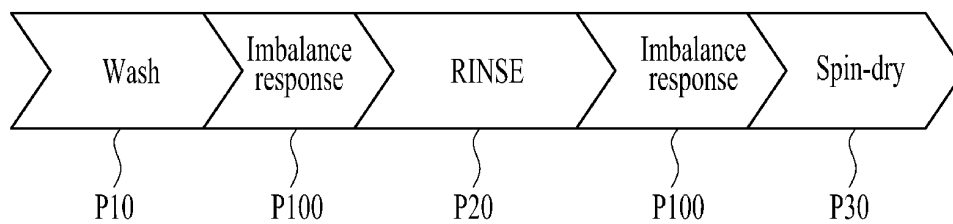


FIG. 4

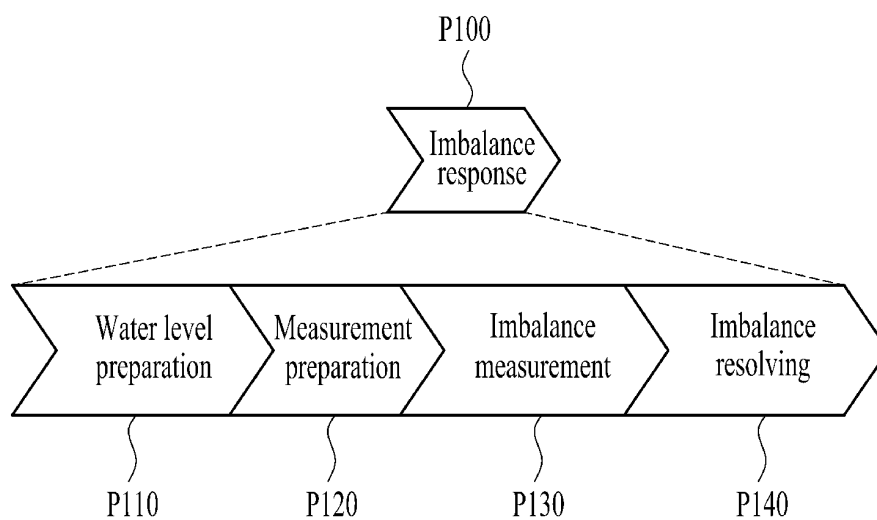


FIG. 5

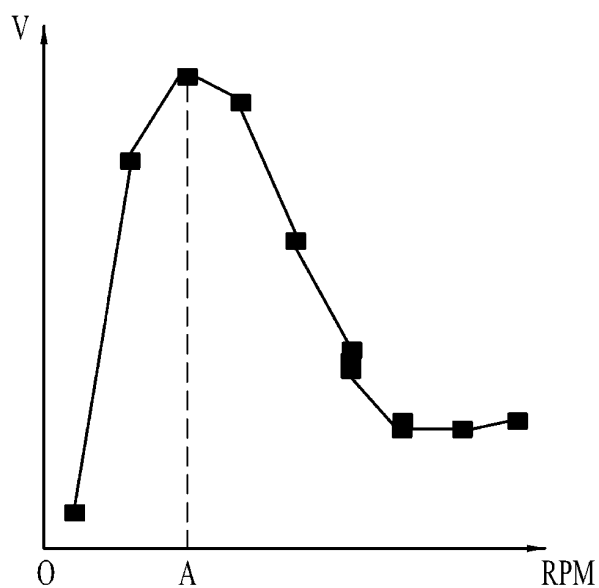


FIG. 6

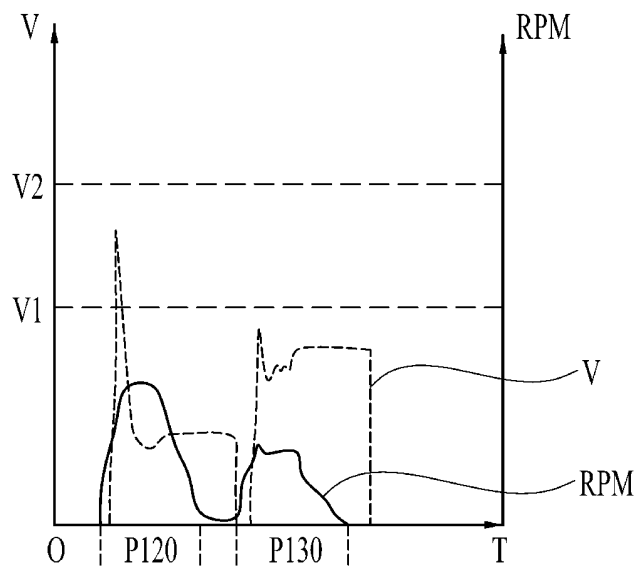


FIG. 7

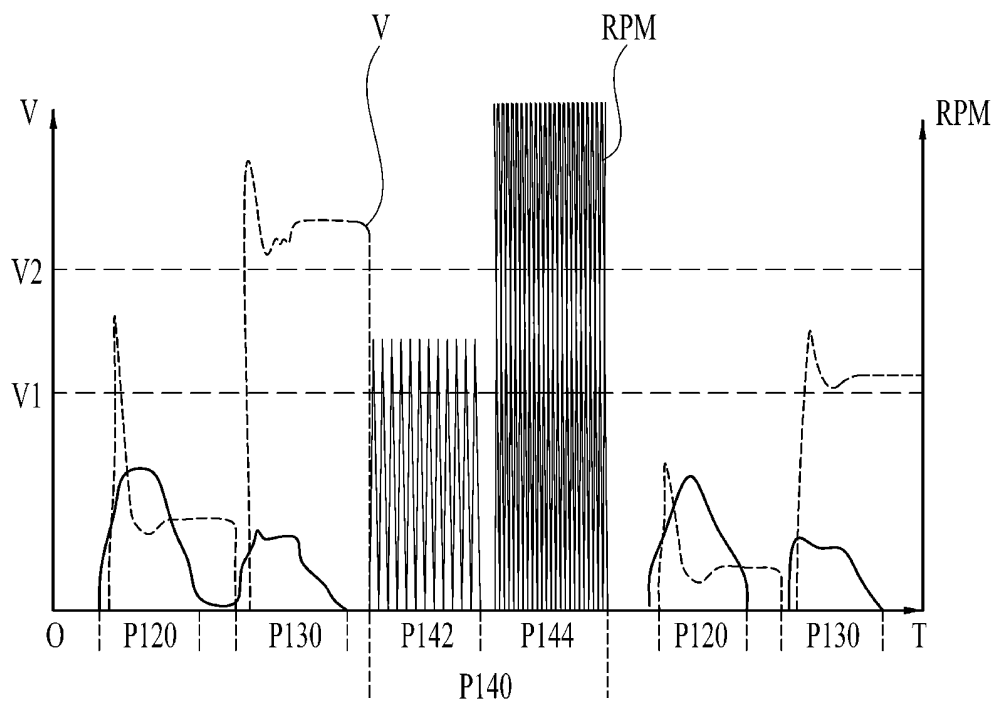


FIG. 8

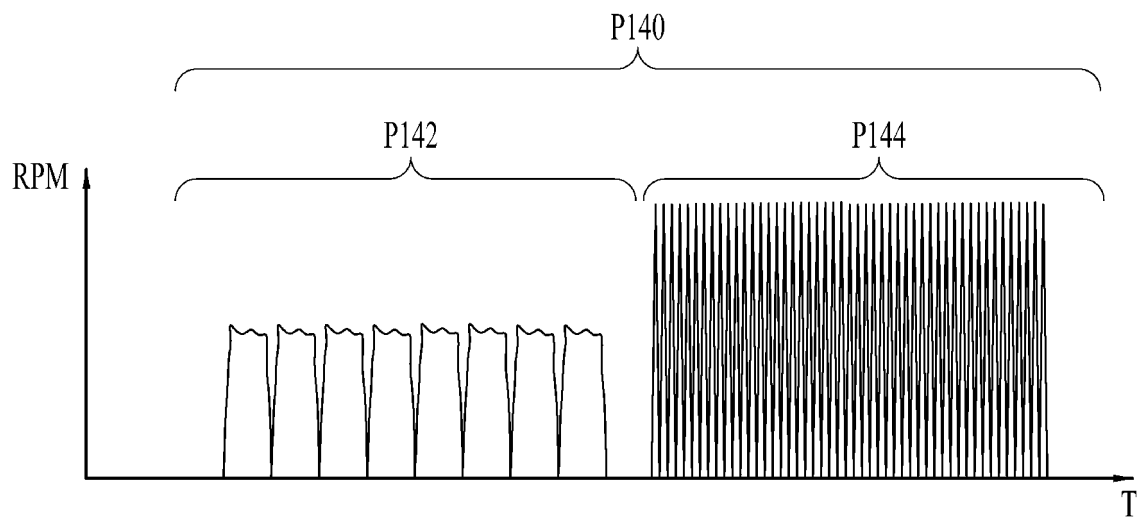


FIG. 9

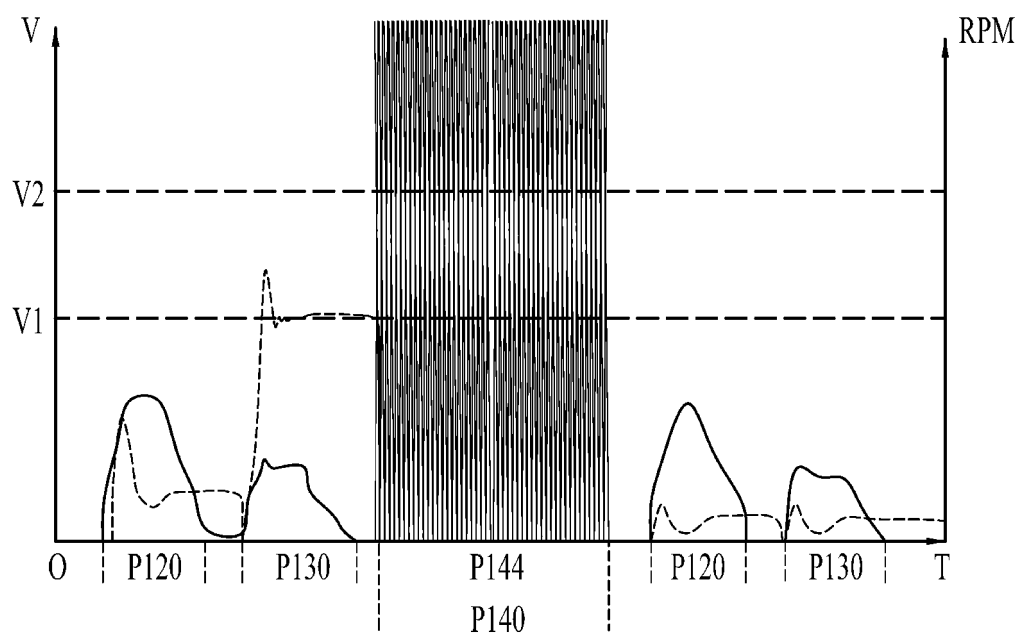
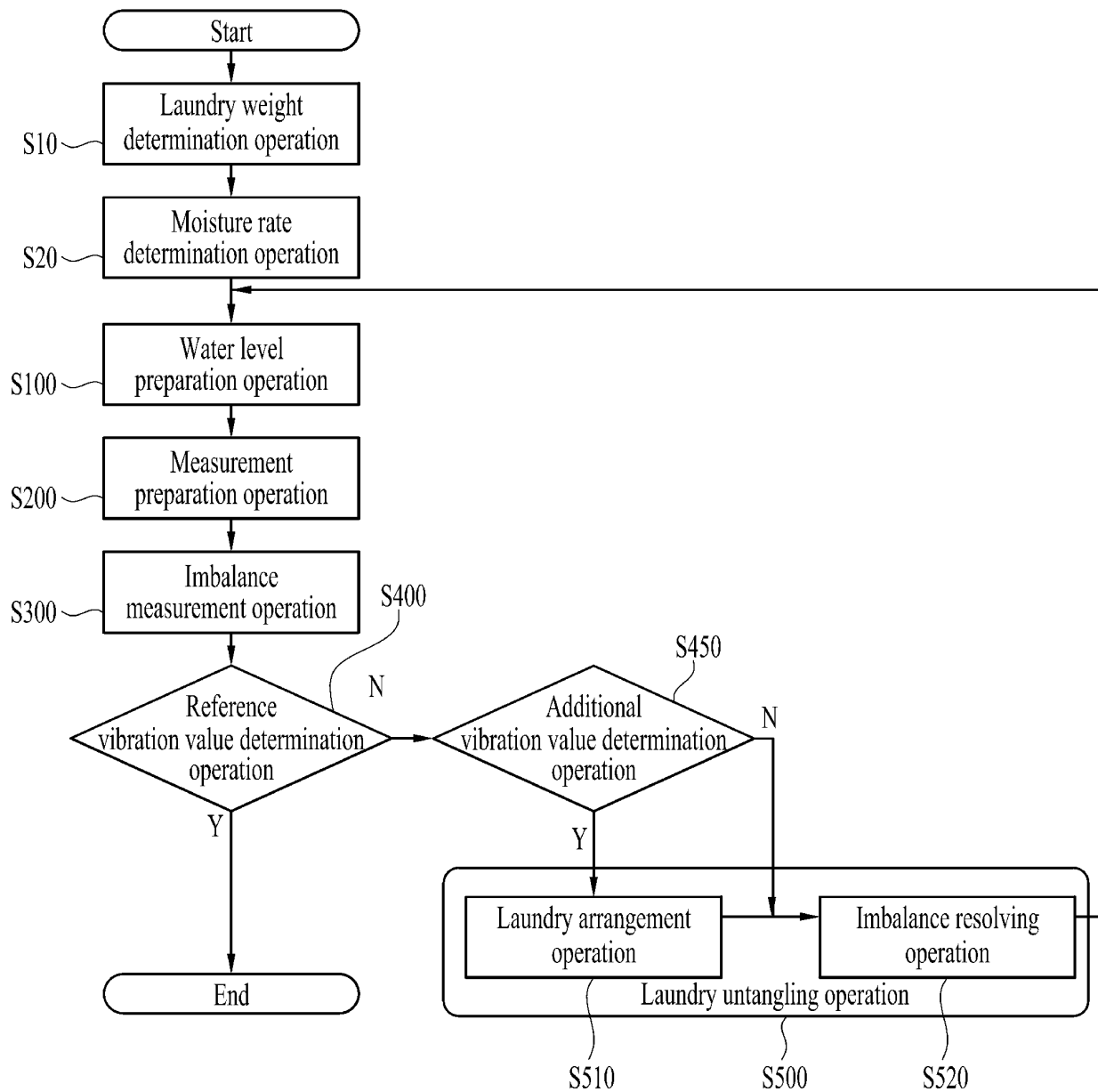


FIG. 10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2023/004078

A. CLASSIFICATION OF SUBJECT MATTER

D06F 34/16(2020.01)i; D06F 33/48(2020.01)i; D06F 33/44(2020.01)i; D06F 33/46(2020.01)i; D06F 37/30(2006.01)i;
D06F 37/36(2006.01)i; D06F 34/18(2020.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D06F 34/16(2020.01); D06F 25/00(2006.01); D06F 33/02(2006.01); D06F 33/30(2020.01); D06F 34/10(2020.01);
D06F 37/20(2006.01); D06F 37/30(2006.01); D06F 39/08(2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models: IPC as above

Japanese utility models and applications for utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & keywords: 드럼(drum), 터브(tab), 언밸런스(unbalance), 의류처리장치(garment processing apparatus), 회전속도(rotational velocity)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2011-0031765 A (LG ELECTRONICS INC.) 29 March 2011 (2011-03-29) See paragraphs [0022], [0033], [0043], [0069] and [0079]; claims 1 and 14; and figures 2 and 4-5.	1-2,7-10,15-17
A		3-6,11-14
Y	KR 10-2016-0094723 A (LG ELECTRONICS INC.) 10 August 2016 (2016-08-10) See paragraphs [0026], [0035], [0122] and [0124]; claim 1; and figures 4-5.	1-2,7-10,15-17
Y	JP 2015-167867 A (LG ELECTRONICS INC.) 28 September 2015 (2015-09-28) See claims 1-2.	2,7-10
A	KR 10-2015-0141803 A (LG ELECTRONICS INC.) 21 December 2015 (2015-12-21) See paragraphs [0018]-[0034]; and figures 1-4.	1-17

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

12 July 2023

Date of mailing of the international search report

12 July 2023

Name and mailing address of the ISA/KR

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Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2023/004078

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-2022-0026862 A (LG ELECTRONICS INC.) 07 March 2022 (2022-03-07) See paragraphs [0323]-[0332]; and figure 12.	1-17

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2023/004078

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Form PCT/ISA/210 (patent family annex) (July 2022)

REFERENCES CITED IN THE DESCRIPTION

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